



芯片制造的未来

黄仁勋说摩尔定律已死。其实还没有

3D元件和奇异新型材料可给它续会儿命

摩尔定律还差两年就要满60岁了，如今它已经变得有点像薛定谔的猫——既死又活。1965年，英特尔公司的联合创始人之一戈登·摩尔（Gordon Moore）提出，一块微芯片上可容纳的晶体管（一种电子元件）的数量每一年就会翻一番，后来他又将翻番的时间从一年改为两年。

摩尔的言论成了一种追求，为整个计算机行业设定了前进步调。1971年生产的芯片可以在一平方毫米中塞入200个晶体管。如今最先进的芯片可以在同样的面积上塞入1.3亿个晶体管，而且每个晶体管的运行速度也比当初快几万倍。如果汽车也以同样的速度进步，那么现如今汽车的最高时速可达到数千万英里。

摩尔很清楚这一进程不可能永远持续下去。每一次翻番都比上一次更困难、成本也更高。2022年9月，芯片制造商英伟达的老板黄仁勋成为最新一个唱衰摩尔定律的人，他宣称摩尔定律“已死”。但并非所有人都赞同他的观点。几天后，英特尔的CEO帕特·基辛格（Pat Gelsinger）表示，摩尔定律其实还“活得好好的”。

参与国际电子器件大会（IEDM）的代表大多站在基辛格一边。这一芯片行业的盛会每年在旧金山举行。研究人员在会上展示了若干让摩尔定律持续下去的创意，比如利用3D结构或把多个芯片堆叠起来，甚至不再使用硅这种过去半个世纪里用来制造微芯片的材料。

晶体管之于电流就像水龙头之于自来水一样。电流通过栅极从晶体管的源极流向漏极。当电压施加到栅极上时，电流接通——我们用二进制中的1来表示。当栅极上没有电压时，电流断开——用二进制中的0来表示。从气候模型、ChatGPT到手机交友应用Tinder、《侠盗猎车手》游戏，所有的计算机程序都由这些1和0构成。

几十年来，晶体管大多是平面结构，栅极位于连接源极和漏极的硅沟道上。制造更小的晶体管也带来了一些可喜的附带好处：晶体管越小，开关速度就越快，并且功耗也越低。这种现象被称为登纳德缩放定律。

然而到2000年代中期，登纳德缩放定律已经失效。随着晶体管源极和漏极之间距离的缩短，出现了量子效应，导致栅极开始无法控制沟道，并且即使晶体管处于关闭状态，电子也会隧穿。如此造成的漏电不仅浪费电能，还会产生难以散去的过多热量。因为这堵“功耗墙”，虽然芯片上的晶体管数量在持续增多，芯片速度却停滞不前（见图表）。

2012年，英特尔开始制造3D芯片。它把原来平面的电流通道变成了凸起于表面上的“鳍”。如此一来，栅极从三面包裹通道，帮助它增强了控制力（见图）。这些鳍式场效应晶体管（FinFET）漏电减少，开关速度提升三分之一，且功耗只有上一代晶体管的一半左右。但是这些鳍不可能无限变薄或变高，芯片制造商如今正在接近其极限。

下一步是翻转鳍，使栅极完全包裹住沟道，从而最大限度地控制沟道。韩国电子巨头三星已经在其最新产品中使用了这种叫作“纳米片”的晶体管。预计英特尔和芯片代工厂台积电也将很快跟进。通过把多个纳米片堆叠起来并缩短其长度，晶体管的尺寸可以进一步缩小30%。

台积电的研究人员廖思雅把芯片3D化比作提高城市密度——用密集的摩天大楼取代四处延伸的郊区。这不仅指晶体管在不断变高。芯片将晶体管分组组成逻辑门，这些逻辑门执行基本的逻辑运算。最简单的逻辑门是反相器，又称“非门”——如果输入为1，则其输出为0；反之亦然。逻辑门是由N型和P型两种不同类型的晶体管组成，这两种晶体管都是通过在硅中“掺杂”其他化学物质来改变其导电性能而制成的。一个反相器需要N型和P型晶体管各一个，通常并排放置。

在今年的IEDM上，廖思雅及其同事展示了一种名为互补场效应晶体管（CFET）的反相器，由晶体管相互堆叠而成。这大幅减少了反相器占用的空间，差不多只需要一个晶体管的空间。台积电表示，芯片3D化可为增

加绝缘层腾出空间，这样就可以减少反相器内部晶体管的漏电，从而降低能耗、减少发热。

研发3D芯片制造的终极目标是将整块芯片一个个堆叠起来，形成一个整体。现代处理器要从计算机其他位置的存储芯片接收所要处理的数据，接收速度是限制其性能的一大因素。计算机内部的数据传输需要消耗大量能量，并且可能需要几十纳秒（一纳秒等于十亿分之一秒）——这对计算机来说是很长的时间。

比利时微电子研究中心（Imec）的研究人员朱利安·瑞卡特（Julien Ryckaert）解释了3D堆叠技术如何可以帮助解决这个问题。将存储芯片夹在数据处理芯片之间，大大减少了将数据传输到指定位置所需的时间和能量。2022年，美国公司AMD（台积电为其代工）推出了它的“X3D”处理器，使用3D技术将一大片内存直接连接到处理器上面。

然而和城市一样，密集也意味着拥堵。微芯片是以圆形硅片为基片、自下而上构建起来的复杂电路。（英特尔将它比作披萨。）首先要制造晶体管。它们的上端有多层用来传输电力和信号的金属线。现代芯片可能有15层以上这样的金属线。

随着芯片上的元件越来越密集，这些电源和数据线的布线变得越来越困难。线路迂回会浪费能量，而且电源线会对数据线造成干扰。3D的逻辑门因为在一定区域内塞入了更多的晶体管，布线就变得更难了。

为了解开这团“乱麻”，芯片制造商正在将电源线移至晶体管下方，这种技术被称为“背面供电”。晶体管和数据线的构建方式和以前一样。然后将晶圆片翻转过来，并在底部加上较粗的电源线。把电源线排布在芯片底部将从根本上改变造价高昂的芯片工厂的运作方式。但缩短电源线的长度意味着减少能耗，也能降低芯片运行时的温度。该技术还在晶体管上方腾出了近五分之一的面积，给设计人员留出了更多空间来塞进额外的数据线。该技术最终会制造出速度更快、能效更高的芯片，而不需要调整晶体管的尺寸。英特尔计划从明年开始在其芯片中使用背面供电，不过把它与全面投

产的3D晶体管结合起来还需要时日。

而即便是利用3D技术也有其上限。一旦晶体管的栅极长度接近10纳米，它所控制的沟道就需窄至大约在4纳米以下。如此微小的尺寸只够几十个原子通过，漏电因而会更加严重。由于硅片表面的粗糙度阻碍了电子的运动，电子的速度会变慢，也就会影响晶体管的正常开关。

因此，一些研究人员正在研究是否可以弃用硅这种让计算机时代得以建立的基础材料，转而使用一类名为过渡金属二硫属化物（TMD）的新材料。TMD可以制成只有三个原子厚的薄片。许多TMD具有良好的导电性能，即便制成最小的晶体管也能减少漏电。

三种尤其被看好的TMD材料分别是：二硫化钼、二硫化钨和二硒化钨。但是芯片制造行业与硅材料打了60年交道，对TMD的了解却要少得多。工程师们已经发现，由于TMD是一种超薄材料，用它们制造的晶体管很难与芯片的金属层连接起来。TMD也很难持续生产，尤其是要达到可靠的批量生产所需规模的话。而且TMD的化学特性决定了很难往它们掺杂别的物质来制造N型和P型晶体管。

这些问题或许并非解决不了。（在行业发展初期，硅也曾遇到过掺杂上的问题。）在今年的IEDM上，英特尔展示了一款用TMD制造的反相器。但斯坦福大学的电气工程师埃里克·波普（Eric Pop）认为，要在商业产品中用TMD取代硅还需要相当长一段时间。他表示，在大多数应用场景下，硅仍然“足够好”。

总有一天，再巧妙的技术也无法进一步缩小晶体管的体积（例如，很难想象如何用不到一个原子大小的材料来制造晶体管）。正如摩尔本人在2003年警告的那样：“没有什么指数级增长能够永远持续。”但是，他又对当时与会的工程师们说：“你们的工作就是永远延后那一天的倒来。”自他讲这番话以来的二十年里，芯片制造商在延后上取得了令人钦佩的成绩。而且他们至少也已蚀刻出了未来20年的发展线路。 ■



Future of chipmaking

Jensen Huang says Moore's law is dead. Not quite yet

3D components and exotic new materials can keep it going for a while longer

TWO YEARS shy of its 60th birthday, Moore's law has become a bit like Schrödinger's hypothetical cat—at once dead and alive. In 1965 Gordon Moore, one of the co-founders of Intel, observed that the number of transistors—a type of electronic component—that could be crammed onto a microchip was doubling every 12 months, a figure he later revised to every two years.

That observation became an aspiration that set the pace for the entire computing industry. Chips produced in 1971 could fit 200 transistors into one square millimetre. Today's most advanced chips cram 130m into the same space, and each operates tens of thousands of times more quickly to boot. If cars had improved at the same rate, modern ones would have top speeds in the tens of millions of miles per hour.

Moore knew full well that the process could not go on for ever. Each doubling is more difficult, and more expensive, than the last. In September 2022 Jensen Huang, the boss of Nvidia, a chipmaker, became the latest observer to call time, declaring that Moore's law was “dead”. But not everyone agrees. Days later, Intel's chief Pat Gelsinger reported that Moore's maxim was, in fact, “alive and well”.

Delegates to the International Electron Devices Meeting (IEDM), a chip-industry shindig held every year in San Francisco, were mostly on Mr Gelsinger's side. Researchers showed off several ideas dedicated to keeping Moore's law going, from exploiting the third dimension to sandwiching chips together and even moving beyond silicon, the material from which

microchips have been made for the past half-century.

A transistor is to electricity what a tap is to water. Current flows from a transistor's source to its drain via a gate. When a voltage is applied to the gate, the current is on: a binary 1. With no voltage on the gate, the current stops: a binary 0. It is from these 1s and 0s that every computer program, from climate models and ChatGPT to Tinder and Grand Theft Auto, is built.

For decades transistors were built as mostly flat structures, with the gate sitting atop a channel of silicon linking the source and drain. Making them smaller brought welcome side benefits. Smaller transistors could switch on and off more quickly, and required less power to do so, a phenomenon known as Dennard scaling.

By the mid-2000s, though, Dennard scaling was dead. As the distance between a transistor's source and drain shrinks, quantum effects cause the gate to begin to lose control of the channel, and electrons move through even when the transistor is meant to be off. That leakage wastes power and causes excess heat that cannot be easily disposed of. Faced with this “power wall”, chip speeds stalled even as transistor counts kept rising (see chart).

In 2012 Intel began to build chips in three dimensions. It turned the flat conducting channel into a fin standing proud of the surface. That allowed the gate to wrap around the channel on three sides, helping it reassert control (see diagram). These transistors, called “finFETs”, leak less current, switch a third faster and consume about half as much power as the previous generation. But there is a limit to making these fins thinner and taller, and chipmakers are now approaching it.

The next step is to turn the fins side on such that the gate surrounds them completely, giving it maximum control. Samsung, a South Korean electronics giant, is already using such transistors, called “nanosheets”, in

its newest products. Intel and TSMC, a Taiwanese chip foundry, are expected to follow soon. By stacking multiple sheets and reducing their length, transistor sizes can drop by a further 30%.

Szuya Liao, a researcher at TSMC, compares going 3D to urban densification—replacing sprawling suburbs with packed skyscrapers. And it is not just transistors that are getting taller. Chips group transistors into logic gates, which carry out elementary logical operations. The simplest is the inverter, or “NOT” gate, which spits out a 0 when fed a 1 and vice versa. Logic gates are made by combining two different types of transistor, called n-type and p-type, which are produced by “doping” silicon with other chemicals to modify its electrical properties. An inverter requires one of each, usually placed side by side.

At IEDM Ms Liao and her colleagues showed off an inverter called a CFET built from transistors that are stacked on top of each other instead. That reduces the inverter’s footprint drastically, to roughly that of an individual transistor. TSMC says that going 3D frees up room to add insulating layers, which means the transistors inside the inverter leak less current, which wastes less energy and produces less heat.

The ultimate development in 3D chip-making is to stack entire chips atop one another. One big limitation to a modern processor’s performance is how fast it can receive data to crunch from memory chips elsewhere in the computer. Shuttling data around a machine uses a lot of energy, and can take tens of nanoseconds, or billionths of a second—a long time for a computer.

Julien Ryckaert, a researcher at Imec, a chip-research organisation in Belgium, explained how 3D stacking can help. Sandwiching memory chips between data-crunching ones drastically reduces both the time and energy necessary to get data to where it needs to be. In 2022 AMD, an American firm

whose products are built by TSMC, introduced its “X3D” products, which use 3D technology to stick a big blob of memory directly on top of a processor.

As with cities, though, density also means congestion. A microchip is a complicated electrical circuit that is built on a circular silicon wafer, starting from the bottom up. (Intel likens it to making a pizza.) First the transistors are made. These are topped with layers of metal wires that transport both electrical power and signals. Modern chips may have more than 15 layers of such wires.

As chips get denser, routing those power and data lines gets harder. Roundabout routes waste energy, and power lines can interfere with data ones. 3D logic gates, which pack yet more transistors into a given area, make things worse.

To untangle this mess, chipmakers are moving power lines below the transistors, an approach called “backside power delivery”. Transistors and data lines are built as before. Then the wafer is flipped and thick power lines are added to the bottom. Putting the power wires along the underside of the chip means fundamental changes to the way expensive chip factories operate. But shortening the length of the power lines means less wasted energy and cooler-running chips. It also frees up nearly a fifth of the area above the transistors, giving designers more room to squeeze in extra data lines. The end result is faster, more power efficient devices without tinkering with transistor sizes. Intel plans to use backside power in its chips from next year, though combining it with 3D transistors in full production is still a while away.

Even making use of an extra dimension has its limits. Once a transistor’s gate length approaches ten nanometres the channel it governs needs to be thinner than about four nanometres. At these tiny sizes—mere tens of atoms across—current leakage becomes much worse. Electrons slow down

because silicon's surface roughness hinders their movement, reducing the transistor's ability to switch on and off properly.

Some researchers are therefore investigating the idea of abandoning silicon, the material upon which the computer age has been built, for a new class of materials called transition metal dichalcogenides (TMDs). These can be made in sheets just three atoms thick. Many have electrical properties that mean they leak less current from even the tiniest of transistors.

Three TMDs in particular look promising: molybdenum disulphide, tungsten disulphide and tungsten diselenide. But while the industry has six decades of experience with silicon, TMDs are much less well understood. Engineers have already found that their ultra-thin profile makes it difficult to connect transistors made from them with a chip's metal layers. Consistent production is also tricky, particularly at the scales needed for reliable mass production. And the materials' chemical properties mean it is harder to dope them to produce n-type and p-type transistors.

Those problems are probably not insurmountable. (Silicon suffered from doping problems of its own in the industry's early days.) At the IEDM, Intel was showing off an inverter built out of TMDs. But Eric Pop, an electrical engineer at Stanford University, thinks it will be a long while before they replace silicon in commercial products. For most applications, he says, silicon remains "good enough."

At some point, the day will arrive when no amount of clever technology can shrink transistors still further (it is hard to see, for instance, how one could be built with less than an atom's worth of stuff). As Moore himself warned in 2003, "no exponential is for ever." But, he told the assembled engineers, "your job is delaying for ever". Chipmakers have done an admirable job of that in the two decades since he spoke. And they have at least sketched out a path for the next two decades, too. ■



青春的智慧

新生神经元能逆转阿尔茨海默症吗？

有科学家认为可以。也有人怀疑这种细胞根本不存在【新知】

阿尔茨海默症的初期症状之一是思维混乱。大多数人可以每天早上把车停在不同地点，晚上又能找到。而阿尔茨海默症患者却很难做到。一些日常活动的记忆，比如吃饭或服药，会在他们的大脑中乱作一团。

区分相似记忆的能力取决于一小块称为齿状回的脑组织。对小鼠的研究表明，齿状回是大脑中少数几个即使在成年期也会生长出新神经元的部位之一。据信这些新神经元有助于区分相似的记忆。

在人身上是否也是如此还不太清楚。但近日神经科学学会（Society for Neuroscience）在华盛顿举行的会议上公布的一系列新研究结果表明，这是有可能的。如果确实如此，那么促进这一生长过程可能会为阿尔茨海默症带来新的治疗方法。

在1960年代以前，科学家一直认为成人大脑不会产生新的神经元。后来有证据表明，成年大鼠和小鼠的大脑中会出现年轻的神经元，特别是在处理气味的嗅球以及齿状回中。这些新神经元是由神经祖细胞（一种类似于干细胞的未分化神经元）发育而来，科学家将这一过程称为神经发生。

至少在小鼠身上，这些新神经元和阿尔茨海默症之间似乎存在关联。经过基因改造而出现类似阿尔茨海默症的小鼠，其大脑中新生神经元的数量也较少。2021和2022年发表的两项研究表明，促进神经发生可以改善这些动物的记忆力。今年4月发表的一篇论文发现，促进神经发生还能使被称为小神经胶质的其他细胞开始清理蛋白质缠结，这些被称为 β -淀粉样斑块的缠结是阿尔茨海默症的症状表现。

这一切都很有希望——如果你是老鼠的话。但要研究人类的神经发生却很棘手。核磁共振扫描仪无法观察单个神经元的生长。科学家必须从尸体上

采集脑组织样本，要么用只与新生神经元结合的化学物质给它们染色，要么测量脑细胞内表达的基因来寻找年轻神经元的印记。

此类论文已发表了数十篇。但是，每有一篇论文找到神经发生的证据，就有另一篇没有找到。支持神经发生的阵营认为，这些无效结果是由于脑组织的质量太差或保存技术粗糙造成的。反方则认为，要么人类在齿状回中没有生长出这些神经元，要么就是即使生长了，也因为数量太少而没有作用。

在华盛顿会议上发表的研究进一步支持了人类神经发生的论证。哥伦比亚大学的莫拉·博尔德里尼（Maura Boldrini）、马德里大学的玛丽亚·洛伦斯-马丁（María Llorens-Martín）、伊利诺伊大学芝加哥分校的奥利·拉扎罗夫（Orly Lazarov）和宾夕法尼亚大学的宋红军展示了人类齿状回中存在新生神经元的证据——尽管他们的大部分发现尚未经过同行评议。

其中三位研究人员还研究了健康老年人或阿尔茨海默症患者的大脑。他们的研究结果表明，随着年龄的增长，这些所认为的新生神经元的生成速度会减慢，而在阿尔茨海默症患者身上更是急剧下降。其中两个团队之前的研究还发现，拥有更多这些神经元的阿尔茨海默患者的记忆力更好些。

但是，虽然新研究为人类神经发生提供了更多证据，却仍不足以下定论。耶鲁大学的研究团队质疑其中一项研究中使用的染色技术是否意外地标记了其他脑细胞，例如星形胶质细胞。他们也很关注这些研究往往只能发现极少量祖细胞的问题。“这些幼年神经元的所有母细胞在哪里呢？”怀疑者之一乔恩·阿雷利亚诺（Jon Arellano）问道。

还有其他疑惑。宋红军发现，在这些所认为的人类新生神经元中表达的基因与其他动物的神经元不同。此外，宋红军和拉扎罗夫都发现，阿尔茨海默症患者大脑中的少数新生神经元与健康大脑中的同类神经元看起来也有很大差异。如果这些新细胞存在某种缺陷，那么增加其数量可能也没什么好处。

但是，尽管不是所有与会的科学家都被说服了，一些制药商似乎已经信心

十足。今年4月，加州制药公司Biomed Industries表示，它声称能促进小鼠神经发生的一种新药在一项早期临床试验中改善了中度阿尔茨海默氏症患者记忆力。如果后续的试验结果同样令人鼓舞，那将进一步证明，阿尔茨海默氏症的神经发生理论可能确有其价值。■



The wisdom of youth

Could newborn neurons reverse Alzheimer's?

Some scientists think so. Others doubt the cells even exist

ONE OF THE first signs of Alzheimer's disease is confusion. Most people can park their car in a different space every morning and find it again in the evening. Those with Alzheimer's find this type of problem much harder. Memories of things they do often, like eating or taking medication, become tangled in their minds.

The ability to distinguish between similar memories depends on a tiny strip of brain tissue called the dentate gyrus. Studies in mice have shown that the dentate gyrus is one of the few bits of the brain to generate new neurons even in adulthood. Those new neurons are thought to help keep similar memories distinct.

Whether something similar happens in humans is less clear. But a clutch of new results described recently at the Society for Neuroscience's conference in Washington, DC, suggest that it might. And if it does, then encouraging the process might offer a new treatment for Alzheimer's disease.

Until the 1960s scientists thought adult brains did not produce new neurons. Then evidence began to emerge of young neurons in the brains of adult rats and mice,—specifically in the olfactory bulb, which processes smell, and the dentate gyrus. These new neurons had developed from neural progenitor cells, a type of undifferentiated neuron akin to a stem cell, in a process scientists call neurogenesis.

And there seems to be a link, at least in mice, between these new neurons and Alzheimer's disease. Mice genetically engineered to have Alzheimer's-like symptoms also have fewer young neurons in their brains. Two studies

published in 2021 and 2022 showed that encouraging neurogenesis could improve memory in such animals. And a paper published in April this year found that boosting neurogenesis also caused other cells known as microglia to begin cleaning up tangles of protein, called amyloid-beta plaques, that are characteristic of Alzheimer's disease.

So far so promising—if you are a mouse. But studying neurogenesis in humans is tricky. MRI scanners cannot watch the growth of individual neurons. Scientists must take samples of brain tissue from cadavers and either stain them with chemicals that bind only to young neurons, or measure the genes that have been expressed within brain cells to look for the hallmarks of youth.

Dozens of such papers have been published. But for every one that has found evidence of neurogenesis, another has failed to do so. The pro-neurogenesis camp thinks the null results are down to poor-quality brain tissue or crude preservation techniques. The antis argue that either humans do not grow these neurons in the dentate gyrus, or if they do, there are too few of them to be useful.

The research presented in Washington strengthens the case for human neurogenesis. Maura Boldrini of Columbia University, María Llorens-Martín of the University of Madrid, Orly Lazarov at the University of Illinois at Chicago and Hongjun Song of the University of Pennsylvania presented evidence of young neurons in the dentate gyruses of humans—though most of their findings have not yet been peer reviewed.

Three of these researchers also studied the brains of healthy older people or people with Alzheimer's disease. Their results suggested that the production of the supposed new neurons slows with age, and falls precipitously in Alzheimer's disease. Previous studies by two of the groups also found that Alzheimer's patients with more of these neurons had better

memories.

But while the new research strengthens the case for human neurogenesis, it is not yet definitive. One group of researchers from Yale University questioned whether the staining technique used in one of the studies was accidentally tagging other brain cells such as astrocytes. They are also concerned that the studies tend to find very few progenitor cells. “Where are all the mothers of these baby neurons?” asked Jon Arellano, one of the sceptics.

There are other wrinkles. Dr Song found a different set of genes expressed in the supposedly young human neurons from those seen in neurons from other animals. And the few young neurons that both Dr Song and Dr Lazarov found in the brains of Alzheimer’s patients looked very different from the same neurons in healthy brains. If the new cells are somehow defective, increasing their number may not help.

But although not all the scientists at the conference were convinced, some drug-makers appear to be. In April, Biomed Industries, a pharmaceutical firm based in California, said that results from an early clinical trial suggested that a new drug that the firm claims increases neurogenesis in mice improved memory in people with moderate Alzheimer’s. If subsequent trials prove to be equally encouraging, that could be further evidence that the neurogenesis theory of Alzheimer’s may indeed have something to it. ■



名副其实

极大望远镜将让天文学改观

它将是世界上遥遥领先的第一大光学望远镜，也是一台强大的时间机器【深度】

智利北部高海拔的阿塔卡马沙漠（Atacama）上日落降临，天空中变幻的色彩引领着欧洲南方天文台（European Southern Observatory，以下简称ESO）驻智利天文学家约瑟夫·安德森（Joseph Anderson）。“晚霞一开始是蓝绿交映，渐渐变得越来越紫，这时我们差不多可以开始观察宇宙了。”夜幕降临后，璀璨的银河横贯中天。海拔2000多米的此时此刻令笔者叹为观止。

在阿塔卡马沙漠有十多个不同的天文观测站，这是有充分理由的。这里远离人类文明的光污染。空气稀薄而干燥，可以提高天文学家所说的“视宁度”。阿塔卡马沙漠平均每年有325个夜晚晴空万里。安德森站在帕拉纳尔山（Cerro Paranal）山顶，向记者展示着“甚大望远镜”（Very Large Telescope，以下简称VLT）。VLT由四个独立的望远镜组成，每一个都是世界上最大的望远镜之一，旁边还有另外四个小得多的望远镜。VLT是地球上产出成果最多的天文设施，每天产出一篇以上的科学论文。2004年，它拍下了第一张太阳系外行星的照片（即一颗围绕太阳以外的恒星运行的行星），并且首次观测到围绕银河系中心巨大黑洞旋转的恒星。

但VLT可能没法保持世界最大望远镜的头衔太久了。在距离VLT一个小时车程、海拔3046米的阿玛索内斯山（Cerro Armazones）的山顶上，屹立着尚未完工的极大望远镜（Extremely Large Telescope，以下简称ELT）。

（ESO喜欢毫无新意的名字。）和太多大型项目一样，ELT的施工进度已经延误。但等建成后（按目前的计划将于2028年竣工，造价15亿欧元[16亿美元]），它将成为已知宇宙中遥遥领先的第一大光学望远镜。ESO的天文学家罗伯特·德·罗莎（Robert de Rosa）表示，这将使“观测天文学的能力向前迈进一大步”。

光学望远镜通过一组镜片收集来自太空的光，并将其投射到各种仪器上。口径更大的镜面可以收集更多的光，意味着相比口径较小的镜面，它可以看到更暗的物体，成像也更清晰。ELT的主镜口径将达到39.3米，是VLT那几个大型望远镜（8.2米）的四倍多，也是加那利群岛（Canary Islands）上加那利大型望远镜（Gran Telescopio Canarias，以下简称GTC）的三倍多，口径10.4米的GTC是目前世界上最大的望远镜。由于望远镜的探测能力取决于其镜面面积，因此只看口径会低估它们之间的能力差异。GTC的镜面集光面积约为75平方米，而ELT将达到978平方米，略小于四个网球场的面积之和（见图1）。

这么大的面积对于天文学的许多分支来说都是福音。从黑洞在塑造宇宙大尺度结构中的作用，到暗物质和暗能量如何影响宇宙膨胀的速度，乃至我们认为的物理常数放在广阔的星系际距离中是否真的是恒定的，ELT将帮助解答各种谜题。

它还将大大推动对太阳系外行星的研究。如今，大多数系外行星的存在都是根据它们对其母星发出的光的影响来推断的，很少能拍到它们本身的照片（所谓直接成像）。在大约5500颗已知系外行星中，科学家只有其中约1%的行星的照片。

ELT的巨大镜面将使天文学家能够将数十光年之外的行星的微弱光芒与其恒星的强烈眩光区分开。这样就应该可以对系外行星大量直接成像。直接成像还将有助于揭示系外行星大气的化学成分，以及是否有任何行星存在外星生命的迹象。

由于望远镜也是时间机器，ELT将能让科学家更深入了解宇宙刚形成后不久的情况。由于光速是有限的，天文学家看到的遥远物体并不是当天的样子，而是望远镜收集到的光线从这些星体发出时的样子。天文学家热切期盼着利用ELT来研究在宇宙年轻时恒星和星系是如何形成的。2021年发射的詹姆斯·韦伯太空望远镜（James Webb Space Telescope）的初期结果已经发现了一系列恒星和星系，它们都似乎非常古老，不太符合现有的宇宙演化理论。ELT可以帮助天文学家解开这个谜团。

这一切的前提是ELT能按计划竣工。在笔者采访时，用于保护望远镜的80米高钢制圆顶仍在建造中。每一块钢板需要约20分钟才能吊起并安装到位，还需要6小时一个个拧紧200个螺栓。每天的工作必须在夜晚之前完成，以免阵风将钢板吹松。完工后，这个5500吨重的圆顶将能够整体旋转，让望远镜得以追踪在天空中移动的恒星。

在智利建设天文台的少数缺点之一是该国容易发生地震。因此，望远镜将浮在一层薄薄的油膜之上，油膜之下放置了数百个橡胶减震器，再往下是3米高的混凝土基座。这将使圆顶免受地震以及隔壁办公区和实验室产生的任何振动的影响。

ELT最令人印象深刻的部分是五个反射镜。天文镜片精密易碎。即使是VLT的那些大型望远镜中相对较小的子镜也很重，如果支撑不当，就会在自重作用下破碎。需要清洁时，工程师必须用带有15个挂钩的特殊安全带将它们吊起。

ELT的主镜太大，无法做成一整张镜面。德国光学公司肖特（Schott）将制造798个独立子镜组成一面主镜。每面子镜都是对角线1.5米的六角形，有一点曲度，用几乎不会热膨胀的高科技玻璃陶瓷制成。这些子镜的镜坯在德国制作，在法国抛光，与荷兰生产的支架组装好后运往智利。

每一面子镜都会经过检查，以确保在运输途中完好无损。ELT的工程师里卡多·帕拉（Ricardo Parra）将这个过程比作敲钟。在玻璃中引起振动，用放置在关键位置的加速度计测量振动幅度。每一面子镜都会再涂上几层化学物质，其中包括提供反射能力的100纳米厚的银。（一纳米为十亿分之一米。）最后再加一层坚硬的氮化硅玻璃以防止银失去光泽。即便如此，ESO认为每面子镜每两年就需要重新做涂层。

要让全部798面子镜协同工作还带来了另一类困难。为了生成可用的图像，每面子镜所在的位置必须十分精确，精度公差仅为数十纳米。每面子镜都由一套传感器和电机支持，它们可以让玻璃表面微微变形，以纠正从微小的温度变化到主镜移动和倾斜时重力角度变化等各种原因造成的翘

曲。

主镜只是光线到达的第一站（见图2）。照射到主镜上的光线将被折射到第二块和第三块副镜上，它们的作用是纠正各种细微的光学缺陷。每块副镜的口径约4米，本身就可以充当一个较大型望远镜的主镜。

第四块副镜的作用是抵消地球大气层的干扰。之所以从地面上会看到星星在闪烁就是大气湍流的影响。ESO的仪表工程师弗雷德里克·冈特

（Frédéric Gonté）将这种效果比作向水中凝望。“试着看看游泳池的池底，你会看到它在动。”他说，“大气层就给我们造成了这种幻象。”

空间望远镜通过在大气层上方飞行来避免这个问题。地面望远镜则可以依靠一种称为自适应光学的技术，即通过让镜面变形以抵消大气造成的扭曲。该技术并非ELT独有。许多现代望远镜都有自适应光学系统，比如VLT的一个独立大型望远镜（其他三个望远镜也正在配备该系统）。但ELT非常庞大，比小型望远镜更容易受到大气湍流造成扭曲的影响。ELT的第四块副镜后面有5000多个促动器，每秒都会对其形状进行一千次联动式微调。如果不做这种调整，ELT的成像将会极其模糊。

要精确计算出每一毫秒间镜面要如何调整，需要天空中有某个形状预先已知的物体。将望远镜实际看到的这个物体的成像与应该看到的成像比较，就可以揭示这一时刻的大气状态，让系统能够抵消它的光学扭曲。通常，这样的物体是正在观测的物体附近一颗明亮的恒星。不过，如果附近没有恒星方便使用，天文学家可以创造一颗人造恒星。向天空发射四束明亮的橙色激光束，让它们在距离地面约90公里处汇聚到一个点上，就形成了“激光导星”，这个高度已经高过了大气层最稠密的部分。因为系统确切地知道这颗人造星应该是什么样子，所以它可以随时根据需要调整镜面的曲率。

你可能会认为，一旦ELT投入使用，所有其他望远镜就都过时了。但事实并非全然如此，因为即使是像ELT这样的仪器也无法完成所有任务。例如，夏威夷的那两台凯克望远镜（Keck）曾经是世界上最大的望远镜，其

镜面口径相对较小，只有十米。但它们的优势是所在的山峰要高得多，那里的视宁度甚至比智利还要好。而且有两台望远镜，就可以同时为两倍之多的天文学家提供服务。

VLT和其他多镜面望远镜还可以使用“干涉测量法”，这是一种组合信号的巧妙方法，让分辨率不取决于单个子镜的大小，而是取决于它们之间的距离。对于VLT而言，这就让它的组合等效口径超过了100米。另一方面，高分辨率是以视野变窄为代价的。冈特表示，ELT并不与VLT等望远镜竞争，“而是它们的补充。”

但说到观测最暗和最远的物体，巨大尺寸的聚光镜面是无可替代的。在这方面，ELT在可预见的未来似乎将无与伦比。计划中的下一个更大的“绝对望远镜”（Overwhelmingly Large Telescope）口径将达到100米。但由于复杂度和成本原因，它的建造计划在2000年代搁置。在ELT以南数百公里处，巨型麦哲伦望远镜（Giant Magellan Telescope）目前正在美国非营利组织卡内基科学研究所（Carnegie Institution for Science）拥有的土地上建造，预计将在2030年代的某个时候收集到第一束光。它将把七面大尺寸子镜组合成一面有效口径为25.4米的巨大主镜。即便如此，它的聚光能力也只有ELT的三分之一左右。

与此同时，一个成员来自美国、加拿大、印度和日本的科学家联盟直力图在夏威夷建造一台巨型望远镜，取名三十米望远镜（Thirty Meter Telescope，以下简称TMT）。听名字就知道它的尺寸很大，但仍然比ELT小。不过目前还不清楚它何时能建成，甚至是否能建成。由于TMT选址在被一些人视为圣山的莫纳克亚山（Mauna Kea），相关争议已导致该项目暂停。看来在接下来的几十年里，想要使用花钱就能建成的最大的望远镜，就只能前往智利北部了。 ■



It does what it says on the tin

The Extremely Large Telescope will transform astronomy

It will be the world's biggest optical telescope by far—and a powerful time machine

IT IS THE colours of a sunset that inspire Joseph Anderson, an astronomer at the European Southern Observatory (ESO) in the high Atacama desert, in northern Chile. “They start off very blue and turquoise. And gradually, as it gets more purple, then we’re getting closer to observing the universe.” Once night falls the sky is dominated by the star-spangled curve of the Milky Way. If there were any extra left to give, more than two kilometres above sea level, your correspondent’s breath would have been taken away.

The Atacama is home to more than a dozen different astronomical observatories, and for good reason. It is far from the light pollution of civilisation. The air is thin and dry, which improves what astronomers call the “seeing”. And the desert averages 325 cloudless nights each year. Dr Anderson is standing on top of a mountain called Cerro Paranal, showing off the Very Large Telescope (VLT). The VLT is made up of four individual telescopes, each individually one of the largest in the world, alongside another four much smaller ones. It is Earth’s most productive astronomical facility, yielding more than one scientific paper each day. In 2004 it took the first picture of an extrasolar planet—one that orbits a star other than the Sun—and was the first instrument to track individual stars whipping around the enormous black hole at the centre of the Milky Way.

But it may not hold that title for much longer. An hour’s drive from the VLT, atop Cerro Armazones, a 3,046-metre peak, sits the half-finished bulk of the ELT, or Extremely Large Telescope. (ESO is a fan of quotidian names.) Like so many big projects, the ELT is behind schedule. But when it is finished—in 2028, on current plans, at a cost of €1.5bn (\$1.6bn)—it will be, by far, the

biggest optical telescope in the known universe. The result, says Robert de Rosa, an astronomer at ESO, will be “a step change in what we can do in terms of observational astronomy”.

Optical telescopes use a series of mirrors to capture light from space and redirect it to their various instruments. A bigger mirror can collect more light, which means it can both see dimmer things and resolve them in finer detail than a smaller one. The ELT’s main mirror will have a diameter of 39.3 metres, more than four times that of the VLT’s big telescopes (8.2 metres) and over three times that of the present record-holder, the 10.4-metre Gran Telescopio Canarias (GTC), in the Canary Islands. Since a telescope’s power depends on the area of its mirror, looking only at the diameter understates the difference. The GTC has a collecting area of around 75 square metres. The ELT will boast 978 square metres, a little smaller than four tennis courts (see diagram 1).

That size will be a boon for many branches of astronomy. The ELT will shed light on everything from the role of black holes in shaping the large-scale structure of the universe to how dark matter and dark energy affect the rate at which it is expanding, and even whether the supposed constants of physics really are constant over vast intergalactic distances.

It should also provide a big boost to the study of planets outside the solar system. These days, the existence of most exoplanets is inferred from the effects they have on the light from their parent stars. Taking pictures of them—so-called direct imaging—is rare. Of the roughly 5,500 known exoplanets, scientists have pictures of only around 1% of them.

The ELT’s enormous mirror will allow astronomers to separate the faint light of a planet from the overwhelming glare of its star from dozens of light-years away. The result should be a direct-imaging bonanza. And direct imaging will also help reveal the chemical composition of exoplanet

atmospheres, and whether any show signs of potential alien life.

And because telescopes are also time machines, the ELT will allow scientists more insight into what happened shortly after the universe began. Since the speed of light is finite, astronomers see distant objects not as they are today, but as they were when the light that arrives in their instruments first set out. Astronomers are keen to use the ELT to investigate how stars and galaxies formed when the universe was young. Early results from the James Webb Space Telescope, launched in 2021, have already turned up an array of stars and galaxies that seem too old to fit easily into existing theories of universal evolution. The ELT could help resolve that mystery.

Assuming, that is, that everything works. When your correspondent visited, the 80-metre-tall steel dome that will shelter the telescope was still being built. Each segment takes around 20 minutes to lift and slot into place; a further six hours are needed to tighten each of the 200 bolts. Work must finish before night, lest gusts of wind blow a panel loose. Once finished, the entire 5,500-tonne dome will be able to rotate so that the telescope can follow the stars as they move across the sky.

One of the few downsides of doing astronomy in Chile is that the country is prone to earthquakes. The telescope will therefore float atop a thin layer of oil. The oil, in turn, will sit atop hundreds of rubber shock absorbers, with the whole lot built on a 3-metre concrete foundation. That will isolate the dome both from earthquakes and any vibrations from the offices and laboratories next door.

The most impressive parts are the mirrors, of which the ELT will have five. Astronomical mirrors are precise, delicate things. Even the comparatively small mirrors of the big VLT telescopes are so heavy that, if not supported properly, they would shatter under their own weight. Engineers must lift them with a special harness with 15 hooks when they need cleaning.

The ELT's main mirror is so big that it cannot be made as a single piece. Instead Schott, a German optics firm, will make 798 separate pieces that will act as a single mirror. Each is a slightly curved, 1.5-metre-wide hexagonal slice of high-tech glass ceramic that undergoes almost no thermal expansion. The segments are cast in Germany, polished in France, and then mated with supports produced in the Netherlands before being transported to Chile.

Each is checked to ensure it has survived the trip unscathed. Ricardo Parra, an ELT engineer, likens the process to ringing a bell. Vibrations are induced in the glass, and measurements made by accelerometers in strategic locations. The segments are finished by coating them with several further layers of chemicals, including a 100-nanometre layer of silver that provides the reflectivity. (A nanometre is a billionth of a metre.) That silver is protected from tarnishing by a layer of hard silicon nitride glass. Even so, the ESO thinks each segment will need re-coating every two years.

Getting all 798 segments to work together presents another set of difficulties. To produce a usable image each segment must be held in a precise position, with an accuracy of just tens of nanometres. Each is backed by a system of sensors and motors that can subtly deform the surface of the glass in order to correct for warping due to everything from small temperature variations to the changing angle of gravity as the mirror moves and tilts.

The primary mirror is just the first stop (see diagram 2). Light hitting it will be redirected towards a secondary and tertiary mirror, which are designed to correct various subtle optical defects. At around 4 metres across, each could be an impressive telescope main mirror in its own right.

The job of the fourth mirror is to counteract the vagaries of Earth's atmosphere. The reason stars appear to twinkle when seen from the ground

is that the atmosphere is constantly churning. Frédéric Gonté, an instrumentation engineer at ESO, compares the effect to peering into water. “Try to see the ground of the swimming pool, you can see it is moving,” he says. “The atmosphere is doing that to us.”

Space telescopes avoid this problem by flying above the atmosphere. Ground-based ones can rely instead on a technology called adaptive optics. This involves deforming the surface of a mirror to cancel out the distortions imposed by the air. The technology is not unique to the ELT. Many modern telescopes sport it, including one of the VLT’s big telescopes (it is being added to the other three). But the ELT’s sheer size makes it more susceptible to atmospheric distortion than smaller telescopes. More than 5,000 actuators behind the ELT’s fourth mirror will make tiny, rippling adjustments to its shape a thousand times each second. Without the adjustments, the ELT’s images would be hopelessly blurred.

Working out exactly how the mirror must be deformed, millisecond by millisecond, requires the presence in the sky of something whose shape is known in advance. Comparing what the telescope actually sees with what it should see reveals the state of the atmosphere at that particular moment, allowing the system to counteract it. Often the object in question is a bright star near the object being studied. If no convenient star is available, though, astronomers can create an artificial one. “Laser guide stars” are made by firing four bright orange laser beams upwards so that they converge in a single point around 90 kilometres up, above the atmosphere’s thickest layers. Because the system knows exactly what the ersatz star should look like, it can make whatever mirror-twisting adjustments are needed.

You might think that once the ELT is up and running, all other telescopes will be rendered obsolete. That is not really true, for even a machine such as the ELT cannot do everything. The twin Keck telescopes in Hawaii, for example, once the world’s largest, have mirrors that are a comparatively

puny ten metres across. But they have the advantage of sitting on a substantially taller mountain, where the seeing is even better than it is in Chile. And the fact that there are two of them means they can serve twice as many astronomers at once.

The VLT, and other multi-mirror telescopes, can also use a technique called interferometry, a clever way of combining signals such that resolving power depends not on the size of individual mirrors, but on the distance between them. For the VLT that is more than 100 metres. On the other hand, that resolving power comes at the cost of a narrower field of view. The ELT is not competing with telescopes like the VLT, says Dr Gonté. “It’s completing.”

But when it comes to detecting the dimmest and most distant objects, there is no substitute for sheer light-gathering size. On that front the ELT looks like being the final word for the foreseeable future. A planned successor, the “Overwhelmingly Large Telescope”, would have sported a 100-metre mirror. But it was shelved in the 2000s on grounds of complexity and cost. The Giant Magellan Telescope is currently being built several hundred kilometres south of the ELT on land owned by the Carnegie Institution for Science, an American non-profit, and is due to see its first light some time in the 2030s. It will combine seven big mirrors into one giant one with an effective diameter of 25.4 metres. Even so, it will have only around a third the light-gathering capacity of the ELT.

A consortium of scientists from America, Canada, India and Japan, meanwhile, has been trying to build a mega-telescope on Hawaii. The Thirty Meter Telescope would, as its name suggests, be a giant—though still smaller than the ELT. But it is unclear when, or even if, it will be finished. Construction has been halted by arguments about Mauna Kea, the mountain on which it is to be built, which is seen as sacred by some. For the next several decades, it seems, anyone wanting access to the biggest telescope money can buy will have to make their way to northern Chile. ■



小伯克希尔

一家加拿大公司如何成为全球最佳科技公司收购者

来认识下星座软件，科技界的伯克希尔·哈撒韦

对于老牌创业公司来说，这是个艰难的时期。英国芯片制造商安谋（Arm）、杂货配送公司Instacart和软件公司Klaviyo近期挂牌上市的表现不佳，打击了市场对IPO的热情。风险投资（VC）资金已经枯竭。研究公司PitchBook的数据显示，处于后期阶段的创业公司所需资金几乎是可获得资金的三倍。许多公司正在寻求出售。被以1亿美元或更高的价格收购的私人公司数量达到了自2022年9月以来的最高峰。

其中一个心满意足的买家是“星座软件”（Constellation Software）。要成为这家加拿大的收购目标，销售额至少要达到500万美元，收入和利润也须显示持续增长。强大的管理团队（最好由创始人领导）是个加分项。尽管该公司在较大规模的交易上花费不菲，但所收购公司的中位数价值约为300万美元。根据加拿大皇家银行（RBC）的数据，自2005年以来，星座软件已斥资87亿美元收购了860多家公司（见图表1）。在此期间，其收入年均增长约25%。今年的收入可能超过80亿美元。在过去五年中，该公司市值以堪比大科技公司的势头猛增250%，达到500亿美元，超过了科技股主导的纳斯达克指数（见图表2）。它现在是加拿大第二大科技公司，仅次于电子商务平台Shopify。

不管是因为运气还是有意为之，星座软件的成功交易所遵循的一些原则看起来与全球重量级收购者伯克希尔·哈撒韦惊人地相似。与伯克希尔的老板沃伦·巴菲特和他的得力助手查理·芒格（于11月28日去世）一样，星座软件的创始人兼总裁马克·莱昂纳德（Mark Leonard）寻觅的也是具有持久竞争优势的企业。星座软件“宇宙”中的软件公司就拥有这样的“护城河”，这些公司专门为汽车经销商、建筑商和水疗中心等不那么光鲜的行业构建数字产品。科技巨头看不上这些相对较小的市场，而较小的竞争对手又缺乏所需的专业知识。结果就是这些既有公司获得了丰厚的利润。

一项交易达成后，星座软件也如伯克希尔一样，以“善意的忽略”来经营业务。它不会整合新收购的公司，也不会空降新的经理人。它放心地让现有领导层负责日常运营，也不会集中共同业务职能以竭力铲除低效。加拿大皇家银行的保罗·特雷伯（Paul Treiber）指出，星座软件认为拆分业务会削弱与客户的联系。子公司的现金流向母公司，母公司再用这些现金收购新企业，而新企业又会产生更多的现金，如此循环。

为了管理800多家公司，星座软件采用了一个控股公司下设六个大型运营集团的结构。在相似的市场里经营的业务被组合在一起。星座软件旗下的Topicus于2021年上市，该经营实体占公司总收入14%，目前估值为58亿美元。其余五大运营单位变得足够壮大时，可能也会上市。和对Topicus一样，星座软件将保留对董事会的控制权。

与伯克希尔类似、但与私募股权基金或风投基金不同的是，星座软件没有既定的退出时间。因此，它可以在投资决策上不急不躁。莱昂纳德在每年的致投资者信中将自己的公司描述为一个“优秀的长期持有者”，与巴菲特的说法如出一辙。这种从长计议的心态也体现在员工薪酬上。奖金不仅仅要看营收增长，还与投资资本回报挂钩。高管必须将四分之三的奖金投资于公司股票，四年内不得出售。这就使管理层的激励机制与股东的利益相一致了。

星座软件的成功揭示了一个关于并购的重要真理，巴菲特对此也不会陌生：连续收购者往往胜过偶尔的交易者。咨询公司麦肯锡的托比亚斯·隆德伯格（Tobias Lundberg）估算，与不常收购的公司相比，经常收购的公司平均每年为股东带来的超额总回报要高出约两个百分点。

隆德伯格将这种优势归结为熟能生巧。正如体育锻炼一样，一家公司收购的次数越多，就越得心应手。来自得克萨斯州的泰勒科技（Tyler Technologies）和来自佛罗里达州的儒博科技（Roper Technologies）等少数公司试图效仿星座软件的“健身”方案，收购利基软件制造商。然而，迄今没有一家公司的块头能与这家加拿大公司相媲美。 ■



Baby Berkshire

How a Canadian company became the world's best acquirer of tech firms

Meet Constellation Software, tech's Berkshire Hathaway

FOR OLDER startups these are tough times. The weak recent stockmarket debuts of Arm, a British chipmaker, Instacart, a grocery-delivery group, and Klaviyo, a software firm, have dampened enthusiasm for initial public offerings. Venture capital (VC) has dried up. Data from PitchBook, a research firm, show that late-stage startups need almost three times as much money as is available to them. Many are putting themselves up for sale. Acquisitions of private firms valued at \$100m or more are at their highest since September 2022.

One happy buyer is Constellation Software. The Canadian firm's targets must have sales of at least \$5m and show consistent revenue and profit growth. A strong management team, preferably founder-led, is a plus. Though it has splurged on larger deals, the median value of firms it acquires is around \$3m. According to Royal Bank of Canada (RBC), since 2005 Constellation has spent \$8.7bn on more than 860 firms (see chart 1). In that time its revenue has grown by about 25% a year on average. This year it could exceed \$8bn. The company's market value is up by a big-tech-like 250% in the past five years, to \$50bn, outperforming the tech-heavy NASDAQ index (see chart 2). It is now Canada's second-largest tech firm after Shopify, an e-commerce platform.

Whether by fluke or design, Constellation's dealmaking success is based on principles that look strikingly similar to those of the world's heavyweight acquirer, Berkshire Hathaway. Like Warren Buffett, Berkshire's boss, and his right-hand man, Charlie Munger (who died on November 28th), the

founder and president of Constellation, Mark Leonard, seeks out businesses with a lasting competitive edge. In Constellation's universe, such a "moat" is enjoyed by software firms that specialise in building digital wares for unsexy industries from car dealerships and builders to spas. Tech giants shun these relatively piddling markets and smaller rivals lack the requisite know-how. The result is rich profits for the incumbents.

After a deal is done Constellation, much like Berkshire, runs the business with benevolent neglect. It does not integrate newly acquired companies or parachute in fresh managers. It is content to leave day-to-day operations to the existing leadership. It does not desperately try to squeeze out inefficiencies by centralising common business functions. Constellation believes that splitting a business weakens its bond with customers, notes Paul Treiber of RBC. Cash from the subsidiaries flows to the parent company, which uses it to buy new businesses. These in turn generate more cash, and so on.

To manage over 800 firms, Constellation is structured as a holding company with six large operating groups. Businesses in similar markets are grouped together. In 2021 Constellation floated Topicus, an operating entity that generated 14% of the firm's total revenue and is now valued at \$5.8bn. When any of the other five big operating units get large enough, they, too, may be listed. As with Topicus, Constellation would retain control of the board.

Like Berkshire but in contrast to private-equity or VC funds, Constellation has no exit clock ticking. It can thus be patient with investment decisions. Mr Leonard's annual letters to investors echo Mr Buffett's in describing the company as a "good perpetual owner". This marathon mentality shapes employee pay. Bonuses are tied to returns on invested capital rather than just revenue growth. Executives must invest three-quarters of their bonus in company stock, which they cannot sell for four years. This aligns management's incentives with those of shareholders.

Constellation's success reveals an important truth about mergers and acquisitions that would also be familiar to Mr Buffett: serial acquirers tend to outdo occasional dealmakers. Tobias Lundberg of McKinsey, a consultancy, calculates that regular buyers on average generate about two percentage points more in excess total returns to shareholders annually compared with irregular ones.

Mr Lundberg puts this edge down to practice. As with exercise, the more buying a company does, the better it gets. A few firms like Tyler Technologies from Texas and Roper Technologies from Florida are trying to emulate Constellation's workout regime of picking up niche software makers. None has so far come close to matching the Canadian company's muscle. ■



外来者突围

外企如何在印度成功——或失败

为什么有些公司扎下根来，有些在撤离

回顾不算久远的历史，外国企业在印度失败的案例比比皆是。一些寻求多元化的全球企业渴望进入快速增长的新兴市场，随着地缘紧张局势不断加剧，还希望撤离中国。就在印度想方设法吸引这些企业的同时，许多跨国公司正纷纷离开这里。过去几年，退出印度的知名外企有阿布扎比商业银行（Abu Dhabi Commercial Bank）、美国汽车制造商福特、瑞士水泥巨头豪瑞（Holcim），以及德国零售商麦德龙等。目前迪士尼正在就出售它在印度的全部或部分流媒体业务进行谈判。11月24日，市值7800亿美元的美国投资巨头伯克希尔·哈撒韦（Berkshire Hathaway）清仓了所持印度数字支付公司Paytm全部2.5%的股份。

这些还只是最近退出的公司。自2018年以来，印度的外国直接投资一直无甚起色。尽管2014年至2021年间有近1.1万家外企进入印度，但一份政府报告发现，同期撤离或关闭的外企多达2783家——对于一个被认为正在高速发展的经济体来说，这个数字高得令人沮丧。

有些公司对印度望而却步可能是因为一些客观存在的困难，比如道路堵塞、空气糟糕以及电信网络覆盖不全等。但毫无疑问，有些公司踟躇不前则是因为在雇用员工、购买土地或合理纳税方面遇到的法律障碍。有些可能就是感觉自己不受待见，因为地方官员和商界领袖常常视外国公司为对本土企业的直接威胁。关键是，许多外国公司发展得不如印度本土对手。根据波士顿咨询公司的数据，外国公司的平均毛营业利润率为12%，而印度公司为15%。当面对与印度透出的潜力反着来的现实，许多原本怀着兴奋之情的外企CEO“幡然醒悟”，一位咨询公司的老板叹道。

这样的公司有很多，但不是全部。英国巨头联合利华的子公司印度斯坦联合利华（Hindustan Unilever）生产的多芬香皂、家乐浓汤宝和其他日常

消费品在印度各地900万家商店都有售。印度最大的汽车销售商马鲁蒂铃木（Maruti Suzuki）是一家与日本合资的公司，第二大汽车销售商则是韩国的现代。日本的本田可能很快就会超过印度对手Hero，成为更大的摩托车制造商。印度人抢购三星手机，使用社交媒体帝国Meta旗下的WhatsApp聊私事，并越来越多地将它用于商务洽谈。他们一半的数字支付都是通过美国零售商沃尔玛拥有的PhonePe完成的。

一些外国公司非但没有退出，反而加倍在印度下注。哪些企业锲而不舍？又是出于什么原因？弄清这两个问题有助于了解外企在印度的成功要素。

首先，能在印度蓬勃发展的一类外国公司是那些自身业务与印度政府的发展重点相一致的企业，比如能够促进出口导向型制造业发展的企业。苹果便是一个典型，它将部分iPhone的制造转移到了在印度开设的代工厂。丹麦的维斯塔斯（Vestas）和德国的Senvion的印度工厂正在生产销往国外的风力涡轮机。据说特斯拉正以在印度建厂作为交换条件，就降低其电动汽车的进口关税与印度谈判。

外国企业帮助修建公路、港口和其他基础设施，从而将产品从工厂运往遥远的市场，也会间接助力印度成就其经济雄心。鉴于印度的经济增长，一家大型金融公司的投资经理把工程企业的印度子公司列为优质投资对象。在过去的十年里，ABB印度分公司的年股市投资总回报率达到21%，是其瑞典和瑞士合资母公司的2.5倍。美国公司霍尼韦尔的全球平均收益率为11%，而其印度子公司为28%。

还有一类外国公司之所以成功，是因为它们努力让自己在印度的业务本土化。一些公司与人脉甚广的本土企业合作。谷歌和Meta已投资数十亿美元，与印度最大的企业集团信实工业（Reliance Industries）建立合作关系，信实旗下电信公司Jio为4.4亿印度人提供移动互联网服务。今年8月，全球最大的资产管理公司贝莱德（BlackRock）重返印度，与信实成立了一家合资企业。贝莱德之前曾与一家较小的印度公司合作并于2018年终止了合作关系。如果此次合作进展顺利，贝莱德将在富达（Fidelity）等公司曾试图凭一己之力拿下却败下阵来的领域取得成功。据报道，中国汽车

公司上汽集团正打算将其面临严苛税务审查的印度子公司MG Auto的大量股份出售给印度钢铁龙头企业JSW。

外国公司还有其他办法让自己的业务更加印度化。星展银行没有将其印度分行的领导权放在新加坡本部，而是在印度设立了一家分支机构，建立印度董事会对印度的监管机构负责。2018年，沃尔玛通过收购印度本土电商平台Flipkart的控股权，巩固了在印度的根基。今年7月，沃尔玛又加大押注，收购了两家美国科技投资公司老虎环球（Tiger Global）和Accel所持有的Flipkart的股份。

最后一个重要的群体在印度稳扎稳打，它们就是那些已经在印度发展壮大的公司。一家主权财富基金的印度负责人表示，这些公司能够做大做强，往往不是因为开创了新市场，而是取代了既有的非正规商品和服务供应。其中许多与ABB和霍尼韦尔一样，其印度子公司的收益率高于母公司，贝恩的尼基尔·欧嘉（Nikhil Ojha）指出（见图表）。有些公司，比如印度斯坦联合利华以及马鲁蒂铃木等，已经在印度经营了几十年。许多印度人都愿意视它们为本土公司。

也有一些外国公司不大受待见，至少一开始是这样。亚马逊自十年前进入印度以来，一直面临各种障碍，比如限制其并购本土企业、销售自有品牌产品，规定其库存规模，以及指控其对街头巷尾数以百万的小卖部生存构成威胁等等。不过这家电子商务巨头没有退却，而是选择了坚守。今年6月，亚马逊CEO安迪·贾西（Andy Jassy）表示，在2030年前，亚马逊将在印度追加65亿美元的投资，使其在印度的总投资达到260亿美元。它正在扩大其电子商务配送网络，并建立多个云计算数据中心。11月，亚马逊在其流媒体服务Prime Video上推出了FanCode频道，专门播放有印度“国球”之称的板球等体育节目。

这种坚持不懈的做法看上去奏效了。印度政府官员似乎正在放松对亚马逊在印度扩张的抵制。他们可能得出了结论，认为亚马逊在物流上的专长正好契合了印度将其工厂与世界连接起来的需要。况且，亚马逊承诺的数十亿美元投资也不会有什么坏处。■



An outside chance

How to succeed—and fail—as a foreign business in India

Why some companies are staying put while others up sticks

THE RECENT history of foreign business in India is littered with failures. Even as the country has tried to lure global businesses keen to diversify into a fast-growing emerging market and, amid rising geopolitical tensions, away from China, many multinational companies are throwing in the towel. Notable departures over the past couple of years include Abu Dhabi Commercial Bank; Ford, an American carmaker; Holcim, a Swiss cement giant; and Metro, a German retailer. Disney is negotiating the sale of all or part of its streaming business. On November 24th Berkshire Hathaway, a \$780bn American investment Goliath, offloaded its 2.5% stake in Paytm, an Indian payments processor.

These are only the latest companies to call it quits. Inbound foreign direct investment has been flat since 2018. Although nearly 11,000 foreign firms entered India between 2014 and 2021, a government report found that 2,783 had left or closed in that period—a dispiritingly high number for a supposedly fast-charging economy.

Some were probably put off by practical challenges, such as clogged roads, unbreathable air and patchy telecoms networks. Some no doubt balked at the legal obstacles to hiring workers, buying land or paying the right taxes. Some may simply have felt unwelcome; local bureaucrats and business leaders often see foreigners as a direct threat to domestic interests. Crucially, many fared less well than home-grown rivals. According to BCG, a consultancy, their gross operating margins average 12%, against 15% for Indian firms. When confronted by India's reality, as opposed to its potential, plenty of excited foreign chief executives quickly find themselves

“disabused”, sighs a consulting boss.

Plenty, but not all. Dove soap, Knorr stock cubes and other consumer staples made by Hindustan Unilever, the Indian arm of a British giant, can be bought in 9m shops across the country. India’s top car-seller is Maruti Suzuki, a joint venture with a Japanese firm, followed by Hyundai of South Korea. Honda of Japan may soon dethrone Hero, an Indian rival, as the bigger maker of two-wheelers. Indians snap up Samsung phones and use WhatsApp, part of Meta’s social-media empire, to talk private and, increasingly, commercial business. They make half of all their digital payments via PhonePe, which is owned by Walmart, an American retailer.

Far from quitting, some foreign companies are doubling down on their Indian bets. Which businesses persevere—and why—helps understand what it takes to succeed in India as a foreign enterprise.

One group of corporate outsiders that can thrive in India are those whose business is aligned with the priorities of the Indian state, such as boosting export-oriented manufacturing. Apple has become the poster child of this approach, by moving some iPhone-making to contract manufacturers setting up shop in India. Vestas of Denmark and Senvion of Germany are producing wind turbines for sale abroad. Tesla is reportedly negotiating lower import tariffs on its electric cars in exchange for setting up an electric-car factory.

An indirect way to shore up India’s economic ambitions is to help build the roads, ports and other infrastructure needed to get products from the factories to faraway markets. An investment manager at a big financial firm lists the Indian subsidiaries of engineering companies as good wagers on Indian growth. Over the past ten years ABB’s Indian affiliate has generated annual total stockmarket returns of 21%, two and a half times those of its Swedish-Swiss parent. America’s Honeywell averaged 11% globally but 28%

for its Indian arm.

Another successful group are foreigners who make an effort to indigenise their Indian business. Some team up with well-connected locals. Google and Meta have invested billions of dollars in partnerships with Reliance Industries, India's biggest conglomerate, whose Jio telecoms unit brought mobile internet to 440m Indians. In August BlackRock, the world's biggest asset manager, returned to India in a joint venture with Reliance. Its earlier foray involving a smaller partner was discontinued in 2018. If this time works out, BlackRock will have succeeded where those trying to go it alone, such as Fidelity, had failed. SAIC Motor, a Chinese car firm, is reportedly looking to sell a large stake in MG Auto, a local subsidiary facing a pernickety tax exam, to JSW, India's steel champion.

Outsiders have other ways to make their business more Indian. Rather than run its Indian bank from its home in Singapore, DBS set up a local affiliate complete with an Indian board accountable to Indian regulators. Walmart strengthened its Indian presence by acquiring a controlling stake in Flipkart, a local e-commerce platform, in 2018. In July the American retailer increased its interest by buying the stakes held by two American tech-investment firms, Tiger Global and Accel.

One last important group is staying put—firms that are already big in India. Often, says the India head of a sovereign wealth fund, they flourish not by creating new markets but by replacing informal provision of existing goods and services. Many, similarly to ABB and Honeywell, earn better returns from their Indian subsidiaries, notes Nikhil Ojha of Bain (see chart). Some, like Hindustan Unilever or Maruti Suzuki, have been in the country for decades. Many Indians would consider them homegrown.

Some are not so well liked, at least at first. Since it entered India ten years ago, Amazon has faced limits on local acquisitions, restrictions on selling

own-label products, rules on inventory size and accusations that it threatened millions of kirana corner shops. Rather than give in, the eemporium has stood firm. In June its boss, Andy Jassy, said it would invest an extra \$6.5bn in India by 2030, bringing its total spending in the country to \$26bn. It is expanding its e-commerce distribution network and building cloud-computing data centres. In November it launched FanCode, a channel on its Prime Video streaming service dedicated to sports including cricket, the national pastime.

This resolute approach appears to be paying off. Resistance to Amazon's Indian growth seems to be easing among government officials, who may have concluded that its logistical expertise is what India needs to connect its factories to the world. Billions of dollars in promised investments can't have hurt, either. ■



巴托比

如何不激励你的员工

道格拉斯·麦格雷戈关于管理和激励的著作很有先见之明

这里有一些简单易用的经验法则。对任何自称思想领袖的人都敬而远之。不穿袜子的人不可信。还有，设置员工赞赏日的公司并不真的赞赏自己的员工。

一年有260多个工作日，只拿出其中一天予以员工认可，这传递出的信息本就有点不对劲（同样的道理，世界上可没有“爱配偶日”，也没有全国性的“别做彻头彻尾的王八蛋周”）。更何况，那些用来表达赏识的点子往往漫不经心到了悲催的地步。你一年到头辛勤工作，就是为了一片凉掉的披萨或者一块印着“你‘石’在棒”几个大字的石头？

这种方法更多地揭示了那些老板们想当然的见解，而非真正激励员工努力工作的因素。麻省理工学院斯隆管理学院（MIT Sloan School of Management）教授道格拉斯·麦格雷戈（Douglas McGregor）在1960年出版的《企业的人性面》（The Human Side of Enterprise）一书中，将管理者对员工的臆断分为两类，分别称之为X理论和Y理论。

1964年去世的麦格雷戈是他那个时代的产物。书中小花絮的出场角色都叫汤姆和哈利这样的名字。但他的理念至今仍然有用。

X理论管理者认为人生来就厌恶工作，他们的任务就是设法让懒鬼们付出些努力。这就需要行使权威和控制。X理论严重依赖给予或不给予奖励来激励人们。福利和披萨属于这种情况，但在X理论中最关键的还是薪酬：工作就是获得工资的代价。

麦格雷戈本人赞同的Y理论是基于一种对人类乐观得多的看法。它假设人们愿意努力工作，而如果员工致力于实现公司目标，就无需管理者发号施令。该理论认为，如果薪酬过低或不公平，就可能会打击士气，但一旦人

们的收入足以满足他们的基本需求，其他动力来源就更为重要了。在这一点上，麦格雷戈是亚伯拉罕·马斯洛（Abraham Maslow）的追随者，在这位心理学家提出的需求层次中，底层是能吃饱饭和有安全感，再往上便是更高层次的概念，如归属感、自尊和使命感。

X理论并没有消亡。它依旧存活在工人必须严格遵守规章制度的低薪行业，以及薪水在早就能满足温饱之后仍在激励人们的高薪行业。每当管理者担心居家办公成了人们摸鱼的万能借口，或是员工敷衍了事、老板霸凌责骂员工时，都是X理论在浮现真容。

然而，Y理论日益占得上风。数不胜数的研究表明，如果人们认为自己的工作很重要，他们就会更加努力地工作。森林湖学院（Lake Forest College）的卡桑德拉·巴茨-巴尔巴里奇（Cassandra Batz-Barbarich）和普渡大学的路易斯·泰伊（Louis Tay）对这类研究的综合分析发现，做有意义的工作与员工敬业度、工作满意度和忠诚度密切相关。信任越来越被视为企业成功的重要因素。企业生产率研究所（Institute for Corporate Productivity）最近的一份报告发现，高绩效的组织更有可能拥有高水平的信任度。

各行各业的公司都在自问如何让Y理论为己所用。一些平淡乏味的行业里的公司煞有介事地编写使命声明，想给人们一个除了赚房租之外的去上班的理由。自主性和责任心的感召力不仅渗透到像奈飞（Netflix）这样的创意公司的管理哲学中，在鼓励员工主动解决问题的精益制造商那里也是如此。一些零售商提高了工资，因为Y理论促使他们相信减少员工的财务不安全感会提高员工留任率和组织绩效。

麦格雷戈本人写道，他写这本书的目的不是让人们选边站，而是要让管理者坦率阐明自己对员工的假定。就这一点来说，他不太成功。遵照X理论把公司经营得财务状况良好仍然是可能的，但要承认这一点是绝无可能的。■



Bartleby

How not to motivate your employees

Douglas McGregor's prescient writing on management and motivation

HERE ARE some handy rules of thumb. Anyone who calls themselves a thought leader is to be avoided. A man who does not wear socks cannot be trusted. And a company that holds an employee-appreciation day does not appreciate its employees.

It is not just that the message sent by acknowledging staff for one out of 260-odd working days is a bit of a giveaway (there isn't a love-your-spouse day or a national don't-be-a-total-bastard week for the same reason). It is also that the ideas are usually so tragically unappreciative. You have worked hard all year so you get a slice of cold pizza or a rock stamped with the words "You rock"?

This approach reveals more about the beliefs of the relevant bosses than it does anything about what actually motivates people at work. In a book published in 1960, called "The Human Side of Enterprise", Douglas McGregor, a professor at MIT Sloan School of Management, divided managers' assumptions about workers into two categories. He called them theory X and theory Y.

McGregor, who died in 1964, was a product of his time. The vignettes in the book feature men with names like Tom and Harry. But his ideas remain useful.

Theory X managers believe that people have a natural aversion to work; their job is to try and get the slackers to put in some effort. That requires the exercise of authority and control. It relies heavily on the idea of giving and withholding rewards to motivate people. Perks and pizza fit into this picture

but pay is critical to theory X; work is the price to be paid for wages.

Theory Y, the one McGregor himself subscribed to, is based on a much more optimistic view of humans. It assumes that people want to work hard and that managers do not need to be directive if employees are committed to the goals of the company. It holds that pay can be demoralising if it is too low or unfair, but that once people earn enough to take care of their basic needs, other sources of motivation matter more. In this, McGregor was a follower of Abraham Maslow, a psychologist whose hierarchy of needs moves from having enough to eat and feeling safe up to higher-order concepts like belonging, self-esteem and purpose.

Theory X is not dead. It lives on in low-wage industries where workers must follow rules to the letter and in high-wage ones where pay motivates people long after they can feed themselves. It surfaces in the fears of managers that working from home is a golden excuse for people to do nothing. It shows up in the behaviour of employees who phone in and bosses who bully and berate.

Nevertheless, theory Y is in the ascendant. You cannot move for research showing that if people think what they do matters, they work harder. A meta-analysis of such research, conducted by Cassandra Batz-Barbarich of Lake Forest College and Louis Tay of Purdue University, found that doing meaningful work is strongly correlated with levels of employee engagement, job satisfaction and commitment. Trust is increasingly seen as an important ingredient of successful firms; a recent report by the Institute for Corporate Productivity found that high-performing organisations were more likely to be marked by high levels of trust.

Firms of all kinds are asking themselves Y. Companies in prosaic industries are trying to concoct purpose statements that give people a reason to come into work that goes beyond paying the rent. The appeal of autonomy and

responsibility permeates the management philosophy not just of creative firms like Netflix but also of lean manufacturers that encourage employees to solve problems on their own initiative. Some retailers have raised wages in the theory Y belief that reducing workers' financial insecurity will improve employee retention and organisational performance.

McGregor himself wrote that the purpose of his book was not to get people to choose sides but to get managers to make their assumptions explicit. On this score he is less successful. It is still possible to run financially viable firms in accordance with theory X. It is impossible to admit it. ■



巴托比

如何在为个体设计的系统中管理团队

如果合作如此重要，为什么企业不采取更多措施促进合作呢？

“Team”（团队）一词中没有“i”（我）这个字母，但在“autopilot”（自动惯性模式）中却有。尽管团队合作在组织中日益重要，但管理员工的流程基本还是老一套。谈到合作，老板们可能口若悬河，但在奖励、考评和招聘上却没有相应的行动。

处于组织中的人从来都在与其他人协同工作。但对团队的强调越来越多，这有多方面原因。技术让想法和信息共享变得更加容易，而混合工作则让这种共享变得更加重要。（微软的会议软件叫Teams而不是Silos[“孤岛”]是有原因的。）软件行业已经将敏捷、敏捷开发框架scrum、OKR（目标与关键成果法）以及其他种种团队合作的信条散播到各个角落。

麻省理工学院斯隆管理学院（MIT Sloan School of Management）的阿卜杜拉·阿尔马图克（Abdullah Almaatouq）最近发表的一篇论文表明，事实证明，团队更擅长解决复杂的问题。还有研究表明，人们对所在的工作团队比对整个企业组织更有感情——你总不大可能和公司标识去吃午餐。

关于是哪些因素让团队有效运作的了解也在不断积累。谷歌著名的亚里士多德项目（Project Aristotle）研究了公司表现最佳的团队的特征，认为“心理安全”（能否放心说出自己的想法）是其中最重要的因素，此外还有团队成员可靠、角色明确和工作有意义等。不同的团队擅长不同的任务。芝加哥大学的吴令飞及其合著者的分析发现，团队规模和科研的类型之间存在相关性。较大的团队发展某一领域内的现有想法，较小的团队用新想法颠覆某个领域。

然而，对团队的重视加强和理解加深通常不会转化为相应的管理实践。招聘流程主要看的是个人已取得的成就，而不是他们过去所在的集体如何。绩效管理在很大程度上仍然只看个人表现。评价通常基于个人目标，奖金

也是如此。衡量标准通常仅基于实际产出，而不是更软性的基于团队的衡量标准，例如人们的受信赖度如何。更糟糕的是，许多老板根本不知道他们的团队到底在做什么。软件公司Soroco以及哈佛商学院和宾夕法尼亚大学沃顿商学院的学者请主管们说出哪些流程最占用手下团队的时间。平均而言，他们不知道或记不起团队成员60%的工作内容是什么，这让他们更像是高功能忘事佬，而不是老板。

这其中大部分情况都是有充分理由的。调动和升迁都是个人行为而非团队行动。根据团队绩效奖励员工可能会导致不公平：“白嫖怪”可能会得到过度的奖励，努力工作的人可能会因为其他人没有尽职尽责而承担后果。量化团队贡献很难。当团队的成员来自不同部门，或者团队只是临时组建时，管理者就更难知道他们的直接下属在做什么。

但这些问题并非无法克服。在招聘时是有可能评估候选人是否具有成为优秀团队成员的特质的。例如，有一项测试要求参与者根据对眼睛的快照来判断人的情绪，能在这个测试中取得良好成绩的就可能是优秀的团队合作者。同事评议可以很好地反映个体在团队中的形象。

至于说根据团队表现来发放奖金可能会导致有人坐享其成，这种担忧似乎也被夸大了。奥胡斯大学（Aarhus University）的安德斯·弗雷德里克森（Anders Frederiksen）和合著者最近调查了在一家制造企业引入基于团队的激励措施的影响，发现这种措施引发了绩效的巨大飞跃。出现这种飞跃不仅是因为这样的措施激励了现有员工提高效率，还因为吸引了生产率更高的新员工。

员工们都是一个一个的人，管理者永远不应该忘记这一点。但如果团队能促成众多奇迹发生，老板就应想出更好的方法来充分利用团队。弄清楚团队一整天在忙什么可能是一个不错的起点。 ■



Bartleby

How to manage teams in a world designed for individuals

If collaboration matters so much, why don't firms do more to promote it?

THERE IS NO “i” in team. But there is one in “autopilot”. Despite the growing importance of teamwork in organisations, the processes used to manage employees have carried on much as before. Bosses may wax lyrical about collaboration, but the way they reward, review and recruit has not caught up.

People in organisations have always worked in concert with others. But the emphasis on teams is growing, for a variety of reasons. Technology has made the sharing of ideas and information easier, while hybrid working has made it more vital. (There's a reason it's not called Microsoft Silos.) The software industry has spread the gospel of teams—agile, scrums, OKRs and all the rest of it—into all kinds of places.

Teams, it turns out, are better at solving complex problems, according to a recent paper by Abdullah Almaatouq of the MIT Sloan School of Management. Research also suggests that people have a greater attachment to their work group than to their organisation; you're less likely to go for lunch with a logo.

Knowledge is also accumulating as to what makes teams tick. Project Aristotle, a famous bit of research by Google into the characteristics of its best-performing teams, identified “psychological safety”—comfort to speak one's mind—as the most important ingredient, alongside things like dependability, role clarity and meaningful work. Different teams excel at different things. Analysis by Lingfei Wu of the University of Chicago and his co-authors found a correlation between team size and types of scientific

research: larger teams develop existing ideas and smaller ones disrupt the field with new ones.

But a greater emphasis on, and understanding of, teams does not generally translate into matching management practices. Recruitment processes focus on the achievements of the individual rather than the collectives they have been in. Performance management is still largely a one-player sport. Reviews are usually based on individual targets, as are bonuses. Metrics are often confined to concrete outputs rather than softer team-based measures, such as how trusted people are. It doesn't help that many bosses have little idea what their teams really do. Soroco, a software firm, and academics at Harvard Business School and the Wharton School of the University of Pennsylvania asked managers to describe the processes that they thought took up most of their teams' time. On average they did not know or could not recall 60% of what their team members did, making them more like high-functioning goldfish than bosses.

There are good reasons for much of this. People move jobs and get promoted one by one, not as battalions. Rewarding people on the basis of team performance can lead to unfairness: free-riders might get too much recognition or hard workers might be penalised for someone else not pulling their weight. It's difficult to quantify team contributions. When teams are made up of people from different departments—or form for limited periods—managers find it harder to know what their direct reports are up to.

But these problems are not insurmountable. When hiring people, it is possible to assess traits that make for good group members: scoring well on a test that asks participants to determine what people are feeling from a snapshot of their eyes is correlated with being a good team player, for example. Peer reviews can give a good sense of how people are seen within teams.

The worry that team-based bonuses may encourage free-riding also seems to be overblown. A recent study by Anders Frederiksen of Aarhus University and his co-authors looked at the impact of introducing group-based incentives at a manufacturing firm, and found it sparked a big leap in performance. That jump was not just because the scheme incentivised existing workers to be more efficient, but also because it attracted more productive new hires.

Employees are individuals; managers should never forget that. But if teams are where a lot of the magic happens, bosses should have better ways to get the most out of them. Working out what they do all day might be a good place to start. ■



巴托比

为什么星期一受误解最深

工作周的第一天有什么不好？

爱尔兰乐队“新城之鼠”（Boomtown Rats）在1979年推出了单曲《我不喜欢星期一》（I Don't Like Mondays），这首歌迅速爆红。歌曲的灵感来自当年发生在美国加州圣地亚哥市的克利夫兰小学（Cleveland Elementary School）的枪击事件。16岁的罪犯称，“不喜欢星期一”是她连开36枪，导致两名成年人死亡、八名儿童和一名警察受伤的主要原因。当然，全世界千百万人对这首歌深有感触并不是因为枪击案，他们大部分人十有八九都不知道这首歌源自一场悲剧。但很多人对于在星期一清早鼓起勇气起床去开始一周工作的艰难都太清楚不过了。

不少老板认为，员工到办公室开启新的一周会带来正能量。很多员工不这么看。2021年在《应用心理学杂志》（Journal of Applied Psychology）上发表的一篇论文发现，人们在周一往往更粗鲁无礼，但随着一周往后推移，他们会越来越彬彬有礼。

黄润泰（Yun Tae Hwang，音译）和艾米·姜（Amy Kang，音译）2015年在《澳大利亚医学杂志》（Medical Journal of Australia）上发表的一篇论文甚至诊断出一种新型疾病——星期一综合征。作者将其定义为“在没有其他局灶性或全身性疾病的情况下出现的一种具有非特异性症状的全身性疾病，症状包括疲劳、嗜睡或无力、精神不振、易怒、头晕、畏光、口干、肌痛和头痛”。

这些症状通常出现在结束一段休息后的第一个工作日，这段休息可能是周末或更长的假期。患者可能因此请病假、决定居家工作，或是即便人在办公室，也是一副爱理不理、生人勿近的样子。正能量什么的就算了吧。

星期一综合征似乎还会传染，蔓延到一周中的其他日子。如今有些美国人抱怨起了“星期天恐惧”，当周末接近尾声时，即将面临周一的恐惧就来

了。周末宿醉、某个最后期限将近或是痛苦的回忆（中学时周一早上要连上两节科学课？）都会让这两种病情加重。人力资源软件公司UKG从2022年开始的一项民意调查显示在美国有近一半的劳动者讨厌自己的工作，这些人的星期一综合征和星期天恐惧症很可能尤其严重。

不过，从非工作状态突然切换到工作状态会影响到每个人，不仅是那些讨厌自己手头活计的人。新冠疫情让很多人重新评估自己工作与生活的平衡。伦敦一位周末也要处理案子的大律师喜欢在德罗涅饭店（The Delaunay）享用一顿优雅的早餐，然后在内殿律师学院大堂（Inner Temple Hall）享用午餐，让自己轻松缓和地进入正式的工作周。越来越多人在推动每周四天工作制，其中一种安排是把星期一算成周末（不过这可能又会导致“星期二综合征”蔓延开来）。在社交媒体上发起的“最低强度星期一”（bare-minimum Mondays）的运动没这么激进，而是更加现实，主张温和地开启新的一周。

所有这些都反映了人类自我放纵和拖延的深层本能；难怪保险杠车贴或T恤上永远不可能写着“感谢上帝，今天周一”。尽管如此，在一周的第一天，员工们也无需陷入冷漠和倦怠之中不可自拔，或是幻想着能有另一种现实。正如罗伯特·弗罗斯特（Robert Frost）在他的诗《仆人们的仆人》（A Servant to Servants）中提出的忠告：“最好的出路永远都是走下去。”

之前的60个来小时你可能是和跟工作无关的人一起度过的。也许你精心准备了——或仅仅是享用了——一顿美食，怎么样也比坐在办公桌前啃三明治强。也许你去了公园散步，或者就是懒洋洋地躺在床上。不管怎样，你几乎一定是头脑清明，神清气爽了。所以接下来的周一上午应该是你一周效率最高的时候，除非你周末净忙着花天酒地了。

对银行家来说，星期一是从待办事项清单上划掉条目的日子。作为本专栏的特邀撰稿人，笔者在星期一早上也是精力充沛（《经济学人》编辑部会在这时开会，计划和讨论这一周的选题）。不必非得把周末过后的第一次起床淋浴、第一杯咖啡和第一趟通勤搞得像是背着一大包石头在徒步一

样。相反，它们可以被注入一种重燃的使命感而帮助你振奋精神。每到星期五下午，笔者就会感到精疲力竭，迫不及待地想回家，直到星期一早上，她才恢复过来，精神抖擞，准备好投入新一周的工作。■



Bartleby

Why Monday is the most misunderstood day

What's wrong with the start of the workweek?

WHEN THE Boomtown Rats, an Irish band, released “I Don’t Like Mondays” in 1979, the song became an instant hit. The inspiration behind it was the Cleveland Elementary School shooting in San Diego that year. The 16-year-old perpetrator listed “not liking Mondays” as her main reason for firing 36 shots, killing two adults and injuring eight children and a police officer. This is not, though, why the song resonated with millions of people around the world; most of them are in all likelihood unaware of its tragic origins. What many do recognise all too well is the difficulty of summoning the energy to get out of bed on Monday mornings in order to face the week ahead.

Many bosses argue that starting off the week in person in the office creates good energy. Plenty of employees beg to differ. A paper published in 2021 by the Journal of Applied Psychology, found that people tend to be more ill-mannered on Mondays, and grow more courteous as the week unfolds.

A paper from 2015 by Yun Tae Hwang and Amy Kang published in the Medical Journal of Australia goes so far as to diagnose a new condition, Mondayitis. The authors define it as “a systemic illness with a non-specific constellation of symptoms including fatigue, lethargy or asthenia, dysthymia, irritability, light-headedness, photophobia, dry mouth, myalgia and headache in the absence of another focal or systemic illness”.

These symptoms typically appear on the first working day after a period off work, which could be a weekend or a longer holiday. They can lead sufferers to call in sick, decide to work from home or, if they do show up in the office,

come across as detached and unavailable. So much for good energy.

Mondayitis appears to be contagious, infecting other days of the week. Some Americans now complain of “Sunday scaries”, when pre-Monday dread sets in as the weekend draws to a close. Both conditions can be aggravated by a weekend hangover, a looming deadline or painful memories (double science in secondary school first thing in the morning?). They are likely to be particularly acute among the nearly half of American workers who, according to a poll from 2022 conducted by UKG, an HR-software company, hate their jobs.

Still, the sudden shift from non-work to work affects everyone, not just those who despise what they do for a living. The covid-19 pandemic has led many people to re-evaluate their work-life balance. A barrister in London who spends weekends working on cases likes to ease into the formal workweek with an elegant breakfast at The Delaunay and lunch in Inner Temple Hall. A broader movement is promoting the idea of a four-day workweek, one permutation of which would make Monday part of the weekend (though this may lead to an epidemic of Tuesdayitis instead). Less ambitiously, and more realistically, a social-media campaign for “bare-minimum Mondays” argues for a gentle start to the week.

All this reflects a deep human instinct towards self-indulgence and procrastination; there is a reason why “Thank God it’s Monday” does not feature on many bumper stickers or T-shirts. Still, on that first day of the week employees do not have to be mired in apathy, weariness and desire that things were otherwise. As Robert Frost counselled in his poem, “A Servant to Servants”, “the best way out is always through.”

The preceding 60 hours or so were probably spent with people who have nothing to do with your job. You may have prepared—or merely enjoyed—a more elaborate meal than an al desko sandwich. You may have gone for a

walk in the park or simply lounged in bed. Either way, you almost certainly cleared your head. Unless you capped the weekend off by going on a bender, this means that the following morning could be your most productive time of the week.

For one banker, Monday is the day to cross items off their to-do list. Your columnist, a guest Bartleby, feels crisp and invigorated on Monday mornings (which is when the editorial meetings take place at The Economist, planning and discussing the coming week's issue). The first shower, coffee and commute after the weekend do not have to feel like a hike with a rucksack full of stones. They can instead be imbued with a renewed sense of purpose and, as such, act as a tonic. It is on Friday afternoons when Bartleby feels depleted and cannot wait to go home—until Monday morning, when revived and spirited, she is ready to do it all over again. ■



【首文】PISA的启示

新冠肺炎是全球学童的灾难

智力浪费代价巨大

在过去二十年里，主要由发达国家组成的经合组织（OECD）的分析师每三年就对几十个地方的学生开展阅读、数学和科学测试，以便更好地比较他们学校的教学质量。由于过去几年里疫情造成的干扰，最新一轮测试在推迟一年后于2022年举行。没人指望它会带来惊喜，但12月5日公布的结果仍是当头一棒。与2018年参加类似测试的同龄人相比，发达国家青少年的阅读能力平均落后了约六个月，数学落后九个月。在几个发达国家，15岁青少年的成绩只达到以前比他们整整小一岁的学生的水平。

在此之前的趋势本就不乐观，这次的结果因而愈发令人气馁。纵观多年的国际测试结果可以发现，疫情来袭时，发达国家一般青少年的算数能力还比不上20来年前的学生。尽管支出一直在增加，但根据经合组织的衡量标准，阅读和科学的平均分数十年来却持续下滑。因此有充分理由认为，即使没有新冠疫情的扰乱，这一次的测试（通常称为PISA测试）成绩也可能会下降。

这份黯淡的成绩单应该促使政府行动起来完成两项任务。首先是继续疫情“追赶”计划，尽管这项工作远未完成，但投入的精力和资金都已开始减退。一家大型考试机构7月发布的数据显示，在最近一个学年里，美国许多学生的进步速度未超过疫情前的正常水平。本月的PISA结果显示，美国分数下滑的程度比其他许多地方略低，但这对数百万青少年来说毫无意义，因为他们仍将带着巨大的技能缺口结束学业。

无论怎样重振追赶计划，降低缺勤率都应该是首要任务。在美国和英国，20%至30%的学生至少缺课十分之一，常常还远多于此。这大约是疫情前的两倍。对于那些正常上课的学生，学校可以给他们提供比平时更多的课程。延长学习时间——在假期、周末和课后——也许是让孩子们赶上进度

的最简单方法。但在许多地方，额外加课在追赶计划中扮演的角色非常有限，因为这得向教师支付更多薪资或者雇用更多教师，成本高昂。再者孩子们也不愿意。

政府的第二项任务是扭转令人沮丧的长期趋势。从国际测试中可以看出哪些做法有效、哪些无效。减少班级人数往往是浪费金钱；拥有高素质的教师更加重要。教育预算可以做到更加有的放矢。在发达国家，弱势群体的学生只能忍受更差的师资和更少的书籍。要真正改变这种状况，就必须与包括教师工会和富裕家长在内的强大游说集团抗争。从理论上讲，这场危机是进行此类改革的大好机会。

更让人感到遗憾的是政客把精力都放在了别处。英国政府将其学生的PISA测试表现形容为一场胜利（与美国一样，英国的排名有所上升，但只不过是因为其分数下滑的幅度略小于平均水平而已）。明年可能上台执政的工党计划对私立学校采取更强硬的立场，要求它们缴税；私立学校不需要政府花钱，而且教学成果优异，但对其征税可能会迫使部分家长转向公立学校而增加公共负担。与此同时，过去几年美国将大量精力浪费在关于历史、性别和种族的教学的激烈但基本无果的争论上。疫情期间无休止的干扰影响了学习。学童们不能再一次被辜负。 ■



The learning power of PISA

Covid-19 was a disaster for the world's schoolchildren

The costs of wasting brainpower are huge

EVERY THREE years for the past two decades analysts at the OECD, a club of mostly rich countries, have asked pupils in dozens of places to take tests in reading, maths and science, the better to compare the quality of their schools. No one was expecting the latest round of exams, sat a year late in 2022 after years of pandemic-induced disruption, to bring good news. But the results, released on December 5th, are still a blow. An average teenager in the rich world is found to have fallen about six months behind in reading and nine months behind in maths, compared with peers who sat similar tests in 2018. In several rich countries 15-year-olds are performing at levels that back then would have been expected of learners a full year younger.

These findings are all the gloomier because of the discouraging trends that preceded them. Years of international testing suggest that, when the pandemic struck, typical teenagers in the rich world were no more numerate than those schooled some 20 years earlier. In reading and science, average scores have been drifting down for a decade, according to the OECD's yardstick, even though spending has been going up. So there are good reasons to think that grades in the latest exams (often known as the PISA tests) might have slipped even without the turmoil of covid-19.

The sombre school report should rally governments to accomplish two tasks. The first is to renew pandemic "catch-up" programmes, for which energy and funding is beginning to flag even though the job is far from complete. Data released in July by a big test-provider suggest that in the most recent academic year many pupils in America made no faster progress than was normal before the pandemic. This month's PISA results suggest

that America's scores may have fallen back a bit less than in lots of other places—but that means nothing to the millions of youngsters who are nonetheless approaching the end of their school days with yawning gaps in their skills.

A priority of any revamped catch-up schemes should be to bring down absenteeism. In both America and Britain 20-30% of pupils miss at least one lesson in ten, and often many more. This is roughly double the rate before the pandemic. As for pupils who are regularly coming to class, schools could be offering them more lessons than usual. Providing more learning time—in holidays, at weekends and after school—is perhaps the simplest way of getting youngsters back up to speed. But in many places extra hours have been given only a minimal role in catch-up plans; they are expensive because teachers would have to be paid more, or more teachers hired. And the children are not keen.

Governments' second task is to turn around the disheartening long-term trends. International tests offer clues about what works and what does not. Cutting class sizes is often a waste of money; having high-quality teachers matters more. Education budgets could be better focused. Across rich countries, disadvantaged pupils put up with less qualified staff and make do with fewer books. Changing much of this means taking on powerful lobbies, including teachers' unions and wealthy parents. In theory the crisis offers a big opportunity to make such reforms.

All the more reason to regret that politicians are focusing their energies elsewhere. Britain's government has painted its pupils' performance in the PISA tests as a triumph (like America it has drifted up the league tables, but only because its scores collapsed a smidgeon less than the average). The Labour Party, which will probably come to power next year, plans to get tougher on private schools by making them pay tax; they cost the government nothing and get excellent results, but taxing them will probably

force some parents to increase the burden on the public sector. In America, meanwhile, the past few years have seen much energy wasted on fiery but mostly fruitless battles about the teaching of history, gender and race. Neverending disruptions during the pandemic were bad for learning. Schoolchildren must not be let down once again. ■



巴托比

生成式人工智能给管理者出了难题

变革性技术可能很难应付

生成式人工智能（AI）的非凡能力，你一试就明白。但对于管理者来说，能力非凡也是个问题。当一项新技术可以影响众多活动，而且采用该技术并不仅仅取决于机器的能力，也取决于麻烦的人类，况且该技术还有些出人意料的缺陷时，要弄清楚该如何应对它的难度就更大了。

一项又一项的研究充分表明，ChatGPT等AI背后的大语言模型（LLM）具有改善各种事务的潜力。LLM能够生成会议纪要、分析数据或起草新闻稿，从而节省时间。它们能够提升客户服务。它们不能组装宜家的书架——但人类也一样不行。

AI甚至可以促进创新。康奈尔大学的卡兰·吉罗特拉（Karan Girotra）及合著者比较了最新版ChatGPT和一所名牌大学的学生的创新能力。一个人单枪匹马可以在15分钟内想出大约五个创意，配备上一个AI后可以想出200个。关键是这些创意的质量还要更高，至少从新产品概念的购买意向调查来看是这样。这样巨大的可能性反而可能让老板们手足无措：如果你什么都能做，最后很容易什么都没做。

LLM的易用性也是有利有弊。有利的一面是，越多人尝试使用生成式AI，就越能发现它的更多用处。越熟悉LLM，就越懂得如何善用它们。投资了一系列AI项目的里德·霍夫曼（Reid Hoffman）给出了一条简单的建议：先用起来。如果你一年前让ChatGPT写了一首俳句，之后就再没碰过它，那么就该多用用了。

熟悉感也可能对抗人类对自动化的本能的警惕。南洋理工大学的佟思亮及合著者于2021年生成式AI尚未风行之时发表的一篇论文精准地捕获了这种疑惧。该研究表明，AI生成的反馈比人类管理者的反馈更能提高员工的绩效。然而，披露这些反馈来自机器却会产生相反的效果：它破坏了信任，

引发了饭碗不保的恐惧，损害了绩效。多接触LLM有可能缓解这些担忧。

但也未必。这项技术的缺陷让事情变得更复杂。剑桥词典将“hallucinate”（幻觉）选为年度热词，它描述的就是LLM胡说八道的倾向。这些模型目前迅速演进，在这方面应该至少会有所改进。但普林斯顿大学的托马斯·麦考伊（R. Thomas McCoy）及合著者新发表的论文显示，有些问题是根深蒂固的。

现有的模型是用互联网数据训练的，在作答时是根据概率来预测下一个单词，因此可能会被意想不到的问题难倒。ChatGPT背后的LLM是GPT-4，让它把一个数乘以1.8再加上 32 ，它算得很准；让它把同样这个数字乘以1.4再加上 31 ，表现就差多了。造成这种差异的原因是，第一种计算是将摄氏度换算为华氏度的方法，因此在互联网上很常见；第二种计算比较罕见，因此在训练数据中很少出现。闭源模型也会存在这样的缺陷。

除此之外，还有一个现实问题：公司很难跟踪员工使用AI的情况。机密数据可能会被上传，并可能在随后的对话中泄露出去。今年早些时候，电子巨头三星禁止员工使用ChatGPT，因为据称有三星工程师向这个聊天机器人分享了源代码。

能力超凡、使用简单、可能出错，这样的混乱组合让老板难以驾驭。但这也指向了一些经验法则。要有针对性。一些咨询顾问爱谈论“灯塔方法”——选择一个对组织其他部分有指导意义的受控项目。与其禁用LLM，不如制定指引，明确哪些信息可以输入LLM。要了解这项技术的工作原理：它不像开车，不用关心引擎盖下面是什么。最重要的是，要亲自去使用它。生成式AI可能让人感觉神奇，要把它用好却得下苦功夫。■



Bartleby

Generative AI generates tricky choices for managers

Transformational technologies can be very trying

THE REMARKABLE capabilities of generative artificial intelligence (AI) are clear the moment you try it. But remarkableness is also a problem for managers. Working out what to do with a new technology is harder when it can affect so many activities; when its adoption depends not just on the abilities of machines but also on pesky humans; and when it has some surprising flaws.

Study after study rams home the potential of large language models (LLMs), which power AIs like ChatGPT, to improve all manner of things. LLMs can save time, by generating meeting summaries, analysing data or drafting press releases. They can sharpen up customer service. They cannot put up IKEA bookshelves—but nor can humans.

AI can even boost innovation. Karan Girotra of Cornell University and his co-authors compared the idea-generating abilities of the latest version of ChatGPT with those of students at an elite university. A lone human can come up with about five ideas in 15 minutes; arm the human with the AI and the number goes up to 200. Crucially, the quality of these ideas is better, at least judged by purchase-intent surveys for new product concepts. Such possibilities can paralyse bosses; when you can do everything, it's easy to do nothing.

LLMs' ease of use also has pluses and minuses. On the plus side, more applications for generative AI can be found if more people are trying it. Familiarity with LLMs will make people better at using them. Reid Hoffman, a serial AI investor, has a simple bit of advice: start playing with it. If you

asked ChatGPT to write a haiku a year ago and have not touched it since, you have more to do.

Familiarity may also counter the human instinct to be wary of automation. A paper by Siliang Tong of Nanyang Technological University and his co-authors that was published in 2021, before generative AI was all the rage, captured this suspicion neatly. It showed that AI-generated feedback improved employee performance more than feedback from human managers. However, disclosing that the feedback came from a machine had the opposite effect: it undermined trust, stoked fears of job insecurity and hurt performance. Exposure to LLMs could soothe concerns.

Or not. Complicating things are flaws in the technology. The Cambridge Dictionary has named “hallucinate” as its word of the year, in tribute to the tendency of LLMs to spew out false information. The models are evolving rapidly and ought to get better on this score, at least. But some problems are baked in, according to a new paper by R. Thomas McCoy of Princeton University and his co-authors.

Because off-the-shelf models are trained on internet data to predict the next word in an answer on a probabilistic basis, they can be tripped up by surprising things. Get GPT-4, the LLM behind ChatGPT, to multiply a number by $9/5$ and add 32, and it does well; ask it to multiply the same number by $7/5$ and add 31, and it does considerably less well. The difference is explained by the fact that the first calculation is how you convert Celsius to Fahrenheit, and therefore common on the internet; the second is rare and so does not feature much in the training data. Such pitfalls will exist in proprietary models, too.

On top of all this is a practical problem: it is hard for firms to keep track of employees’ use of AI. Confidential data might be uploaded and potentially leak out in a subsequent conversation. Earlier this year Samsung, an

electronics giant, clamped down on usage of ChatGPT by employees after engineers reportedly shared source code with the chatbot.

This combination of superpowers, simplicity and stumbles is a messy one for bosses to navigate. But it points to a few rules of thumb. Be targeted. Some consultants like to talk about the “lighthouse approach”—picking a contained project that has signalling value to the rest of the organisation. Rather than banning the use of LLMs, have guidelines on what information can be put into them. Be on top of how the tech works: this is not like driving a car and not caring what is under the hood. Above all, use it yourself. Generative AI may feel magical. But it is hard work to get right. ■



水晶球

谷歌的人工智能发现了220万种科学界未知的材料

有无数种可能的晶体存在。AI可以帮助罗列和编目

晶体有各种各样的用途，其中一些比另一些用处更大。摆在新时代疗愈店里的那些能让轻信的人乖乖掏出钞票。但它们也可以用作太阳能电池板的光收集层，催化工业反应以制造氨和硝酸等物质，还可以制成用于微芯片的硅。用途如此多样是因为“晶体”指的是一个庞大的化合物家族，它们仅有的共同点是原子结构都由重复的单元组成——相当于三维的瓷砖拼接。

这个家族的成员数量之庞大，在谷歌的人工智能公司DeepMind于《自然》上发表的一篇论文中可见一斑。科学家们已知的晶体大约有48,000种，每种的化学成分都不相同。DeepMind开发了一个名为材料探索图谱网络（Graph Networks for Materials Exploration，以下简称GNOME）的机器学习工具，可以运用现有的化学结构库预测新的化学结构。它预测出了220万个晶体结构，每一个在科学上都是全新的。

为了验证这个机器的预测，DeepMind与加州大学伯克利分校的研究人员合作，在《自然》上发表了第二篇论文。他们从所预测出的化合物中选择了58种，并在两周多一点的时间内就成功合成了其中41种。DeepMind的团队表示，自他们开始准备论文以来，其他研究团队已经制造出700多种其他晶体。

为了辅助其他任何有兴趣的实验室探究这一机器学习的丰硕成果，DeepMind公开了38.1万个他们认为最稳定的结构。其中包括成千上万种可能具有超导结构的晶体，电流在其中能以零电阻流动，还有数百种可能用于电池的锂离子导体。在这两个方向上，DeepMind的工作均让研究人员已知的候选材料总数增加了数十倍。

没有参与这项研究的伦敦帝国理工学院的材料科学家阿隆·沃尔什（Aron Walsh）表示，DeepMind的研究令人惊叹。但他说“这只是探索的开始，

而不是终点”，指出这台机器只是触及了所有可能性的皮毛。在他自己最近的一篇论文中，他尝试算出有多少种含有四种化学元素（所谓的四元化合物）的稳定晶体可能被制造出来。他最后得出的保守估计是32万亿种。但GNoME只观察在相对较低的温度和压力下形成的晶体。而晶体只是物质宇宙的一个子集，这个宇宙包括无定形固体（如玻璃）、气体、凝胶和液体等各种形态。

DeepMind的220万个新晶体中有没有哪个会有实际用途还有待观察。即使没有，这种用于预测的方法也可能有重要价值。除了提示新的晶体之外，AI还可能揭示有关晶体形成的尚未破解的规则。

DeepMind的伊金·多乌什·楚布克（Ekin Dogus Cubuk）特别指出了这方面的一个发现。他说，以前人们认为由六种元素组成的六元化合物的晶体非常罕见。但DeepMind的AI在这38.1万种稳定化合物的样本中就发现了大约3200种。如果能更好地了解晶体是如何形成的，以及可能形成什么类型的晶体，那些想对这220万种新材料的性能一探究竟的科学家们也许就不用费力逐一合成它们了。 ■



Crystal balls

A Google AI has discovered 2.2m materials unknown to science

Zillions of possible crystals exist. AI can help catalogue them

CRYSTALS CAN do all sorts of things, some more useful than others. They can separate the gullible from their money in New Age healing shops. But they can also serve as the light-harvesting layer in a solar panel, catalyse industrial reactions to make things like ammonia and nitric acid, and form the silicon used in microchips. That diversity arises from the fact that “crystal” refers to a huge family of compounds, united only by having an atomic structure made of repeating units—the 3D equivalent of tessellating tiles.

Just how huge is highlighted by a paper published in *Nature* by Google DeepMind, an artificial-intelligence company. Scientists know of about 48,000 different crystals, each with a different chemical recipe. DeepMind has created a machine-learning tool called GNoME (Graph Networks for Materials Exploration) that can use existing libraries of chemical structures to predict new ones. It came up with 2.2m crystal structures, each new to science.

To check the machine’s predictions, DeepMind collaborated on a second paper, also published in *Nature*, with researchers at the University of California, Berkeley. They chose 58 of the predicted compounds and were able to synthesise 41 of them in a little over two weeks. The team at DeepMind say more than 700 other crystals have been produced by other groups since they began preparing their paper.

To help any other laboratories keen to investigate the computer’s bounty, the firm has made public a subset of what they think should be the 381,000

most stable structures. Among them are many thousands of crystals with structures potentially amenable to superconductivity, in which electrical currents flow with zero resistance, and several hundred potential conductors of lithium ions that could find a use in batteries. In both cases DeepMind's work has increased the total number of candidate materials known to researchers tens of times over.

Aron Walsh, a materials scientist at Imperial College London who was not involved in the research, says DeepMind's work is impressive. But "this is the start of the exploration rather than the end," he says, noting that the machine has only scratched the surface of what might be possible. In a recent paper of his own he tried to calculate how many stable crystals incorporating four chemical elements (so-called quaternaries) might be potentially manufacturable. He wound up with a conservative estimate of 32trn. For its part, GNoME looked only at crystals that form under relatively low temperatures and pressures. And crystals are only one subset of a universe of materials that includes everything from amorphous solids such as glass through to gases, gels and liquids.

Whether any of DeepMind's 2.2m new crystals will be useful remains to be seen. Even if they do not, the techniques used to make the predictions could be valuable. Besides suggesting new crystals, AI may also shed light on as-yet-unknown rules that govern how they form.

Ekin Dogus Cubuk at DeepMind highlights one such finding. Previously, he says, crystals made from six elements, called senaries, were thought to be vanishingly rare. But DeepMind's AI found around 3,200 in its sample of 381,000 stable compounds. A better understanding of how crystals form, and what sorts are possible, might also save scientists curious to test how the 2.2m new materials behave from the tedious task of synthesising each one of them by hand. ■



【首文】绿芽萌发

COP28瞄准气候变化的根本成因，这是第一次

现在，把外交转化为行动吧

两周前，气候活动人士和外交官们最初齐聚迪拜参加联合国气候大会COP28时，取得显著进展的机会似乎显得很渺茫。中东再次爆发战争，地缘秩序分崩离析。峰会主办国阿联酋是全球的主要产油国之一，峰会主席苏丹·贾比尔（Sultan al-Jaber）是该国国家石油公司的负责人，这使得此次会议有可能演变成一场大型漂绿行动。

然而，COP28打破了悲观者的预期。世界各国首次同意摆脱煤炭、石油和天然气这些导致全球变暖的主要成因。联合国气候变化框架公约的198个缔约方达成了一项协议，其中呼吁“以公正、有序、公平的方式减少能源系统”对化石燃料的依赖。

一些人会对这当中所做的妥协感到失望。欧洲人本希望达成“逐步淘汰”化石燃料的协议，但化石燃料生产国拒绝签署。小岛国表示它们的声音未被听到。协议规定只是将逐步淘汰“未经消减技术处理”的煤电，这意味着这种最脏的燃料仍可能继续燃烧，只要其排放在源头被捕获即可。尽管如此，这份文件仍是迈出了重要而务实的一步。

逐步淘汰化石燃料的呼吁在政治上很天真，在经济上也不可行。COP通过达成共识来运作，这意味着大型产油国对任何协议都有否决权。而且，化石燃料在未来几十年内很可能仍是能源组合的一部分。即使乐观的预测也显示，在实现2050年全球净零排放的情境中，在经减排技术处理后，石油和天然气仍将发挥实质性作用。尽管清洁能源取得了巨大的进展，但到那时它仍不太可能完全取代化石燃料。

气候外交也比悲观者的预期更有成效。事实证明，贾比尔更愿意为他的国家争取一次谈判成功，而不是为其经济利益而扭曲谈判。包括贾比尔的公司在内，有50家石油公司在之前承诺减少排放强效温室气体甲烷，这表明

由一位石油专业人士主持会议确实带来了一些好处。

在此次峰会前，中美两国达成的协议帮助奠定了基础。这意味着全球最大的两个污染国和地缘竞争对手共同推动了在协议中重新加入一些关于化石燃料的内容，帮助引导了顽固的产油国同意协议。甚至明年峰会的举办地巴库（Baku）也是和谐的象征。亚美尼亚支持阿塞拜疆申办峰会，这两个交战邻国正逐渐走向和平。

然而，达成一项全球协议只是迈出了一小步。远为重大和艰巨的一步将是把纸面上的言辞转化为现实世界里的行动。该协议向石油公司发出信号，特别是富裕国家的石油公司，预示它们可能会发现经营变得更加困难，例如获得勘探许可要面对法律挑战。但要减少对化石燃料的依赖，最终就得要让它们失去竞争力。在富裕国家，同步实施碳定价和对清洁技术的精准补贴可以实现这一点。

贫穷国家将需要帮助。峰会在很大程度上回避了这个棘手的问题。拥有化石燃料储量的发展中国家认为，不给予援助就期望它们在收入来源本就不多的情况下放弃其中一项是不公平的。据智库能源转型委员会（Energy Transition Commission）称，如果要尽早淘汰煤电，富裕国家就要在2030年前每年向贫穷国家提供250亿至500亿美元左右的拨款和其他优惠融资，以让煤炭资产提前退役。

这为一场激烈的斗争提供了背景。贫穷国家的项目成本要远高于富裕国家，因为私营部门会要求溢价来弥补相关风险。但富裕国家将力求限制它们对发展中国家的财务责任。弥合这道鸿沟将决定是否能够开启化石燃料时代的终篇，远重要过在迪拜外交场面上的握手寒暄。 ■



Green shoots

In a first, COP28 targets the root cause of climate change

Now to turn diplomacy into action

AS ACTIVISTS AND diplomats first assembled in Dubai for COP28, the UN's climate summit, a fortnight ago, the chances of significant progress seemed slim. War had returned to the Middle East and the geopolitical order was fragmenting. The choice of the summit's host country—the United Arab Emirates, one of the world's leading petrostates—and its chairman, Sultan al-Jaber, the head of its national oil company, threatened to turn the event into a giant exercise in greenwashing.

Instead, COP28 defied the pessimists. For the first time the world has agreed to move away from the coal, oil and natural gas that are the principal causes of global warming. The 198 parties to the UN Framework Convention on Climate Change agreed on a text that called for a transition away from fossil fuels “in energy systems, in a just, orderly and equitable manner”.

Some will be disappointed at the compromises made. The Europeans had hoped to agree to “phase out” fossil fuels entirely, to which fossil-fuel producers refused to sign up. Small island countries say their voices were not heard. The deal states that only “unabated” coal power will be phased down, leaving the option of the dirtiest fuel continuing to be burnt as long as its emissions are captured at source. Nonetheless, the document is an important, and realistic, step forward.

The call to phase out fossil fuels was both politically naive and economically unfeasible. COP operates by consensus, meaning that the big petrostates had a veto on any deal. Moreover, fossil fuels are likely to remain part of the energy mix for decades to come. Even optimistic forecasts

suggest a substantial role for oil and gas, balanced by technologies that remove their greenhouse-gas emissions, in scenarios for the world to achieve net zero by 2050. Although clean energy has made vast strides, it is unlikely to displace fossil fuels fully by then.

Climate diplomacy also proved to be more potent than the pessimists had expected. Mr al-Jaber proved keener to ensure a negotiating success for his country than to distort the process to favour its economic interests. An early pledge from 50 oil companies, including Mr al-Jaber's firm, to reduce their emissions of methane, a potent greenhouse gas, suggests that there were some benefits to an oilman running the show.

An agreement between America and China ahead of the summit helped lay the groundwork. It meant that the two largest polluters and geopolitical rivals together pressed for restoring some language on fossil fuels into the deal, which helped steer recalcitrant petrostates towards agreement. Even the choice of the venue for next year's summit—Baku—was a symbol of harmony. Armenia lent its support for Azerbaijan's bid as the two warring neighbours inch towards peace.

Yet a global agreement is only one small step. A far bigger and harder one will be to translate words on a page into action in the real world. The deal sends a signal to oil companies, especially in rich countries, that they may find it harder to do business, for example because of legal challenges to exploration licences. But reducing reliance on fossil fuels will ultimately depend on making them uncompetitive. A combination of carbon prices and well-targeted subsidies for clean technologies can do so in the rich world.

Poorer countries will need help. The summit largely sidestepped this thorny issue. Developing countries with fossil-fuel reserves argued that it was unfair to expect them to forgo one of their few revenue streams without

being given aid to do so. According to the Energy Transition Commission, a think-tank, getting rid of coal power early will require the rich world to make available around \$25bn-50bn a year in grants and other concessional finance to poor countries over the rest of this decade, to retire coal assets early.

This provides the backdrop for a fierce battle. Projects in poor countries are much costlier than those in rich ones, because the private sector demands a premium to compensate for the associated risk. But rich countries will try to limit their financial obligations to the developing world. Bridging the gap, far more than diplomatic backslapping in Dubai, will determine whether the beginning of the end for the fossil-fuel era has come. ■



南方策略

中国企业为何涌向墨西哥

该国为通往美国开了个后门

近来中国投资大量涌入墨西哥。仅10月就有两起值得注意的事件。在墨西哥北部与美国接壤的新莱昂州（Nuevo León），州政府宣布，生产挖掘机和其他建筑设备的中国临工重机将在该州建设一座工厂，预计将带来50亿美元的投资。同一天，太阳能电池板制造商天合光能表示将在该州投资多达10亿美元。现在，这两家公司及其他中国企业都可以在新莱昂州的中墨合作的华富山工业园（Hofusan）安家落户。

中国企业对墨西哥兴趣大增可以追溯到2018年，当时的美国总统特朗普发起了贸易战，措施包括提高对中国进口产品的关税。他的继任者拜登维持了加征的关税。拜登自己提出的《通胀削减法案》等美国优先政策正在鼓励美国企业考虑在北美展开“近岸外包”，很大程度上是为了挫败中国。疫情及其造成的供应链混乱也促使制造商向美国市场靠拢。随着中国的工资和其他成本不断上涨，在墨西哥设点开始显得更便宜了。

墨西哥以前尝试过吸引中国资金。墨西哥中国商业科技商会（Mexico-China Chamber of Commerce and Technology）的塞萨尔·弗拉格兹（César Fragoz）表示，该商会在2008年组织了一些活动鼓励中国资本流入，但没有收到成效。当时美国还没有对中国企业，中国不需要通过墨西哥进入美国。墨西哥城的墨西哥国立自治大学中墨研究中心（Centre for Chinese-Mexican Studies at UNAM）的恩里克·杜塞尔·彼得斯（Enrique Dussel Peters）表示：“吊诡的是，最先对明确针对中国的政策做出积极反应的是中国的企业。”

中国能在墨西哥找到进入美国的后门是因为墨西哥与美国和加拿大签有自由贸易协定。位于墨西哥的中国公司无法享受该自贸区的所有好处，具体要看它们所使用零部件的来源而定，因为根据北美自由贸易区的规定，产

品的零部件必须有一定比例来自北美。但杜塞尔·彼得斯指出，2021年美国从墨西哥进口产品的平均关税为0.2%，远低于从中国进口产品的关税。

虽然很难获得准确的统计数据，但据一些估计，中国对墨西哥的外国直接投资从2000年至2004年间的总计5亿美元上升至2022年的25亿美元。尽管这一数字低于2016年近60亿美元的峰值，但却是2018年的两倍多，而且还在不断上升（见图表）。这些投资的性质不同于中国在拉丁美洲其他地区的投资。在巴西和智利等国，中国的大部分投资都集中在原材料或基础设施方面，通常是靠中国国有企业的支持。在墨西哥，中国的投资则集中在服务业和制造业，包括电子、汽车和家用电器。

在1990年代和2000年代，墨西哥对美国的出口不敌中国。现在，中国的投资正在帮助墨西哥的出口商。9月，墨西哥自2000年代初以来首次超越中国，成为对美第一大商品出口国。1995年至2021年间，与中国的净贸易为拉丁美洲创造了680万个就业岗位，而该地区与美国的贸易创造了670万个就业岗位。中国投资者对环境和人权也没那么多讲究。他们还学会了应对在墨西哥经营的各种挑战，例如不安全和基础设施薄弱等。

如果中国在墨西哥势力日增加加剧了它与美国的紧张关系，结果就可能适得其反。杜塞尔·彼得斯表示，大多数中国在墨西哥的制造和组装似乎都是为了出口，尤其是出口到美国。这令一些美国的立法者感到不安。在最近致美国贸易代表戴琪的一封信中，四名国会议员警告说，在墨西哥的中国汽车制造商试图“通过我们的自由贸易协定获得进入美国市场的优惠待遇，并规避所有（针对中国的）关税”。如果中国在规避关税上做得过于成功，可能会发现这扇后门也会和前门一样砰然关闭。■



The southern strategy

Why Chinese companies are flocking to Mexico

The country offers a back door to the United States

CHINESE INVESTMENTS have been pouring into Mexico lately. Last month alone brought two notable ones. The government of Nuevo León, a northern state bordering the United States, announced that China's Lingong Machinery Group, which makes diggers and other construction equipment, would build a factory that it estimates will generate \$5bn dollars in investment. The same day Trina Solar, a solar-panel manufacturer, said it would invest up to \$1bn in the state. Both companies and their corporate compatriots can now find a home away from home at Hofusan, a Chinese-Mexican industrial park in Nuevo León.

Chinese companies' heightened interest in Mexico dates to 2018 when Donald Trump, America's president at the time, launched a trade war that included raising tariffs on imports from China. His successor, Joe Biden, has kept the tariffs in place. Mr Biden's own America-first policies, such as the Inflation Reduction Act, are encouraging companies to consider "nearshoring" in North America, in large part to thwart China. The pandemic and the snarl-ups in supply chains it caused also pushed manufacturers to move closer to the American market. And setting up in Mexico has begun to look cheaper, as wages and other costs in China rise.

Mexico has tried to lure Chinese money before. The Mexico-China Chamber of Commerce and Technology organised events in 2008 to encourage the flow of capital but they were unsuccessful, says the chamber's César Fragoz; back then China had no need to use Mexico as a way into America, which had yet to turn its back on Chinese companies. "The irony is that the first to react positively to an explicit policy against China are Chinese firms," says

Enrique Dussel Peters of the Centre for Chinese-Mexican Studies at UNAM, a university in Mexico City.

China gets a back door into America because Mexico is part of a free-trade agreement with the United States and Canada. Depending on what components they use, Chinese companies based in Mexico cannot enjoy all the benefits of the trading bloc, whose rules dictate what percentage of a product must originate in North America. But, Mr Dussel Peters notes, the average American tariff on imports from Mexico in 2021 was 0.2%, far lower than on those from China.

Accurate statistics are hard to come by but, according to some estimates, Chinese foreign direct investment in Mexico increased from a total of \$500m in 2000-04 to \$2.5bn in 2022 alone. That is below a peak of nearly \$6bn in 2016, but more than twice the figure in 2018—and rising (see chart). The nature of these investments differs from how China spends its money in the rest of Latin America. In countries such as Brazil and Chile most Chinese investments are in raw materials or infrastructure, often courtesy of Chinese state-backed companies. In Mexico, Chinese investment is in services and manufacturing, including of electronics, cars and home appliances.

In the 1990s and 2000s Mexican exports to America lost out to Chinese competition. Now Chinese investments are helping Mexico's exporters. In September Mexico overtook China for the first time since the early 2000s to become the leading exporter of goods to the United States. Net trade with China generated 6.8m jobs in Latin America between 1995 and 2021, compared with 6.7m for the region's exchange with the United States. Chinese investors are also less particular about environmental and human rights. And they have learned to deal with the challenges of working in Mexico, such as insecurity and poor infrastructure.

A growing Chinese presence in Mexico could backfire if it raises tensions with the United States. Most Chinese manufacturing and assembly in Mexico seems to be aimed at exports, observes Mr Dussel Peters—especially to America. This is alarming some lawmakers across the border. In a recent letter to Katherine Tai, the US Trade Representative, four members of Congress warned of Chinese carmakers in Mexico trying to take “advantage of preferential access to the US market through our free-trade agreements and circumvent any [China-specific] tariffs”. If China is too successful in skirting tariffs it may find its back door as well as the front entrance slammed shut. ■



实物社会转移带来的改变

经济学家如何低估了中国的消费

政府补贴的炝黄瓜大有乾坤

“消费是所有生产的唯一归宿和目的。”亚当·斯密指出。但他这句“完全不证自明”的格言在中国却从未产生过太大影响。今年早些时候，中国的统计学家透露，2022年中国的居民消费仅占GDP的37%，为2014年以来的最低水平。

尽管取消新冠疫情控制措施应该稍微提高了这一比例，对中国的数据做些微调却可能大幅提高它。中国公布的核心统计数据可能少算了居民收入和消费。仔细观察，会发现这两项都高于公布数据，而且增速也都更快。

近20年来，中国的政策制定者一直寻求经济“再平衡”——从出口和投资转向更注重即时满足的消费。例如，财政部在今年的预算草案中宣布“要促进恢复和扩大消费……多渠道增加居民收入。”但进展缓慢。近年来，国际货币基金组织用不同颜色标记的“再平衡计分卡”对中国的成果进行评分。今年2月最新发布的计分卡大部分显示为红色。

经济再平衡的支持者通常会指出两个问题。其一是中国居民将很大一部分收入存了起来；其二是他们的收入只占了国民收入大蛋糕中太小的一块。在颇有力的北京大学教授迈克尔·佩蒂斯（Michael Pettis）的论述中，第二个问题成为重要的论据。他指出，在西方，居民收入通常占GDP的70%至80%。而在中国，这一比例仅为55%。他认为，经济再平衡必然涉及将财富、继而将权力转移到老百姓手里。

事实上，一些观察人士如今猜测中国领导人习近平是否已经对这一目标彻底失去了兴趣。对他来说，中国生产的归宿和目的并不局限于消费——还包括一些雄心壮志，比如让中国成为韧性强的大国、减少对西方主导的“卡脖子”技术的依赖。根据一份揭秘文件，一位在上世纪七、八十年代就认识习的教授回忆，他年轻时就“反感中国社会铺天盖地的商业化”。

但是，尽管习不是经济再平衡的热切支持者，他的再平衡记分卡得分可能比一般认为的要好。经济学家长期以来都认为，中国的数据少算了居民收入和支出。各项调查可能没有捕捉到富人未申报的“灰色”收入。此外，国民经济账户可能还低估了居住在自有房产中的房主支付给自己的隐性“租金”。

不那么广为人知的是，中国统计人员在核算时很难将政府向个人提供的低成本或免费的商品和服务纳入其中。这些转移支付包括教育和医疗保健支出，尤其是药品报销。它们还包括文化便利设施和受补贴的食品等。弗吉尼亚大学的朱洪申特别提到了社区食堂——它们通常设在公家建筑内，但由私人承包商经营，以非常优惠的价格提供平菇、炝黄瓜等美味菜肴。

按照国际标准，这些福利应该以“实物社会转移”（有时缩写为STIK）的形式出现在官方统计数据中。然后再将它们计入居民收入和消费，就能得到一幅更为全面的“调整后”图景。“原则上，完整的收入定义应该包括社会转移支付。”一个名为堪培拉小组（Canberra Group）的国际专家团队在2001年提出，尽管他们也承认在实际操作中要做到这一点并不容易。

而中国在这方面尤其吃力。过去，中国没有清晰或单独地公布这些数据，而是将它们纳入政府消费等国民经济账户的其他部分。如果忽略这些转移支付，那么2020年中国居民的可支配收入仅占国民收入的62%（2010年则低至56%）。正如佩蒂斯所认为的那样，这一比例看起来低得惊人。但这一定程度上是由它遗漏的各种因素造成的。如果从其他国家的可支配收入中同样剔除实物社会转移，它们的比例看起来和中国也差不多。比如欧元区2020年的这一比例就会低于64%（见图表1）。按照这一标准，欧洲有十来个国家的居民可支配收入占国民收入的比例低于中国。

所幸如今中国的统计人员可以做得比以前更好了。朱洪申指出，过去几年，他们已经开始在每年的统计年鉴中公布实物社会转移的数据。这部分在2020年达到6.8万亿元人民币（接近国民收入的7%），占GDP的比重超过了美国。这让中国国家统计局能够公布一个“调整后”可支配收入数据，更易于与经合组织成员国进行国际间比较。

如果加上这些实物社会转移，中国居民收入占国民收入的比例将提高到69%，尽管这一数字落后于大部分经合组织成员国，但还不至于垫底。此外，在过去十年里它们的增速快于经济增速，这让习的经济再平衡得分显现出更乐观的前景。把这些实物社会转移包括在内，居民消费占GDP的比例从2010年的39%上升到2019年新冠疫情暴发前的45%（见图表2）。

这样的修正确实让政府消费看起来更疲软了。而中国的实物社会转移占国民收入的比例相比经合组织的平均水平仍然不高。因此还有提升的空间。如果习反对中国社会的商业化，政府可以转而提供更多他认为国民应该消费的东西。这将是习实现朝向消费的再平衡却不想向消费主义妥协的一个办法。 ■



STIK shift

How economists have underestimated Chinese consumption

The surprising relevance of state-subsidised spicy cucumber

“CONSUMPTION IS THE sole end and purpose of all production,” Adam Smith pointed out. But his “perfectly self-evident” maxim has never held much sway in China. Earlier this year the country’s statisticians revealed that household consumption accounted for only 37% of China’s GDP in 2022, its lowest level since 2014.

Although removing covid-19 controls should have helped lift that figure a bit, tweaks to Chinese data could lift it rather more. China’s headline statistics may understate household income and consumption. Look closer, and both appear higher than reported—and both have risen faster.

For almost two decades, Chinese policymakers have sought to “rebalance” the economy from exports and investment towards spending on more immediate gratifications. “We will work to restore and expand consumption...and increase personal income through multiple channels,” the finance ministry declared in this year’s budget, for example. Yet progress has been slow. In recent years, the IMF has graded China’s efforts on a colour-coded “rebalancing scorecard”. The latest card, published in February, was mostly red.

Advocates of rebalancing typically identify two problems. First, Chinese households save a lot of their income; second, their income is too small a slice of the national cake. The second problem features prominently in the arguments of Michael Pettis, an influential professor at Peking University. In the West, he has noted, household income typically represents 70-80% of GDP. In China, by contrast, it is only 55%. Rebalancing, he has argued, will

necessarily involve shifting wealth and therefore power to ordinary people.

Indeed, some observers now wonder whether Xi Jinping, China's leader, has soured on the goal altogether. For him, the end and purpose of Chinese production is not limited to consumption—it also includes ambitions such as making China a resilient power, less dependent on “chokehold” technologies that are dominated by the West. As a young man, he was “repulsed by the all-encompassing commercialisation of Chinese society”, according to the leaked account of a professor who knew him in the 1970s and 1980s.

But although Mr Xi is no fervent champion of rebalancing, his scorecard may be better than commonly thought. Economists have long believed that China's figures understate household earning and spending. Surveys probably fail to capture the unreported “grey” income of the wealthy. And the national accounts probably still underestimate the implicit “rent” that homeowners pay themselves when they live in property they own.

Less well known are the struggles of China's statisticians to account for goods and services that governments provide to individuals at little or no cost. These transfers include education and health care, not least reimbursements for medicines. They also encompass cultural amenities and subsidised food. Zhu Hongshen of the University of Virginia has highlighted community canteens, often housed in state-owned buildings but operated by private contractors, which provide tasty dishes, such as oyster mushroom or spicy cucumber, at heavily discounted prices.

According to international standards, these goodies should appear in the official statistics as “social transfers in kind” (sometimes abbreviated to STIK). They can then be added to household income and consumption to provide a fuller “adjusted” picture. “In principle, social transfers should be included in a complete definition of income,” argued an international team

of experts known as the Canberra Group in 2001, although they recognised it is not straightforward to do in practice.

China in particular has struggled. In the past, it has not reported them cleanly or separately, shovelling them into other parts of the national accounts, including government consumption. If these transfers are ignored, then the disposable income of China's households was only 62% of national income in 2020 (and as low as 56% in 2010). This seems strikingly low, as Mr Pettis has argued. But that is partly because of everything it leaves out. If social transfers in kind are also stripped out of the disposable income of other countries, their numbers look more like China's. The figure for the euro area would be less than 64% in 2020 (see chart 1). By this measure, a dozen European countries had a smaller income share than China.

Fortunately, China's statisticians can now do better. In the past few years, they have begun publishing figures for social transfers in kind in their annual statistical yearbooks, Mr Zhu has pointed out. These amounted to 6.8trn yuan (\$1trn, or almost 7% of national income) in 2020, larger, as a share of GDP, than America's. That has enabled China's National Bureau of Statistics to publish an "adjusted" figure for disposable income that makes international comparisons with OECD countries easier.

Adding these social transfers in kind raises China's share of household income to 69% of national income, placing it near the bottom of the pack, but not at the very bottom. Moreover, since they have grown faster than the economy over the past decade, they make Mr Xi's rebalancing record more promising. Household consumption, including these transfers, increased from 39% of GDP in 2010 to 45% in 2019 before the pandemic struck (see chart 2).

Such revisions do make government consumption look weaker. And China's social transfers in kind, as a share of national income, are still not high

compared with the OECD average. There is thus scope to raise them. If Mr Xi objects to the commercialisation of Chinese society, the state could instead provide more of the things that he thinks his citizens should be consuming. That would be a way for Mr Xi to rebalance towards consumption without reconciling himself to consumerism. ■



科技狂人对阵广告狂人

马斯克的X公司尤其易受广告商抵制的冲击

让广告主滚蛋的风险

马斯克看不上广告业，对病毒式口号的运用倒是自有一套。在11月29日《纽约时报》举办的一次活动上，有人问这位全球首富对各家公司从他去年收购的社交网络X（当时还叫推特）撤下广告作何感想。“如果有人想以此要挟我，”他回答道，“去他妈的吧。”他口中这种“去他妈”的态度对于亿万富翁来说可能是再自然不过的。但对于一家去年90%左右的收入来自广告的公司而言，就很大胆了。从X上撤下广告的公司包括苹果和迪士尼，而马斯克先前曾以它们的存在为依据，说明X对品牌来说是个安全的空间。

广告主对该平台上的不良内容感到担忧。自从马斯克解雇了X 80%的员工后（其中包括许多审查员），似乎有更多的恶意言论逃过了筛查。上个月，监督组织美国媒体事务（Media Matters for America）报告称，IBM等品牌的广告出现在赞美希特勒的帖子旁边（X对报告所述提出异议并将该组织告上法庭）。

相比主流媒体，社交网络更能随意地叫广告主滚蛋。美国一个普通电视网络的大部分广告收入来自不到100个大客户，而社交网络则可能有数百万个小客户。据研究公司Sensor Tower估计，一年前，最大的社交网络Facebook有45%的国内销售来自其最大的100家广告客户；2020年，包括联合利华和星巴克等巨头在内的600多家公司对它发起抵制，对广告销售几乎没有影响。但是X缺乏Facebook那种先进的广告定向系统，并且依赖大品牌的推广活动。2022年10月马斯克收购推特时，其100个最大客户占到美国广告收入的70%。

据Sensor Tower称，自那以后其中一半的客户已经离开了X。12月1日，沃尔玛表示已经离开，原因是在X上投放的广告效果不佳。影响已经很严

重。9月，马斯克表示X在美国的广告业务下降了60%。其他地区的广告主可能不那么在意马斯克开打的文化战。但X异常依赖美国市场。Facebook的母公司Meta的大部分收入来自海外，而在被马斯克收购之前，推特的56%的收入来自美国。即便在“去他妈”事件之前，另一家研究公司Insider Intelligence也预计今年X的全球广告收入将减少一半以上（见图表）。

马斯克的拥趸坚持认为，冒犯惺惺作态的广告人和倒向“觉醒文化”的品牌让X的普通人用户群体拍手称快。相比于Meta推出的新竞争对手Threads，X仍然拥有近五倍的用户。然而Sensor Tower的报告显示X应用的下载量较一年前有所减少，并估计它失去了15%的月活跃用户。

一些观察人士将这归因于对僵尸虚假账号的清理。即便如此，X必须以新的方式利用现有用户创造收入，以此弥补广告收入的下降。其中一个想法是推出X Premium，每月付费3到16美元可以得到额外功能和刷到更少的广告。到目前为止，似乎没有太多人愿意接受这种模式：Sensor Tower估计，X在过去一年内售出了6000万美元的订阅服务，相当于马斯克收购之前年广告收入的1%。马斯克曾谈到将X打造成一个“全能应用”，能处理支付、通话等等。但即使是乐观派也承认这还得等上好几年。

在那之前，目标是用一大批小广告主取代离开的大广告主。据说X正在为小型企业开发广告技术，像Facebook那样瞄准长尾客户。时间紧迫。如果广告销售进一步下滑，可能就需要投资者或马斯克本人出手援助。X的员工们得拼劲全力，赶在被他们的老板赶走之前吸引来广告主。■



Mad man v mad men

Elon Musk's X is especially vulnerable to an ad boycott

The perils of telling advertisers to clear off

FOR SOMEONE who despises the advertising industry, Elon Musk has a way with viral slogans. At a New York Times event on November 29th the world's richest man was asked how he felt about firms pulling ads from X, the social network he bought last year when it was known as Twitter. "If somebody's going to try to blackmail me," he replied, "go fuck yourself." The "GFY" approach, as he dubbed it, may come naturally to billionaires. But it is bold for a company that last year made 90% or so of its revenue from ads. Those that have pulled ads from X include Apple and Disney, whose presence Mr Musk previously cited as evidence that X was a safe space for brands.

Advertisers are worried about unsavoury content on the platform. Since Mr Musk fired 80% of X's staff, including many moderators, more bile seems to be leaking through the filters. Last month Media Matters for America, a watchdog, reported that ads for brands such as IBM had appeared alongside posts praising Adolf Hitler (X disputes this and is suing Media Matters).

Social networks are freer than mainstream media to tell advertisers to get lost. Whereas a typical TV network in America gets most of its ad revenue from fewer than 100 big clients, social networks can have millions of small ones. A year ago the largest, Facebook, was getting 45% of its domestic sales from its 100 biggest advertisers, reckons Sensor Tower, a research firm; a boycott against it in 2020 by more than 600 firms, including giants like Unilever and Starbucks, had little effect on sales. But X lacks Facebook's sophisticated ad-targeting apparatus, and relies on campaigns by big brands. In October 2022, when Mr Musk bought Twitter, its 100 top clients

accounted for 70% of American ad sales.

Half of them have since left X, Sensor Tower says. On December 1st Walmart said it had gone, owing to its ads' poor results on X. The impact has been severe. In September Mr Musk said that X's American ad business was down by 60%. Advertisers in other regions may be less bothered by the culture wars that Mr Musk is fighting. But X is unusually reliant on America. Whereas Meta, Facebook's parent company, makes most of its money abroad, 56% of Twitter's revenue came from America before Mr Musk bought it. Even before GFY, Insider Intelligence, another research firm, expected X's worldwide ad sales to fall by more than half this year (see chart).

Mr Musk's fans insist being rude to air-kissing admen and "woke" brands delights X's everyman users. X still has nearly five times as many as Threads, a newish rival from Meta. Yet Sensor Tower reports that the X app is being downloaded less often than a year ago, and estimates that it has lost 15% of monthly users.

Some observers put this down to a purge of bots and fake users. Still, X must monetise the users it has in new ways to make up for the declining ad dollars. One idea is X Premium, which offers extra features and fewer ads for between \$3 and \$16 a month. So far there seem to be few takers: Sensor Tower estimates that X has sold \$60m-worth of subscriptions in the past year, equivalent to 1% of pre-Musk annual ad sales. Mr Musk has talked of turning X into an "everything app", handling payments, calls and more. But even optimists concede this would take years.

Until then, the aim is to replace the departing big advertisers with an army of little ones. X is said to be working on its ad technology for smaller firms, eyeing a Facebook-like long tail of clients. There is no time to lose. Further drops in ad sales could necessitate a bail-out from investors, or from Mr

Musk himself. X's employees have their work cut out to attract advertisers faster than their boss repels them. ■



5%问题

中国能在2024年摆脱经济困境吗？

习必须决定是否设定一个高增长目标【深度】

在2007年至2009年的全球金融危机过后，经济学家们很快就意识到，世界经济将再无法回到过去。尽管它会渡过难关，但只会恢复到一种“新常态”，而非危机前的状态。几年后，中国领导人也采用了这个词，用它描述中国从飞速增长、廉价劳动力和巨额贸易顺差的状态的转变。他们认为，这些变化代表了中国经济的必然演进过程，应该接受它而非竭力抵抗。

经历了长时间的新冠疫情管控后，中国今年重启经济，但表现令人失望，让这种论调再度浮现。中国的增长前景似乎呈现“结构性”疲软，这也是评级机构穆迪近期表示可能不得不下调中国中期信用评级的原因之一。多位经济学家宣称中国难以管控的房地产市场步入了新常态。一些评论人士希望，在中美两国领导人近期会晤后，两国关系能找到一个新的平衡。9月，中国社会科学院的蔡昉指出，中国人口减少、消费人群老龄化、雇主变得挑剔，这些因素的混合带来了一种“新”新常态。

因应新常态做调整成了当务之急。中国领导人很快将在北京召开中共中央经济工作会议。他们的商议将帮助制定2024年的经济增长目标，该目标将于明年3月公布。多数人预测中国经济增长将低于5%。穆迪的预测为4%。因此，官员们必须决定要花多大的力气抵抗这种经济减速。

如果他们认定这是一种新的平衡，也许就会接受现状并相应调低增长目标。假如他们认为中国经济仍有加快增长的空间，则可能沿用对2023年设定的5%的目标。要在2024年实现这样的目标将比在今年更困难，因为经济不会再一次因重启受到提振。不过把目标定高一点也可能有用处，能突显政府求增长的决心，并使投资者相信在必要时政府会提供更多财政支援。

要思考中国经济的增长前景，就不能不先讨论中国的房地产业将如何走出低迷。尽管大多数经济学家都认同上海财经大学校长刘元春所说的中国房地产市场“不能重返过去的辉煌”，但至于未来会多黯淡，看法就没那么一致了。过去，预期房价会上涨的购房者的投机性需求推高了销售。而未来，市场将只能主要满足购买首套房或者改善型住房的基本需求。

这样的基本需求还有多少？2020年的人口普查显示，中国当前人均居住面积为42平方米，与许多欧洲国家相当。表面上看，这表明市场已经饱和。但正如研究公司龙洲经讯（Gavekal Dragonomics）的咬丽蔷所指出的，欧洲的数字通常只计算房屋使用面积。但中国的数字是建筑面积，包括了多户分摊的公共区域面积。

据咬丽蔷估计，中国含公摊面积的人均居住面积最终可能达到45至50平方米左右。因此，中国的房地产销售即使永远无法重返过去的辉煌，却可能仍有机会在2023年的低迷水平上实现增长。她认为销售额会跌至比2019年低约25%。但最近几个月的降幅已接近40%。

房地产开发商也可以从政府新启动的“城中村”改造中获益。随着中国城市的扩张，以往被归为农村的乡镇和村庄已被城市包围——是城市走向人们，而不是反过来。据中国评级机构东方金诚的数据，在2011年到2020年的十年间，1.75亿农村人口变为城镇居民，其中约55%属于这样的“就地城镇化”。一些估计显示，未来几年，中国政府的“城中村”改造项目将覆盖35个城市的4000万人口。

中国房地产的低迷也揭示出中国财政措施需要进入一个“新常态”。经济放缓影响卖地，切断了地方政府一个至关重要的收入来源。这使它们更难承受下属企业和它们发起的地方“融资平台”的债务压力。正如穆迪指出，这些或有负债正在“明晰化”。

中央政府想阻止由地方政府融资平台发行的任何公开交易的债券发生直接违约。但它也很希望避免更广泛的救助，因为这会助长日后对这些融资平台轻率放贷。尽管中央政府勉为其难地提供的任何援助都会削弱公共财

政，但如果违约会削弱对国有金融体系的信心，拒施援手也可能带来昂贵的财政代价。目前看来，中央政府、地方政府和地方政府融资平台之间的关系仍在梳理中。

无论如何，房地产部门在中期似乎注定要萎缩。哪些行业能接替它？官员们已经开始谈论“新三样”——电动汽车、锂电池和可再生能源（尤其是风能和太阳能）这三大产业。但高盛的魏美琪指出，尽管势头喜人，但这些产业的规模相对较小，仅占中国GDP的3.5%。相比之下，算上与之关联的上游供应商、消费需求和地方政府财政，房地产仍占到GDP的近23%。即使“新三样”一起以每年20%的速度扩张，在未来几年对经济的拉动也无法弥补房地产衰退对经济的拖累（见图表1）。

整体而言，“新三样”的劳动密集程度也不如房地产，后者带来了既包含蓝领工作（建筑工人）又创造白领岗位（房地产经纪和银行员工）的有益组合。从一组行业转到另一组行业的过渡期会使工作和职业发展变得不那么明朗。蔡昉担心，劳动力市场的这种不确定性将抑制中国消费者的支出，他们本来也将随着年龄增长变得更为保守。

在反复无常的疫情封控期，消费者信心崩溃，居民储蓄猛增（见图表2）。许多评论人士认为，这一经历留下了持久的创伤。消费者在接受调查时仍在表达沮丧悲观的情绪。但是他们在商店里购物时似乎又没那么“手紧”。目前居民消费增速高于收入增速。一个例证是他们争相抢购华为搭载了速度出人意料的国产芯片的新款智能手机Mate 60。

那么一个问题是，中国新常态的一个特点会不会是储蓄率长期走高。有经济学家担心房价进一步下跌会令人们财富受损，进而抑制消费。而另一方面，如果人们发觉不必再为购买越来越贵的房子而存钱，他们在消费品上的花销就可能提高。高盛的闪辉认为，如果说零售（不包括汽车，以及家具等“家装用品”）与房价真有什么关联，那也是负相关。房价下降，零售增长会略为加快。她认为储蓄率将继续下降，尽管是逐步下降。

所有这些变化对整体经济有何影响？人们普遍预测明年的经济增速在

4.5%左右。中国的政策制定者可能接受它为经济的新常态，就像他们接受了2012年后经济放缓的现实一样。但这次他们应该接受吗？

按经济学教科书的说法，在经济刚开始过热时，政策制定者就能判断出经济是否超过速度限制。经济过热的传统标志是通货膨胀。以此标准衡量，中国经济的增速还可以比目前水平更快一些。在截至10月的一年里，消费价格下降。预计GDP平减指数这一衡量物价的宽泛指标今年也将下降（见图表3），引发通缩之忧。

经济过热的另一个潜在迹象是过度放贷。央行组织国际清算银行（BIS）计算一个国家的“信贷缺口”，即比较企业和居民的信贷存量与其长期趋势的偏离度。从2012年到2018年，以及在2020年中期，中国的信贷缺口超过了占GDP10%的安全阈值。但之后这个“缺口”就消失了。中国现在的问题不是企业和居民信贷供应过多，而是贷款需求疲软。

因此，这两个检验指标都没有显示目前中国经济增长过快。而增长过慢会有它自己的问题。假如中国的政策制定者不采取更多措施提振需求，通缩可能将无法避免，进而削弱企业的盈利能力，加重债务负担，加深消费者的悲观情绪。正如国际货币基金组织（IMF）前总裁克里斯蒂娜·拉加德（Christine Lagarde）所说，全球金融危机爆发后，许多经济体“在低于应有水平的增长中混日子”。它们甘愿接受“新常态”，结果却堕入了“新平庸”。中国也可能发现自己在犯同样的错误。 ■



The 5% question

Will China leave behind its economic woes in 2024?

Xi Jinping must decide whether to set an ambitious growth target

AFTER THE global financial crisis of 2007-09, economists quickly understood that the world economy would never be the same again. Although it would get past the disaster, it would recover to a “new normal”, rather than the pre-crisis status quo. A few years later the phrase was also adopted by China’s leaders. They used it to describe the country’s shift away from breakneck growth, cheap labour and monstrous trade surpluses. These changes represented a necessary evolution in China’s economy, they argued, which should be accepted, not resisted too strenuously.

After China’s long campaign against covid-19 and its disappointing reopening this year, the sentiment is popping up again. China’s growth prospects seem “structurally” weaker—one reason why Moody’s, a rating agency, said this week that it might have to cut the country’s credit rating in the medium term. Several economists have declared a new normal in China’s unruly property market. Some commentators hope for a new equilibrium in China’s relations with America following the recent meeting between the two countries’ leaders. In September Cai Fang of the Chinese Academy of Social Sciences identified a “new” new normal, brought about by a mixture of China’s shrinking population, greying consumers and picky employers.

Calibrating the new normal is a matter of some urgency. China’s leaders will soon gather in Beijing for the Communist Party’s Central Economic Work Conference. Their deliberations will help set a growth target for 2024, which will be announced in March. Most forecasters expect China’s economy to grow by less than 5%. Moody’s forecasts 4%. Officials must thus decide how

strenuously to resist this slowdown.

If they think it represents a new equilibrium, they may accept it and lower their growth target accordingly. If they think China has room to grow faster, they may stick with the 5% target they set for 2023. Meeting such a goal will be more difficult in 2024 than it was this year, because the economy will not benefit from another reopening boost. However, an ambitious target could also serve a purpose, underlining the government's commitment to growth, and reassuring investors that more fiscal help is on its way if required.

It is impossible to think about how the economy will grow without first considering how China's property slump will end. Although most economists agree that the market "cannot return to its past glory", as Liu Yuanchun of the Shanghai University of Finance and Economics has put it, there is less agreement on how inglorious its future must be. In the past, sales were buoyed by speculative demand for flats from buyers who assumed they would rise in price. In the future, the market will have to cater chiefly to fundamental demand from buyers who want a new or better home.

How much fundamental demand remains? China now enjoys a living area of 42 square metres per person, according to the census of 2020; an amount comparable to many European countries. On the face of it, this suggests that the market is already saturated. But the European figures typically count only the useable area of a property, as Rosealea Yao of Gavekal Dragonomics, a research firm, has pointed out. The Chinese number, on the other hand, refers to everything that is built, including common areas shared by several households.

Ms Yao has estimated that China might eventually reach a living space per person of about 45-50 square metres when common areas are included. The country's property sales might therefore have room to grow from their

depressed levels of 2023, even if they never return to the glories of earlier years. Ms Yao believes that sales needed to fall by about 25% from their levels in 2019. Yet in recent months the drop has been closer to 40%.

Property developers could also benefit from the government's new efforts to renovate "urban villages". As China's cities have expanded, they have encompassed towns and villages that were once classified as rural—the cities move to the people not the other way around. This "in-situ urbanisation" accounted for about 55% of the 175m rural folk who became city-dwellers over the ten years from 2011 to 2020, according to Golden Credit Rating International, a Chinese rating agency. By some estimates, the government's "urban villages" project could span as many as 40m people in 35 cities over the next few years.

China's property slump has also revealed the need for a "new normal" in the country's fiscal arrangements. The downturn has hurt land sales, cutting off a vital source of revenue for local governments. That has made it more difficult for them to sustain the debts of the enterprises they own and the "financing vehicles" they sponsor. These contingent liabilities are "crystallising", as Moody's puts it.

The central government would like to prevent an outright default on any of the publicly traded bonds issued by local-government financing vehicles. But it is also keen to avoid a broader bail-out, which would encourage reckless lending to such vehicles in the future. Although any assistance that the central government grudgingly provides will weaken the public finances, a refusal to help could prove fiscally expensive, too, if defaults undermine confidence in the state-owned financial system. For now, the relationship between China's central government, its local governments and local-government financing vehicles remains a work in progress.

Whatever happens, property seems destined to shrink in the medium term.

What will take its place? Officials have begun to talk about the “new three”, a trio of industries including electric cars, lithium-ion batteries and renewable energy, especially wind and solar power. But despite their dynamism, such industries are relatively small, accounting for 3.5% of China’s GDP, according to Maggie Wei of Goldman Sachs, a bank. In contrast, property still accounts for almost 23% of GDP, once its connections to upstream suppliers, consumer demand and local-government finances are taken into account. Even if the “new three” together were to expand by 20% a year, they cannot add as much to growth in the next few years as the property downturn will subtract from it (see chart 1).

The new three as a group are also not as labour-intensive as property, which generates a useful mixture of blue-collar jobs (builders) and white-collar careers (estate agents and bankers). A period of transition from one set of industries to another can make jobs and career paths less predictable. Mr Cai worries that this labour-market uncertainty will inhibit spending by Chinese consumers, who will anyway become more conservative as they age.

During erratic pandemic lockdowns, consumer confidence collapsed and household saving jumped (see chart 2). Many commentators believe that the experience has left lasting scars. Consumers still say they are gloomy in surveys. Yet they seem less stingy in the shops. Their spending is now growing faster than their incomes. They have, for example, snapped up Huawei’s new Mate 60 smartphone, with its surprisingly fast Chinese chips.

One question, then, is whether China’s new normal will feature a permanently higher saving rate. Some economists fear that further declines in house prices will inhibit consumption by damaging people’s wealth. On the other hand, if people no longer feel obliged to save for ever-more expensive flats, then they might spend more on consumer items. Hui Shan of Goldman Sachs argues that retail sales, excluding cars and “moving-in

items”, such as furniture, are, if anything, negatively correlated with house prices. When homes become cheaper, retail sales grow a little faster. She believes the saving rate will continue to edge down, albeit gradually.

What do these shifts add up to for the economy as a whole? The consensus forecast for Chinese growth next year is of about 4.5%. China’s policymakers might accept this as the new normal for the economy, just as they accepted the slowdown after 2012. But should they?

According to economic textbooks, policymakers can tell when an economy is surpassing its speed limit when it starts to overheat. The traditional sign of overheating is inflation. By that measure, China can grow faster than its present pace. Consumer prices fell in the year to October. And the GDP deflator, a broad measure of prices, is forecast to decline this year (see chart 3), raising the spectre of deflation.

Another potential sign of overheating is excessive lending. The Bank for International Settlements, a club of central bankers, calculates a country’s “credit gap”, which compares the stock of credit to companies and households with its trend. From 2012 to 2018 and again in mid-2020, China’s credit gap surpassed the safe threshold of 10% of GDP. Yet the gap has since disappeared. China’s problem now is not excessive credit supply to companies and households. It is weak loan demand.

Therefore neither test suggests that China’s economy is growing too fast. And growing too slowly poses its own dangers. If China’s policymakers do not do more to lift demand, they might fail to dispel deflation, which will erode the profitability of companies, increase the burden of debt and entrench the gloominess of consumers. After the global financial crisis, many economies “muddled along with subpar growth”, as Christine Lagarde, then head of the IMF, put it. They resigned themselves to a “new normal”, only to instead lapse into a “new mediocre”. China could find itself

making the same mistake. ■



自由交流

如何挽救中国经济

上一次刺激计划为下一次提供的经验教训

今年早些时候，中国的一家出版社出版了《In Defence of Public Debt》一书的中文译本。该书由加州大学伯克利分校的巴里·艾兴格林（Barry Eichengreen）和其他几位作者合著。它深入历史，试图通过强调政府借贷被忽视的好处来让相关辩论重回平衡。艾兴格林认为，背负高额债务的国家如果过早采取财政紧缩措施、忽视增长或接受通缩，可能就会陷入麻烦，结果只会更难偿还债务。其中文版的出版恰逢其时。许多经济学家认为，中国政府今年的财政政策过于谨慎，导致增长令人失望和通缩的危险。

幸好中国政府现在已经开始松开钱袋子。它罕有地将预算赤字目标从GDP的3%修订为3.8%，允许各省发行“再融资债券”，这将帮助它们偿还一部分由名为地方政府融资平台的附属基础设施投资公司欠下的成本更高的债务。金融监管机构敦促银行满足那些状况尚可的房地产企业的“合理”融资需求，不歧视私营开发商。官员也更经常谈论“三大工程”：保障性住房、“平急两用”设施，以及“城中村”改造。

但仅仅这些措施本身是不够的。智库MacroPolo的宋厚泽担心“刺激措施不足以重振经济”。政府似乎更担心刺激过度而非不足。尽管有支持公务债务的理据，但许多中国人仍然对它持怀疑态度。即使是为政府借债辩护的人也小心翼翼，不敢表现得过于激进。艾兴格林那本书的中文版没有按英文标题直译为《捍卫公共债务》，而变成了更温和的《全球公共债务：经验、危机与应对》。

该如何解释政府在财政上的审慎态度？原因也许出在意识形态上，但也可能是并不久远的历史所致。十五年前的11月，为应对全球金融危机，中国政府宣布了约4万亿元的财政刺激计划。金融监管机构还允许地方政府通

过设立融资平台规避借贷限制，这些平台可以发行债券并从银行借款。正如墨尔本大学的黄佩华所说，地方政府积极响应，“热情高涨”。在27个月内，加上这些额外的借贷，最初的4万亿元刺激规模膨胀到了9.5万亿（占2009年GDP的27%）。

这一轮信贷狂潮成功地恢复了经济增长。但在之后的那些年里，刺激措施在中国背上了污名。中国官员一再警告，对经济放缓采取类似的“大水漫灌”式措施存在风险。这轮放贷潮被指特别偏向国企、挤压了制造业投资，阻碍了工业研发支出。

现就职于康奈尔大学的丛林及其合著者此前根据19家银行的机密贷款数据指出，2009年和2010年增加的信贷供应更偏向国企而非私企。而在私企中，更多信贷流向了那些资本利用效率较低的企业。几位作者猜测，在危机中，银行更愿意向享有地方政府支持的企业提供贷款，无论是国企还是有人脉但效率低的私企。复旦大学的范剑勇和合著者认为，在地方政府借贷最多的地区，工业企业的研发支出因资本成本上升受到挤压。这些地方政府的领导者往往是急于出政绩的新晋党委书记。

看完这些研究很容易得出结论，认为2008年的刺激计划是一个错误。但刺激计划有缺陷并不意味着还不如不刺激。例如，丛林的论文并没有显示信贷供应的增加妨碍了私企借贷，只是表明相对于国企，私企从中受益更少。范剑勇和他的同事在对研发的研究中也控制了各地增长率的影响。这意味着，如果刺激措施促进了增长，而增长又促进了研发，那么这种有益影响会被从研究结果中剥除。

既然刺激措施达到了贷款和投资“大水漫灌”的水平，这种情况下如果私企还严重缺乏信贷就有些奇怪了。而事实上，智库彼得森国际经济研究所（Peterson Institute for International Economics）的尼古拉斯·拉迪（Nicholas Lardy）编制的数据显示，2009年和2010年向私企提供的贷款增长迅速。私营制造企业的投资也很强劲。香港中文大学的宋铮与人合著了另一篇关于中国财政扩张的有影响力的论文，他认为刺激性支出反而挤出了中国积累的外国资产，包括央行购买的美国国债数额。

尽管如此，正如宋铮的论文所言，对地方政府放松财政限制还是投下了“长长的阴影”。在危机过去很久以后，地方政府融资平台仍在继续借贷。地方政府如今看起来无法偿还这些平台积累的部分债务，加重了中国经济的阴霾。与许多经济学家一样，宋铮认为，下一次刺激措施应该采用不同的财政机制，转而向家庭发放补贴。例如，中国大陆可以复刻香港发行电子消费券的做法，如果在几个月内的期限内没有使用，电子消费券就会自动失效。

十五年过去了，中国2008年信贷热潮的副作用提供的前车之鉴是要采取更好的刺激措施，而不是不采取刺激措施。正如艾兴格林的书所指出的那样，以公共借贷拯救经济可能会遗留财政金融难题。但这并不等同于说“当初不借钱才更好”。 ■



Free exchange

How to save China's economy

Lessons from the last stimulus for the next one

EARLIER THIS year a Chinese publisher released a translation of “In Defence of Public Debt”, a book by Barry Eichengreen of the University of California, Berkeley, and several others. Reaching deep into history, the book seeks to restore balance to the debate on government borrowing by emphasising its neglected benefits. Mr Eichengreen argues that indebted countries can get into trouble when they turn to fiscal restraint too soon, neglect growth or succumb to deflation, which only makes debt harder to service. The arrival of the translated edition was timely. Many economists believe the Chinese government’s fiscal caution this year has contributed to disappointing growth and the danger of falling prices.

Thankfully, China’s government has now begun to loosen the purse strings. It has taken the rare step of revising its budget-deficit target from 3% of GDP to 3.8%. It has allowed provinces to issue “refinancing bonds”, which will help them repay some of the more expensive debt owed by affiliated infrastructure firms known as local-government financing vehicles. Financial regulators have urged banks to meet the “reasonable” financing needs of the less rickety property developers, without discriminating against private ones. Officials also talk more often about “three major projects”: affordable housing; leisure facilities that can also help China cope with disasters and emergencies; and efforts to renovate “urban villages”, or formerly rural enclaves.

But these steps by themselves will not be enough. Houze Song of MacroPolo, a think-tank, worries that the “stimulus is not big enough to reflate the economy”. The government seems to fear an excessive response more than

it fears an inadequate one. Many in China view public debt as suspect despite the arguments in its favour. Even defenders of public borrowing are careful not to appear too strident. The Chinese edition of Mr Eichengreen's book is not called "In Defence of Public Debt". It carries the more anodyne title "Global Public Debt: Experience, Crisis, Response".

What explains the government's fiscal reticence? It may be ideology. But it may also be recent history. Fifteen years ago this month, China's government announced a fiscal stimulus worth about 4trn yuan (or \$590bn) in response to the global financial crisis. Financial regulators also gave their blessing to local governments to sidestep restrictions on their borrowing by setting up financing vehicles that could issue bonds and borrow from banks. Local governments responded with "frenzied enthusiasm", as Christine Wong of the University of Melbourne put it. With the extra borrowing, the initial 4trn yuan ballooned into 9.5trn yuan (or 27% of 2009 GDP) spread over 27 months.

The frenzy successfully revived growth. But in the years since, stimulus has acquired a stigma in China. Chinese officials have repeatedly warned of the dangers of a similar "flood-like" response to economic slowdowns. The lending spree has been accused of privileging state-owned enterprises, crowding out manufacturing investment, and impeding spending on industrial R&D.

Drawing on confidential loan data from 19 banks, Lin William Cong, now of Cornell University, and co-authors have shown that the increased supply of credit in 2009 and 2010 favoured state-owned enterprises over private firms. And among private firms, it favoured those making less productive use of their capital. The authors guess that in a crisis, banks prefer to lend to companies that enjoy the backing of local governments, whether they be state-owned enterprises or well connected but inefficient private firms. Jianyong Fan of Fudan University and co-authors argue that spending on

R&D by industrial firms was squeezed by higher capital costs in parts of the country where local governments borrowed most heavily. These localities were often led by newly promoted party secretaries who were eager to shine.

It is easy to read these studies and conclude that the 2008 stimulus was a mistake. But the flaws of that response do not mean that it was worse than nothing. The paper by Mr Cong, for example, does not show that the increased supply of credit hurt borrowing by private firms, merely that it benefited them less than it helped state-owned firms. The study of R&D by Mr Fan and his colleagues also controls for each locality's growth rate. That means that if the stimulus boosted growth, and growth boosted R&D, this beneficial effect will be stripped out of their results.

Since the stimulus amounted to a "flood" of lending and investment, it would be surprising if private firms were parched of credit. Indeed, lending to them grew briskly in 2009 and 2010, show figures compiled by Nicholas Lardy of the Peterson Institute for International Economics, a think-tank. Investment by private manufacturers was also strong. Instead stimulus spending crowded out China's accumulation of foreign assets, including the American Treasury bonds bought by its central bank, argues Zheng Song of the Chinese University of Hong Kong, co-author of another influential paper on China's fiscal expansion.

Looser financial limits on local governments nonetheless cast a "long shadow", as Mr Song's paper put it. Their financing vehicles continued to borrow long after the crisis. Some of the debts these vehicles have accumulated now look impossible for local governments to repay, adding to the gloom hanging over China's economy. Like many economists, Mr Song believes the next stimulus should adopt different fiscal machinery, providing handouts to households. Mainland China could, for example, copy the electronic consumption vouchers distributed in Hong Kong, which are forfeited if they are not spent within a few months.

Fifteen years on, the side-effects of China's 2008 lending spree are an argument for better stimulus, not zero stimulus. Public borrowing to rescue an economy can leave a difficult financial legacy, as Mr Eichengreen's book points out. But that is different from saying that "not borrowing would have been better". ■



经济学人视频

人造子宫是未来趋势吗？

这项技术是艺术、设计、生物和工程的交汇点，良好的模型是成功的关键。



The Economist Film

Are artificial wombs the future?

It is at the intersection of art, design, biology and engineering. Good modeling is the key to success here.



世界展望2024

旅行者面临又一个混乱的年份

需求恢复快于供应，导致延误和涨价

没人喜欢以在机场苦等航班来开始或结束一个来之不易的假期。可惜，这将是许多旅行者在2024年的遭遇。

人们已经恢复了在世界各地跑来跑去的兴趣。联合国世界旅游组织（UN World Tourism Organisation）估计，在疫情后“报复性旅游”热潮的推动下，2023年全球游客数量将恢复到疫情前水平的95%，高于2022年的63%。商务旅行的反弹速度也快于预期：全球商务旅行协会（Global Business Travel Association）目前预计商务旅行支出将在2024年恢复到疫情前水平，而不是之前估计的2026年。

然而，对于航空业来说，恢复运力没有那么简单。扭转疫情引发的大规模裁员仍需要时间。由于航班供不应求，机票涨价速度已快过通胀，增加了航空公司的利润。但它们的运营难以承受压力。在美国，航班延误的比例持续上升。

旅行者在2024年碰到的麻烦不只在飞行上。世界各地的城市都在打击爱彼迎（Airbnb）等短租民宿。纽约9月生效的一项新法律要求房东向市政府登记，并且在客人入住期间留在出租屋内。爱彼迎称该法律为“事实上的禁令”。柏林、巴黎和罗马也实施了限制措施，维也纳等其他城市也将在2024年效仿。市政府希望这些限制措施能够缓解其居民在房租和房价上的压力。对于旅行者来说，结果是选择更少、价格更高。

中国可能增加事态的不确定性。行业组织世界旅行和旅游理事会（World Travel and Tourism Council）预测，2024年，中国出境旅行和旅游支出将达到2019年水平的约90%，而2023年为2019年的一半。但疲软的中国经济可能会拖累这一复苏。这对于那些依赖中国需求的企业来说不是个好消息。而对于其他游客来说，这可能意味着他们重新踏上环球之旅没那么

拥挤了。

《经济学人》全球商业记者托马斯·李-德弗林 ■



The World Ahead 2024

Travellers face another year of disruption in 2024

Demand is recovering faster than supply, which means delays and higher prices

NOBODY ENJOYS starting or ending a hard-earned holiday by wasting hours in an airport waiting for a flight. Alas, that is what many travellers will face in 2024.

People have recovered their appetite for whizzing around the world. The UN World Tourism Organisation estimates the global number of travellers will be at 95% of pre-pandemic levels in 2023, up from 63% in 2022, driven by a post-pandemic “revenge tourism” boom. Business travel is also rebounding faster than expected: the Global Business Travel Association now anticipates a return to pre-pandemic levels of business-travel spending in 2024, rather than its previous estimate of 2026.

For the airline industry, however, restoring capacity has not been straightforward. Reversing the mass lay-offs triggered by the pandemic is taking time. With demand for flights outstripping supply, prices have risen faster than inflation, padding airlines’ profits. But operations are buckling under the pressure. In America, the share of flights delayed continues to rise.

Flying will not be the only pain point for travellers in 2024. Cities around the world are cracking down on short-term rentals like those accessed through Airbnb. A new law that came into effect in New York in September requires hosts to register with the city and be present during a guest’s stay. Airbnb calls the law a “de facto ban”. Berlin, Paris and Rome have also implemented restrictions, and others including Vienna will follow suit in 2024. Municipal governments hope these curbs will ease pressure on rents and house prices

for residents. For travellers, the result is less choice and higher prices.

China could yet throw out a wild card. The World Travel and Tourism Council, a trade group, forecasts that Chinese outbound travel-and-tourism spending will reach roughly nine-tenths of 2019 levels in 2024, up from half in 2023. But a flagging Chinese economy could derail that recovery. That would be bad for businesses counting on Chinese demand. For other tourists, however, it might mean a less crowded return to globetrotting. ■

THOMAS LEE-DEVLIN, Global business correspondent, The Economist ■



世界展望2024

新疗法将使用基因剪刀和其他妙招

从镰状细胞病到青光眼，这些是值得留意的药物

治疗镰状细胞病和 β 地中海贫血这两种遗传性血液疾病的新药将在2024年登上新闻头条。其中最引人注目的是首款CRISPR基因编辑药物，它于2023年底历史性地问世了。基因编辑使用分子剪刀编辑DNA，比起使用病毒载体将治疗基因注入细胞的旧技术基因疗法，这种修饰形式更为精确。用基因编辑制造新药的进展快得惊人——相比研发缓慢又困难的基因疗法要快得多。

在镰状细胞病上，由Crispr Therapeutics和Vertex研发的基因编辑药物exa-cel很可能会比Bluebird Bio的基因疗法lovo-cel先一步获批。两种疗法都先从患者体内提取干细胞，然后编辑它们（exa-cel）或用病毒载体转染（lovo-cel），然后回输到患者体内，纠正遗传缺陷。据称疗效持续一生。

但这些药物的花费超过每名患者200万美元。即使在美国，一些患者也很难买到它们。而在大多数镰状细胞病患者居住的较贫穷国家根本无处可寻。

基因编辑技术具有巨大的灵活性，并且能以非遗传性疾病为靶标，这使得它显现出特别光明的前景。明年，Crispr Therapeutics和Caribou Biosciences将在开发可治疗癌症和其他疾病的开架细胞治疗产品方面取得进展。

免疫系统的主力军T细胞可以从捐赠者那里收集到，并通过基因编辑重编程以对抗癌症，而不会引发患者身体的免疫排斥。有了这种方法后，强大的CAR-T细胞疗法就不再需要以高昂的成本为每名患者定制实施了。

Crispr Therapeutics正在研发类似的技术来制造胰腺中生成胰岛素的胰腺

细胞的移植细胞。人们也在致力开发“体内”基因编辑，把基因编辑药物包装在脂质纳米粒中递送入体内。

基因编辑技术也在其他方面取得进展。Verve Therapeutics正在使用一种名为“碱基编辑”的更精确的基因编辑法来对抗心血管疾病，这种方法可以改变基因组中的单个碱基而不损坏DNA分子本身。用它来降低胆固醇水平的前期研究很快会有结果。与此同时，来自Excision的另一种疗法EBT-101旨在利用基因编辑消除体内的艾滋病毒感染，将于2024年完成首次1期试验的患者入组。

未来一年的其他亮点包括：一种治疗尿路感染的新抗生素将迎来备受期待的审评决定，这类感染中有许多对现有抗生素耐药；两种“五价”脑膜炎球菌疫苗，可预防多种血清型脑膜炎；还有一种创新的“微创”眼部植入物，能持续释放微量的青光眼药物。它的疗效有望远好过滴眼液，因为患者常常会忘记定期使用滴眼液——你可能会说，这是来年又一个值得我们拭目以待的新疗法。

《经济学人》医疗编辑娜塔夏·洛德 ■



The World Ahead 2024

New medical treatments will use genetic scissors, and other clever tricks

From sickle-cell disease to glaucoma, these are the drugs to look out for

NEW MEDICINES to treat sickle-cell disease and beta thalassaemia, two genetic blood disorders, will make headlines in 2024. Most notable of these is the first CRISPR-gene-edited drug, which made its historic arrival in late 2023. Gene editing uses molecular scissors to edit DNA. It is a more precise form of modification than gene therapy, an older technology that uses a viral vector to inject a working gene into a cell. Gene editing has moved astonishingly quickly through drug pipelines—much faster than gene therapies, which have been slow and difficult to develop.

For sickle-cell disease, the gene-edited therapy, exa-cel, developed by Crispr Therapeutics and Vertex, is likely to be approved just ahead of a gene-therapy drug from Bluebird Bio, lovo-cel. In both cases, stem cells are first extracted from a patient's body. They are then either edited (exa-cel) or transfected with the viral vector (lovo-cel), and returned to the body, where they correct the genetic defect. The effects are said to last a lifetime.

But these drugs will cost more than \$2m per patient. Even in America some patients will struggle to get hold of them. In poorer countries, where most patients with sickle-cell disease live, they will be impossible to obtain.

The great flexibility of the gene-editing technology, and its ability to target non-genetic diseases, means it has a particularly bright future. The coming year will see progress in efforts by Crispr Therapeutics and Caribou Biosciences to develop off-the-shelf cell products that can treat cancer and other diseases.

The workhorse of the immune system, the T-cell, can be gathered from donors and reprogrammed, via gene editing, to fight cancer without triggering an immune rejection by the patient's body. This approach means that powerful CAR-T treatments no longer have to be manufactured individually, and expensively, for each patient.

Crispr Therapeutics is developing similar technology to create replacement insulin-producing cells in the pancreas. There are also efforts to develop "in vivo" gene editing, to allow gene-editing treatments to be delivered into the body by packaging them in lipid nanoparticles.

Gene-editing technology is advancing in other ways, too. Verve Therapeutics is focusing on cardiovascular disease using a more precise approach to gene editing known as "base editing", which can change a single base in the genome without damaging the DNA molecule itself. Look for news of its early-stage work, on a treatment to lower cholesterol levels. Meanwhile another treatment, EBT-101 from Excision, which aims to use gene editing to eliminate HIV infection from the body, will complete enrolment of patients for its first phase-1 trial in 2024.

Other coming highlights in the year ahead include a hotly anticipated decision on a new antibiotic for urinary-tract infections, many of which are resistant to existing antibiotics; two "pentavalent" meningococcal vaccines that protect against a wide range of serotypes of meningitis; and an innovative "microinvasive" eye implant that continuously releases minuscule amounts of a drug for glaucoma, an eye disease. It promises to deliver far better results than eye drops, which patients often forget to apply regularly. Yet another exciting new treatment to keep an eye on, you might say, in the coming year. ■

NATASHA LODER, Health editor, The Economist ■



世界展望2024

自动驾驶汽车正在缓慢前行

在让乘客等待多年之后，它们终于要来了

用不着高精度传感器就可以看到自动驾驶汽车在通往普及的路上曾有多少目标没能达成。通用汽车公司曾承诺在2019年之前大量普及自动驾驶汽车。福特汽车和网约车公司Lyft则认为2021年更现实些。十年来，马斯克一直大声宣称，完全自动驾驶的特斯拉汽车最多还需要一年时间就将问世。在乏味的长途驾驶中，坐在方向盘前打个盹仍然是一个遥不可及的梦想。但在2024年，自动驾驶汽车的广泛应用将又向我们靠近一点点。

在未来的一年里，自动驾驶出租车将超越测试区，更多的驾驶者将享受到强大的自动驾驶功能。对自动驾驶的追求分为三个阵营：致力于开发完全自动驾驶出租车的公司；专注于各种形式的驾驶辅助功能的汽车制造商；以及独辟蹊径的特斯拉。

呼叫自动驾驶出租车将变得更加普遍。Waymo（Alphabet旗下公司）和Cruise（通用汽车的自动驾驶部门）早已开始测试车辆。它们在旧金山昼夜不停地收取乘车费用，不需要安全驾驶员（不过Cruise在10月份发生一起涉及行人的事故后被吊销了许可）。

2024年，已在奥斯汀、洛杉矶和凤凰城运营的此类车辆以及亚马逊Zoox公司的无人车可能会出现在亚特兰大、迈阿密和西雅图等其他美国城市。在中国，科技巨头百度和小马智行（Pony.ai）都在北京和其他城市有小规模运营，也有类似的扩张计划——百度的计划是到2025年扩张到65个城市。

建立自动驾驶出租车业务需要多年投资，前景仍不明朗。许多汽车制造商认为，为一般车辆添加自动驾驶技术是更快实现盈利的途径。一些汽车制造商已经拥有“2级”系统，可以转向、刹车和变道。但梅赛德斯-奔驰率先推出了驾驶领航（Drive Pilot），这是一种无需持续监控的“3级”系统。该

系统已在德国投入使用，并将于2024年铺开到美国的几个州，为该公司最豪华的一些车型提供每年2500美元的订户选项。最重要的是，梅赛德斯将在驾驶领航功能开启时承担全部法律责任。其他汽车制造商也不甘落后：福特、斯特兰蒂斯和其他公司也很可能在2024年推出类似的“3级”系统。

剩下的就是特斯拉了。尽管大肆炒作，但特斯拉的自动驾驶系统仍属于“2级”，需要持续的监督和手握方向盘。马斯克声称，可能在2024年推出的下一个版本的自动驾驶水平要高得多。也许会吧。无论如何，无人驾驶之旅正在悄然接近。

《经济学人》产业编辑西蒙·赖特 ■



The World Ahead 2024

Self-driving cars are slowly moving forward

Having kept riders waiting for years, they are finally arriving

A HIGH-PERFORMANCE sensor is not needed to detect the list of missed targets for the widespread adoption of self-driving cars. General Motors once promised autonomous vehicles (AVs) in abundance by 2019. Ford and Lyft, a ride-hailing firm, had reckoned 2021 was more plausible. For a decade, Elon Musk has loudly proclaimed that fully autonomous Teslas were a year away at most. Taking a nap behind the wheel on a tediously long drive remains a distant dream. But broad adoption of AVs will inch closer in 2024.

In the coming year robotaxis will spread beyond test zones and powerful self-driving features will become available to more motorists. The pursuit of autonomy has split into three camps: firms working on fully autonomous robotaxis; carmakers focused on various forms of driver assistance; and Tesla, which does its own thing.

Hailing robotaxis will become more commonplace. Waymo (owned by Alphabet) and Cruise (GM's AV arm), have long been testing vehicles. They have been charging for rides in San Francisco around the clock, with no need for safety drivers (though Cruise's licence was suspended in October after an accident involving a pedestrian).

In 2024 such vehicles, already operating in Austin, Los Angeles and Phoenix, as well as AVs from Amazon's Zoox, may pop up in other American cities including Atlanta, Miami and Seattle. In China, Baidu, a tech giant, and Pony.ai, also both with small operations in Beijing and other cities, have similar expansion plans—in Baidu's case to 65 cities by 2025.

Establishing a robotaxi business requires years of investment, and the prospects remain uncertain. Many carmakers think a faster route to profit is to add self-driving tech to ordinary cars. Some already have “level 2” systems that can steer, brake and change lanes. But Mercedes-Benz is leading the way with Drive Pilot, a “level 3” system that does not require constant supervision. Already available in Germany, it will become available in several American states in 2024, as a \$2,500-a-year subscription option in some of the firm’s fanciest models. Crucially, Mercedes assumes full legal liability when Drive Pilot is on. Other carmakers are not far behind: Ford, Stellantis and others are likely to launch similar “level 3” systems in 2024.

And that leaves Tesla. Despite much hype, its self-driving system is “level 2”, requiring constant supervision and hands on the steering wheel. Mr Musk claims the next version, likely to be made available in 2024, provides a far higher level of autonomy. Perhaps it will. One way or another, the driverless journey is creeping ever closer. ■

SIMON WRIGHT, Industry editor, The Economist ■



世界展望2024

电动汽车将使中国成为全球最大的汽车出口国

它在电池制造方面的领先地位至关重要

机动车中的内燃机每年导致了约15%的二氧化碳排放。要淘汰内燃机，就必须实现交通电气化，而这又需要数量空前的电池。2024年，一个新的全球电池生产基础设施的轮廓将在中国、欧洲和美国显现出来——这个工厂网络能够生产出足够多的电池来储存驱动全球汽车所需的能量。

大多数现有和规划的电池工厂都位于中国。欧洲的许多工厂都是由中国公司建造的。分析机构基准矿物情报（Benchmark Mineral Intelligence）称，到2030年，中国将拥有全球电池生产能力的69%，低于2022年的78%，但仍满足每年生产9000万辆汽车所需的电池。相比之下，预计到2030年，欧洲和美国的产能将各占全球产能的14%左右，分别足够装配1900万辆汽车。

中国之所以领先，部分原因是中国政府支持电动汽车制造和落地的时间更长。中国政府从2010年代初就开始实行电动汽车购置税减免，到2022年，仅通过消费者激励措施就投入了约300亿美元支持电动汽车市场；电动汽车制造商还通过地方政府获得了进一步支持。这些补贴造成了许多新兴电动汽车公司之间的竞争。现在，大多数此类公司都已倒闭，而比亚迪和宁德时代等赢家则占据了强势地位。中国原有的电子产品供应链优势也为电动汽车制造商助推了一把。由于政府禁止在市中心使用汽油动力摩托车，到2010年，中国的电动自行车保有量已超过1亿辆。

欧洲和美国最近才开始迎头赶上。在美国，2022年通过的《通货膨胀削减法案》（IRA）为电动汽车购买者提供税收减免，但前提是汽车不含来自中国或俄罗斯的零部件。IRA还为电池制造商提供税收减免，减免额约为生产成本的三分之一。根据基准矿物情报的计算，未来十年美国汽车制造商将获得1400亿美元的补贴。2023年初，欧盟提出了一项类似的措施，即

《绿色交易工业计划》，为成员国自行提供补贴和部分资金开辟了道路。

得益于这些刺激措施，现在看来，到2030年，欧洲和美国的电池生产能力将足以满足国内对电动汽车的需求。中国的电池产能将是其国内市场需求数的三倍。到2024年，中国就将首次成为世界上最大的汽车出口国。而无论欧洲和美国花多少钱试图赶上，在可预见的未来，中国在电池方面的主导地位都将持续下去。

《经济学人》特别项目撰稿人哈尔·霍德森 ■



The World Ahead 2024

EVs are poised to make China the world's biggest car exporter

Its lead in battery-making is crucial

COMBUSTION ENGINES in motor vehicles account for about 15% of carbon-dioxide emissions each year. Eliminating them requires the electrification of transport, which in turn requires batteries in unprecedented quantities. In 2024 the outlines of a new global battery-production infrastructure will come into focus in China, Europe and America—a network of factories capable of churning out batteries in sufficient amounts to store the energy required to propel the global fleet of vehicles.

The majority of battery factories, existing and planned, are in China. Many in Europe are being built by Chinese firms. Benchmark Mineral Intelligence, a firm of analysts, says that China will have 69% of global battery-production capacity by 2030, down from 78% in 2022, but still sufficient to make enough batteries for 90m cars every year. Europe and America, in contrast, are each forecast to have around 14% of global capacity by 2030, enough for 19m vehicles each.

China holds this lead in part because its government has been supporting electric-vehicle (EV) manufacturing and adoption for longer. Tax breaks for EV purchases began in the early 2010s, and by 2022 the Chinese government had poured around \$30bn into supporting the market through consumer incentives alone; EV manufacturers received further support through local governments. These subsidies created competition between many new EV companies. Most have now gone bust, leaving winners such as BYD and CATL in a strong position. China's pre-existing strengths in the electronics supply chain also gave EV manufacturers a boost. By 2010 there were already more than 100m electric bikes in China, thanks to government bans of

petrol-powered motorcycles in city centres.

Europe and America have only recently started to catch up. In America the Inflation Reduction Act (IRA), passed in 2022, provides tax breaks for EV buyers, but only if the car contains no parts from China or Russia. The IRA also offers battery-makers a tax credit which covers about one-third of the cost of production. All told, Benchmark calculates that American automakers will receive \$140bn in subsidies over the next decade. In early 2023 the European Union proposed a similar measure, the Green Deal Industrial Plan, which opened the way for member-states to offer subsidies of their own, as well as providing some funding.

Thanks to these stimulus efforts, it now looks as though both Europe and America will have sufficient battery-production capacity to cover domestic demand for EVs by 2030. China is set to have three times more battery capacity than it needs to service its home market. As 2024 begins, China is poised to become the world's largest car exporter for the first time. And no matter how much money Europe and America spend trying to catch up, China's battery dominance will last for the foreseeable future. ■

HAL HODSON, Special projects writer, The Economist ■



世界展望2024

头显市场争霸战将愈演愈烈

它们是下一个大技术平台

2024年最受期待的电子产品是苹果的Vision Pro。这款时尚的头显可将用户带至“星球大战”战场的中心，或将世界上最大的Excel电子表格投影到他们的办公室里。这款神奇的眼镜把虚拟现实（VR）与“混合现实”结合起来，使用前置摄像头向用户展示外部世界的实时视频，并可在其上叠加计算机图形。该设备用眼球移动和手势控制。苹果说它是该公司史上最宏伟大胆的产品——它3499美元的定价也是。

苹果将与各种竞争对手争夺消费者的注意力。首当其冲的是Meta（原Facebook），该公司在疫情封锁期间推出的Quest 2头显大受欢迎，当时元宇宙一度变得比现实生活还有趣。它于2023年末推出升级版Quest 3，提供混合现实功能。Quest 3比苹果的设备更基础，但因售价仅499美元，销量会更大。之后还会推出更高级的版本。

谷歌可能会重新加入头显竞赛。十年前，它推出了名为谷歌眼镜的带摄像头的智能眼镜，但以失败告终。名为Iris的高科技眼镜计划似乎再度折戟。它的最新招数是与韩国巨头三星和美国芯片制造商高通合作。三家公司正在开发一个混合现实项目，可能会带来一款头显。

较小的公司正在创造自己的利基市场。美国视频游戏公司Valve为游戏玩家生产VR耳机，中国的VR公司Pico也一样。Pico的母公司字节跳动还拥有TikTok，这款应用在美国引发质疑，这种局面可能会导致Pico很难销售一款追踪眼球的设备。

目前还不要期待哪款头显能够席卷全球。市场研究公司Omdia预测，在2024年，视频头戴设备的全球销量将增长三分之一，但总量将仍仅为1800万套。（智能手机销量将超过10亿部。）苹果的Vision Pro由于零部件供应限制以及价格高昂，销售量可能不会超过20万部。投资公司韦德布什证

券（Wedbush Securities）的丹·艾夫斯（Dan Ives）预测，它“将在2024年大受开发者的欢迎，然后在2025年走向消费者”。

2024年值得关注的事情是那些开发人员发现可以拿Vision Pro干什么。智能手机真正风靡世界要等到各种应用出现之后，这些应用把联网的手机从一件新奇玩意变成了不可或缺的日常工具。头显目前主要用于游戏，仍缺乏让大多数人感觉不可或缺的用例。但如果程序员开始捣弄Vision Pro了，情况可能就会有变化。未来几个月里，科技观察者将把目光投向苹果的新设备——而它的四个内置摄像头也会径直回望他们。

《经济学人》技术和媒体编辑汤姆·维恩莱特 ■



The World Ahead in 2024

The fight to control the headset market will intensify

They are the next big tech platform

THE MOST eagerly awaited gadget of 2024 is Apple's Vision Pro, a sleek headset that can transport users to the middle of a "Star Wars" battlefield, or simply project the world's biggest Excel spreadsheet into their office. The magic goggles combine virtual reality (VR) with "mixed reality", using front-mounted cameras to show the user a live video-feed of the outside world, onto which computer graphics can be superimposed. The device is controlled with eye movements and hand gestures. Apple calls it the most ambitious product it has ever made. At \$3,499 its price is ambitious, too.

Apple will be jostling for consumers' attention with various rivals. Chief among them is Meta, formerly known as Facebook, which had a big hit with its Quest 2 headset during covid-19 lockdowns, when the metaverse was briefly more enjoyable than real life. It launched an upgraded Quest 3 late in 2023, offering mixed reality. The Quest 3 is more basic than Apple's device, but at \$499 will outsell it. Fancier models will follow.

Google may re-enter the headset race. A decade ago it launched camera-toting smart specs called Google Glass, which flopped. Plans for high-tech glasses called Iris seem to have gone the same way. Its latest gambit is a partnership with Samsung, a South Korean giant, and Qualcomm, an American chipmaker. The three are working on a mixed-reality project which may produce a headset.

Smaller firms are creating their own niches. Valve, an American video-game company, makes VR headsets for gamers, as does Pico, a Chinese-owned VR firm. Pico's parent company, Bytedance, also owns TikTok, an app that has

aroused suspicion in America—a situation that might make it hard to sell a device that tracks your eyeballs.

Don't expect any headset to take the world by storm just yet. Worldwide sales of video headgear will grow by a third in 2024, but will still total only 18m units, forecasts Omdia, a market-research company. (Smartphone sales will exceed 1bn.) Apple's Vision Pro will probably sell fewer than 200,000 units, because of supply constraints on components, as well as the price tag. It "will be a hit with developers in 2024 and then consumers in 2025", predicts Dan Ives of Wedbush Securities, an investment company.

The thing to watch in 2024 is what those developers find to do with the device. Smartphones took off only after the launch of apps that turned internet-connected phones from novelties into vital everyday tools. Headsets, used mostly for gaming, still lack compelling use cases for most people. But as programmers begin to play around with the Vision Pro, that could change. In the months ahead, tech-watchers will have their eyes on Apple's new gadget—and it will have its four internal cameras looking right back at them. ■

TOM WAINWRIGHT, Technology and media editor, The Economist ■



世界展望2024

半导体仍将是美国与中国科技竞争的核心

预计美国将在全球范围内加大对芯片和芯片制造设备的制裁力度

华为Mate 60 Pro手机在8月29日甫一上市，技术专家们就争先恐后地把它大卸八块，看看它是如何工作的。这家中国电信设备制造商以某种方式成功打造了一款全新的5G智能手机——很少有人觉得它能做到这一点。在美国的制裁阻止了华为购买先进半导体或制造设备后，华为被迫于2020年放弃制造此类手机。华为智能手机的销量一度在全球范围内超过了苹果的iPhone手机，在这以后一蹶不振。然而，当工程师们仔细检查Mate 60 Pro的内部结构时，却发现了一个中国制造的芯片，似乎表明美国的制裁已被本土创新所克服。

这款名为麒麟9000S的芯片由中国领先的芯片制造商中芯国际制造，它的出现是一个具有深刻象征意义的时刻。中美科技战于2019年正式打响，当时特朗普政府禁止向华为出售高端芯片。2022年，总统拜登在这些制裁框架的基础上全面禁止向中国所有公司销售先进半导体。此后，北京领导人以安全为由，禁止了美国公司美光向中国公司销售它生产的部分芯片作为报复。中国还开始限制镓和锗这两种制造最先进芯片所需的稀有金属的出口。

因此，华为的新手机及其芯片在中国被视为模式转变的标志。政府喉舌《人民日报》9月12日的社论写道：“人们从中看到，美国制裁无法阻止中国技术进步。”当地社交媒体上的照片显示，深圳的孩子们在华为广告前鞠躬。在美国，Mate 60 Pro既被用来证明对华制裁失败因而应该放弃制裁，也被用来论证应该加强制裁。而事实上，它凸显了华为和其他中国企业在未来取得新突破的难度。

Mate 60 Pro的性能与三星Galaxy S20相当，后者于2020年发布，采用世界领先的芯片制造商台积电生产的芯片。落后三年听起来也许并不多，但中

芯国际使用的是上一代基于深紫外（DUV）技术的光刻机来蚀刻芯片。

行业观察家认为，麒麟9000S代表了DUV技术的极限。台积电的高级芯片采用的是更先进的极紫外（EUV）技术。中芯国际和其他中国芯片制造商无法采用这种技术，因为EUV机器只能由荷兰公司阿斯麦（ASML）制造，而且受美国制裁的限制。

简而言之，尽管麒麟9000S令人印象深刻，但可能也标志着中国在没有EUV技术的情况下所能达到的极限，而EUV技术必须由中国自主研发。这可能需要很多年的时间——而在此期间走在前头的台积电也不会停止脚步。Mate 60 Pro并不像先前看起来的那样是技术大战中的决定性一击。这款手机内核的其他方面预示着2024年科技大战的走向。

人们发现这些手机含有韩国公司SK海力士生产的内存芯片。海力士自称已多年未与华为开展业务。但中国公司找到了巧妙的变通办法，通过地下市场获得了芯片。因此，美国很可能在全球范围内加大制裁力度。拜登政府已经把日本、荷兰和韩国等盟国拖入了这场斗争，令这些国家的公司感到不满。2024年，美国可能会扩大制裁的适用范围，也许会扩大到中东等地，据传中国企业正在中东购买芯片。

这可能会阻碍中国企业创造新的高科技产品的能力——从智能手机到训练人工智能模型所需的专用系统。但这也会消耗美国盟友对其科技战的耐心。

《经济学人》驻上海中国商业与金融编辑唐·维兰德 ■



The World Ahead 2024

Semiconductors will remain central to America's tech rivalry with China

Expect America to step up global enforcement of its sanctions on chips and chipmaking gear

AS SOON AS the Huawei Mate 60 Pro handset went on sale on August 29th, technologists raced to smash it open and see how it worked. The Chinese telecoms-equipment maker had somehow succeeded in creating a new 5G smartphone—something few thought it could accomplish. Huawei had been forced to give up making such devices in 2020 after American sanctions blocked it from buying advanced semiconductors or the equipment needed to make them. Sales of Huawei smartphones, which at one stage even outsold Apple's iPhones globally, collapsed. Yet as they sifted through the innards of the Mate 60 Pro, engineers discovered a Chinese-made chip that seemed to show that American sanctions had been overcome by indigenous innovation.

This chip, the Kirin 9000S, was manufactured by SMIC, the leading Chinese chipmaker, and its appearance was a deeply symbolic moment. China's tech war with America began in earnest in 2019 when Donald Trump's administration banned the sale of high-end chips to Huawei. In 2022 President Joe Biden built on the framework of those sanctions to introduce a blanket ban on the sales of advanced semiconductors to all companies in China. Since then leaders in Beijing have retaliated by banning the sales of some chips made by Micron, an American firm, to Chinese companies, on security grounds. They also began restricting exports of gallium and germanium, two rare metals needed to make state-of-the-art chips.

Huawei's new phone, and the chip that powers it, are thus seen in China as signalling a paradigm shift. "People can see from this that American

sanctions cannot stop China's technological progress," read an editorial on September 12th in the People's Daily, a government mouthpiece. Photos on local social media showed children bowing in front of Huawei advertisements in Shenzhen. In America, the Mate 60 Pro was used as evidence both to argue that sanctions on China were failing and should be abandoned and to argue that they should be tightened. In fact, it highlights just how difficult it will be for Huawei and other Chinese firms to make new breakthroughs in 2024 and beyond.

The performance of the Mate 60 Pro is on a par with Samsung's Galaxy S20, a handset released in 2020 and powered by a chip manufactured by TSMC of Taiwan, the world's leading chipmaker. Being three years behind may not sound like a lot, but SMIC is using a previous generation of lithography machines, based on a technology called DUV, to etch its chips.

Industry observers reckon that the Kirin 9000S represents the limit of DUV technology. TSMC's superior chips are made using more advanced EUV technology. And that is off-limits to SMIC and other Chinese chipmakers because EUV machines are made only by ASML, a Dutch company, and are covered by American sanctions.

Impressive as it is, in short, the Kirin 9000S probably marks the boundary of what China can achieve without EUV technology, which it will have to develop on its own. That is likely to take many years—and TSMC will continue to race ahead in the meantime. The Mate 60 Pro is not the decisive blow in the tech war that it seemed. And other aspects of the phone's innards signal the direction the tech war will take in 2024.

The handsets were found to contain memory chips made by SK Hynix, a South Korean firm. It says it has not done business with Huawei in years. But Chinese companies have found clever workarounds to get their hands on chips via underground markets. For this reason, America is likely to step up

global enforcement of its sanctions. The Biden administration has already dragged allies such as Japan, the Netherlands and South Korea into the fight, to the displeasure of companies in those countries. In 2024 it may expand that group, perhaps in places such as the Middle East, where Chinese firms are rumoured to be buying chips.

That may hamper Chinese firms' ability to create new high-tech products, from smartphones to the specialised systems needed to train artificial-intelligence models. But it will also sap the patience that America's friends have for its tech war. ■

DON WEINLAND, China business and finance editor, The Economist, Shanghai ■



世界展望2024

生成式人工智能将在2024年成为主流

精通数据的企业将首先受益

当新技术出现时，它们会在不同时间使不同群体受益。生成式AI（Generative AI）首先帮到了软件开发人员——他们从2021年起就可以使用能编写代码的AI助手GitHub Copilot。第二年出现了其他工具，如ChatGPT和DALL-E 2，它们可以让各种各样的消费者即刻生成文字和图片。

2023年，随着投资者对生成式AI的前景愈感兴奋，科技巨头获益了。Alphabet、亚马逊、苹果、Meta、微软和英伟达的同等权重股价指数增长了近80%（见图表）。科技公司会受益，是因为它们要么供应了这类AI模型本身，要么提供了驱动和支持这些模型的基础设施。

在2024年，最大的受益者将是科技行业以外的公司，它们会认真采用AI以期降低成本并提高生产率。预期企业会开始大量采用该技术的理由有三。

首先，大公司在2023年已经花了很多时间在试用生成式AI。许多公司现在用它生成从法律合同到营销材料的文本初稿。摩根大通使用该技术分析了美联储会议内容，尝试为其交易部门收集信息。

随着实验阶段逐步结束，企业正计划更大规模地部署生成式AI。这可能意味着用它来总结会议录音或加强研发。毕马威会计师事务所（KPMG）的一项调查发现，五分之四的公司表示计划到2024年中期将这方面投资增加50%以上。

其次，更多的AI产品将上市。2023年末，微软推出了一款AI聊天机器人来辅助其生产力软件（如Word和Excel）用户。它也为Windows操作系统推出了同样的产品。谷歌也将效仿，将AI嵌入谷歌文档和表格中。创业公司也将蜂拥挤入。2023年，风险资本投资者向生成式AI投入超过360亿美

元，是2022年的两倍多。

第三个原因是人才。对AI专家的需求仍然很大。研究公司PredictLeads表示，标准普尔500强公司中，约三分之二的公司发布了提及AI的招聘广告。而就这些公司而言，它们的广告目前有5%提到该技术，高于过去三年的平均2.5%。但这个吃紧的人才市场正在放松。咨询公司麦肯锡的一项调查发现，在2023年，企业表示招聘AI相关职位变得容易了些。

哪些公司将成为早期采用者？较小的公司可能会跑在前面。这就是在智能手机和计算云等之前的技术浪潮中发生的情况。小鱼小虾通常更加灵活，并将技术视为获得相对于大鱼的优势的一个途径。

在较大的公司中，那些以数据为中心的公司（如医疗和金融服务公司）将能够采取最快的行动。这是因为数据管理不善是部署AI的一大风险。企业主管们担心有价值的数据会通过AI工具泄露出去。缺乏可靠的数据管理的公司可能必须首先重组其系统，然后才能切实部署生成式AI。使用这项技术可能让人感觉身处科幻世界，但让它安全地工作却是一项乏味得多的事务。

《经济学人》美国技术编辑盖伊·斯克瑞文 ■



The World Ahead 2024

Generative AI will go mainstream in 2024

Data-savvy firms will benefit first

WHEN NEW technologies emerge they benefit different groups at different times. Generative artificial intelligence (AI) first helped software developers, who could use GitHub Copilot, a code-writing AI assistant, from 2021. The next year came other tools, such as ChatGPT and DALL-E 2, which let all manner of consumers instantly produce words and pictures.

In 2023 tech giants gained, as investors grew more excited about the prospects of generative AI. An equally weighted share-price index of Alphabet, Amazon, Apple, Meta, Microsoft and Nvidia grew by nearly 80% (see chart). Tech firms benefited because they supply either the AI models themselves, or the infrastructure that powers and delivers them.

In 2024 the big beneficiaries will be companies outside the technology sector, as they adopt AI in earnest with the aim of cutting costs and boosting productivity. There are three reasons to expect enterprise adoption to take off.

First, large companies spent much of 2023 experimenting with generative AI. Plenty of firms are using it to write the first drafts of documents, from legal contracts to marketing material. JPMorgan Chase, a bank, used the technology to analyse Federal Reserve meetings to try to glean insights for its trading desk.

As the experimental phase winds down, firms are planning to deploy generative AI on a larger scale. That could mean using it to summarise recordings of meetings or supercharging research and development. A survey by KPMG, an audit firm, found that four-fifths of firms said they

planned to increase their investment in it by over 50% by the middle of 2024.

Second, more AI products will hit the market. In late 2023 Microsoft rolled out an AI chatbot to assist users of its productivity software, such as Word and Excel. It launched the same thing for its Windows operating system. Google will follow suit, injecting AI into Google Docs and Sheets. Startups will pile in, too. In 2023 venture-capital investors poured over \$36bn into generative AI, more than twice as much as in 2022.

The third reason is talent. AI gurus are still in high demand. PredictLeads, a research firm, says about two-thirds of S&P 500 firms have posted job adverts mentioning AI. For those companies, 5% of adverts now mention the technology, up from an average of 2.5% over the past three years. But the market is easing. A survey by McKinsey, a consultancy, found that in 2023 firms said it was getting easier to hire for AI-related roles.

Which firms will be the early adopters? Smaller ones will probably take the lead. That is what happened in previous waves of technology such as smartphones and the cloud. Tiddlers are usually more nimble and see technology as a way to gain an edge over bigger fish.

Among larger companies, data-centric firms, like those in health care and financial services, will be able to move fastest. That is because poor data management is a big risk for deploying AI. Managers worry about valuable data leaking out through AI tools. Firms without solid data management may have to reorganise their systems before it is feasible to deploy generative AI. Using the technology can feel like science fiction, but getting it to work safely is a much more humdrum affair. ■

GUY SCRIVEN, US technology editor, The Economist ■



世界展望2024

人工智能将改变好莱坞叙事的方方面面

但也会造成更多的摩擦

重聚提供了一个机会，让人们反思发生了多大的变化。明年好莱坞的一次机会是《这里》（Here）的首映，《阿甘正传》的演员、导演和编剧在40年后将齐聚一堂，打造一部不相关的新电影。《这里》的故事发生在一个房间里，时间跨度长达数十年，基本上就是一部“此时此地”的电影。主演汤姆·汉克斯和罗宾·怀特将使用新的人工智能（AI）工具来“减龄”，使他们在某些场景中变得更加年轻，并让电影制作人能够在拍摄过程中实时看到容颜转变。

现在，生成式AI意味着可以在几秒钟内生成图像。歌曲可以按照已故或在世歌手的风格来创作。亚马逊上有超过3000本书将ChatGPT列为作者或共同作者，这为“捉刀人”或“影子写手”一词赋予了新的含义。

现在也许还为时过早，但2024年将是未来的预演。有三件事值得关注。首先是利用AI讲述新型故事，因为讲故事会变得更加个性化和互动化。电影会改变，游戏也会改变——在游戏里，人们比电影观众更容易选择自己的冒险经历。可提供的娱乐的数量也将激增。

就像互联网的到来导致社交媒体和YouTube上发布的“用户生成内容”激增一样，生成式AI也将促使视频和其他资料在网上激增。有人预测，到2025年，多达90%的网络内容将由AI生成。内容管理和良好的搜索工具将至关重要，而关于是否以及如何标记AI生成内容的问题也将引起争论。

没有人确切知道叙事的性质会发生怎样的变化，但它肯定会变化。电影历史学家大卫·汤姆森（David Thomson）将生成式AI比作有声电影的出现。当电影不再无声时，它改变了情节转折点的表现方式，也改变了观众与角色的共情深度。克里斯托巴尔·巴伦苏埃拉（Cristóbal Valenzuela）经营的RunwayML公司为创意人士提供AI增强软件工具。他表示AI更像是一种“新

型摄影机”，提供了全新的“重新想象故事的机会”。这两位说的都是对的。

好莱坞编剧的罢工让AI是否会开始制作剧本成为人们关注的焦点。目前，电影公司已同意做出让步，不会绕过编剧室而改用ChatGPT。要完全由AI制作一部长篇大片，可能还需要几年的时间。

真正应关注的第二个重大发展是如何将AI用作节省时间的工具。生成式AI将自动化和简化配音、剪辑、特效和背景设计等复杂任务。要想一窥未来，请看看2023年获得奥斯卡最佳影片奖的《瞬息全宇宙》吧。其中有一个场景使用了RunwayML提供的“动态遮罩”工具来剪掉绿幕背景，让一块会说话的石头更加真实可信。它将原本可能需要数天时间的视频剪辑压缩到几个小时。

第三件值得关注的事，是创作者（也称版权所有者）与AI平台运营者之间的冲突变得更激烈。未来一年，作家、音乐家、演员和艺术家很可能会提起大量诉讼，控告他们的文字、音乐和图像在未经同意或未支付报酬的情况下被用于训练AI系统。也许他们可以达成某种许可安排，让AI公司开始向版权所有者就用于训练模型的内容付费。但是，不经过激烈的法律斗争，这种情况是不会发生的。

AI也带来了关于故事的未来和集体叙事的性质的最大问题。例如，生成式AI会不会只是简单地模仿以前的热门作品，从而产生更多缺乏深度的衍生大片和山寨版流行歌曲，而不是原创故事和艺术形式？当娱乐变得更加个性化时，是否还会有故事成为人类集体意识的一部分，感动大批人，成为他们共同的谈资？

随着创作者努力应付AI的崛起，他们会把对技术的焦虑输出到他们的作品中。等着看更多的人类与机器之间发生“终结者”式冲突的故事吧。生活模仿艺术——艺术也模仿生活。

《经济学人》文化编辑亚历山德拉·苏伊奇·巴斯 ■



The World Ahead 2024

AI will transform every aspect of Hollywood storytelling

But it will also cause more friction

REUNIONS OFFER a chance to reflect on how much has changed. One will happen during the coming year in Hollywood when “Here” premieres, bringing together the actors, director and writer behind “Forrest Gump” 40 years later for a new, unrelated film. Set in a single room over decades, “Here” is very much a film of the here and now. The stars, Tom Hanks and Robin Wright, will be “de-aged” using new AI tools, rendering them more youthful in some scenes and enabling the film-makers to see the transformation in real time while shooting.

Generative AI now means images can be produced in seconds. Songs can be created in the style of singers dead or alive. More than 3,000 books on Amazon name ChatGPT as the author or co-author, lending new meaning to the term “ghostwriter”.

It is still early days, but 2024 will be a preview of what is to come. Three things are worth watching. The first is how AI will be used to tell new types of stories, as storytelling becomes more personalised and interactive. Films will change and so will gaming, an industry where people can choose their own adventures more easily than moviegoers can. The amount of entertainment available will also balloon.

Like the arrival of the internet, which led to an explosion of “user-generated content” being posted to social media and YouTube, generative AI will contribute to reams of videos and other material proliferating online. Some predict that as much as 90% of online content will be AI-generated by 2025. Curation and good search tools will be vital, and there will be debates about

whether, and how, to label AI-generated content.

No one is quite sure how the nature of storytelling will change, but it is sure to. David Thomson, a film historian, compares generative AI to the advent of sound. When movies were no longer silent, it altered the way plot points were rendered and how deeply viewers could connect with characters. Cristóbal Valenzuela, who runs a company called RunwayML, which offers AI-enhanced software tools to creative types, says AI is more like a “new kind of camera”, offering a fresh “opportunity to reimagine what stories are like”. Both are right.

The Hollywood writers’ strike shone a spotlight on the question of whether AI would start producing scripts. For now, studios have agreed to concessions and will not bypass writers’ rooms to employ ChatGPT instead. It will probably be a few years before a full-length blockbuster is produced entirely by AI.

Instead, the second big development to watch is how AI will be used as a time-saving tool. Generative AI will automate and simplify complex tasks like dubbing, film-editing, special effects and background design. For a glimpse of the future, watch “Everything Everywhere All at Once”, which won the Academy Award for Best Picture in 2023. It featured a scene that used a “rotoscoping” tool offered by RunwayML to edit out the green-screen background and make a talking rock more believable. It compressed into hours what might have otherwise taken days of video-editing.

The third thing to watch for is more dramatic clashes between creators (otherwise known as copyright-owners) and those who run AI platforms. The coming year is likely to bring a deluge of lawsuits from authors, musicians, actors and artists about how their words, music and images have been used to train AI systems without consent or payment. Perhaps they can agree on some sort of licensing arrangement, in which AI companies start

paying copyright-holders for content to train their models. But that will not happen without an intense legal brawl.

AI presents bigger questions about the future of stories and the nature of collective storytelling. For example, will generative AI simply imitate previous hits, resulting in more derivative blockbuster films and copycat interpretations of pop songs that lack depth, rather than original stories and art forms? And as entertainment becomes more personalised, will there still be stories that become part of humanity's collective consciousness and move large numbers of people, who can talk about them together?

As creators grapple with AI's rise, they will channel their anxieties about technology into their work. Look out for more "Terminator"-style clashes between man and machine. Life imitates art—and art life. ■

ALEXANDRA SUICH BASS, Culture editor, The Economist ■



世界展望2024

AI模型将变得更小更快

它们也会在其他许多方面取得进步

在2023年，人们对人工智能（AI）的兴趣近乎白热化。在OpenAI于2022年11月推出互联网上最有名、效果最好的聊天机器人ChatGPT后的六个月里，“人工智能”话题在谷歌搜索引擎上的流行度几乎翻了两番。到2023年8月，麦肯锡最近一次全球调查的受访者中有三分之一表示，他们所在的机构在至少一种职能中使用生成式AI。

在2024年，这项技术将如何发展？研究员正从三大维度改进AI模型：规模、数据和应用。

先看规模。过去几年里，AI研究中公认的信条是“大即好”。计算机在变得更强大的同时尺寸变小了，但大型语言模型（LLM）却不是这样，这种模型的大小以几十亿或几万亿个“参数”论。据研究公司SemiAnalysis称，ChatGPT豪华版背后的LLM GPT-4需要用到超过16,000个专用GPU芯片，花费好几周训练，成本超过1亿美元。据芯片制造商英伟达（Nvidia）称，如今，当以任何尚够用的规模部署LLM时，推理成本（让经过训练的模型响应用户查询的成本）都超过了训练成本。

随着AI模型转变为商业化日用品，人们越来越关注如何能把它们变得更小、更快而不折损性能。一种方法是用更多的训练数据来训练更小的模型。例如，谷歌DeepMind于2022年开发的LLM“龙猫”（Chinchilla）的性能优于OpenAI的GPT-3，尽管其大小仅为GPT-3的四分之一（它接受了四倍的数据训练）。另一种方法是降低模型包含的参数的数值精度。华盛顿大学的一个团队已经证明，有可能把“龙猫”大小的模型压缩到一个GPU芯片上，性能却不会明显下降。至关重要的是，小模型在日后运行时的成本要低得多。有些甚至可以在一台笔记本电脑或一部智能手机上运行。

然后是数据。AI模型这种预测机器接受的训练数据越多效果越好。但焦点

也在从“多少”转向“多好”。这一点尤其重要，因为找到更多训练数据变得越来越难：2022年的一项分析表明，新的高质量文本库存可能会在未来几年内耗尽。使用模型的输出来训练未来模型可能会生成能力较差的模型，因此LLM的普遍采用使得互联网作为训练数据源的价值降低。但数量不代表一切。找出训练数据的正确组合仍然更像一门艺术而非科学。而模型正在越来越多地接受各种类型数据的组合的训练，它们包括自然语言、计算机代码、图像，甚至视频，这赋予了它们新的能力。

可能出现哪些新应用？AI存在“能力过剩”的问题，即它的发展速度快过人们能够利用它的速度。人们的注意力已经从展示它们的可能性转向弄清楚什么是实际可行的。最重要的进步将不在于模型本身的质量，而在于学习如何更有效地利用它们。

目前，使用模型的方式主要有三种。首先是“提示工程”，也就是按它们本来的用处，向它们输入特定的提示。需要精心设计输入的短语或问题来引导模型生成所需的输出。第二种是“微调”模型以提高其在特定任务中的性能。这涉及使用针对该任务定制的狭窄数据集，对已存在的模型进行一轮额外训练。例如，可以使用医学期刊中的论文微调一个LLM，使其能更好地回答健康相关问题。第三种是将LLM嵌入到更大、更强的架构中。LLM就如同一台发动机，而要让它在特定的应用中发挥作用，就需要围绕它构建汽车。

这方面的一个例子是“检索增强生成”，这是一种将LLM与额外的软件和特定主题知识数据库相结合的方法，以降低其给出错误回答的概率。当被提问时，该系统首先搜索其数据库。如果发现了相关的内容，就将问题连同这些事实信息一起传递给LLM，要求它根据所提供的信息来生成答案。以这种方式提供信息源意味着用户可以对答案的准确性更有信心。它也让LLM可以被个性化定制，就像谷歌的NotebookLM让用户可以提供自己的知识数据库。

在人们聚焦于AI的商业潜力之际，对通用人工智能的探索也在继续。LLM和其他形式的生成式AI可能是拼图中的一块，或前进中的一步，而可能不

是最终的答案。正如斯坦福大学的克里斯·曼宁（Chris Manning）所说：“没有理由相信……这就是终极的神经架构，而我们永远找不到更好的了。”

《经济学人》科学记者艾比·伯提斯 ■



The World Ahead 2024

AI models will become smaller and faster

They will improve in plenty of other ways, too

INTEREST IN artificial intelligence (AI) reached fever pitch in 2023. In the six months after OpenAI's launch in November 2022 of ChatGPT, the internet's most famed and effective chatbot, the topic "artificial intelligence" nearly quadrupled in popularity on Google's search engine. By August 2023, one third of respondents to the latest McKinsey Global Survey said their organisations were using generative AI in at least one capacity.

How will the technology develop in 2024? There are three main dimensions on which researchers are improving AI models: size, data and applications.

Start with size. For the past few years, the accepted dogma of AI research has been that bigger means better. Although computers have got smaller even as they have become more powerful, that is not true of large language models (LLMs), the size of which is measured in billions or trillions of "parameters". According to SemiAnalysis, a research firm, GPT-4, the LLM which powers the deluxe version of ChatGPT, required more than 16,000 specialised GPU chips and took multiple weeks to train, at a cost of more than \$100m. According to Nvidia, a chipmaker, inference costs—getting the trained models to respond to users' queries—now exceed training costs when deploying an LLM at any reasonable scale.

As AI models transition to being commercial commodities there is a growing focus on maintaining performance while making them smaller and faster. One way to do so is to train a smaller model using more training data. For instance, "Chinchilla", an LLM developed in 2022 by Google DeepMind, outperforms OpenAI's GPT-3, despite being a quarter of the size (it was

trained on four times the data). Another approach is to reduce the numerical precision of the parameters that a model comprises. A team at the University of Washington has shown that it is possible to squeeze a model the size of Chinchilla onto one GPU chip, without a marked dip in performance. Small models, crucially, are much less expensive to run later on. Some can even run on a laptop or smartphone.

Next, data. AI models are prediction machines that become more effective when they are trained on more data. But focus is also shifting from “how much” to “how good”. This is especially relevant because it is getting harder to find more training data: an analysis in 2022 suggested that stocks of new, high-quality text might dry up in the next few years. Using the outputs of the models to train future models may lead to less capable models—so the adoption of LLMs makes the internet less valuable as a source of training data. But quantity isn’t everything. Figuring out the right mix of training data is still much more of an art than a science. And models are increasingly being trained on combinations of data types, including natural language, computer code, images and even videos, which gives them new capabilities.

What new applications might emerge? There is some “overhang” when it comes to AI, meaning that it has advanced more quickly than people have been able to take advantage of it. Showing what is possible has turned into figuring out what is practical. The most consequential advances will not be in the quality of the models themselves, but in learning how to use them more effectively.

At present, there are three main ways to use models. The first, “prompt engineering”, takes them as they are and feeds them specific prompts. This method involves crafting input phrases or questions to guide the model to produce desired outputs. The second is to “fine-tune” a model to improve its performance at a specific task. This involves giving a pre-existing model an extra round of training using a narrow dataset tailored to that task. For

instance, an LLM could be fine-tuned using papers from medical journals to make it better at answering health-related questions. The third approach is to embed LLMs in a larger, more powerful architecture. An LLM is like an engine, and to make use of it for a particular application, you need to build the car around it.

One example of this is “retrieval augmented generation”, a technique that combines an LLM with extra software and a database of knowledge on a particular topic to make it less likely to spit out falsehoods. When asked a question, the system first searches through its database. If it finds something relevant, it then passes the question, along with the factual information, to the LLM, requesting that the answer be generated from the information supplied. Providing sources in this way means users can be more confident of the accuracy of responses. It also allows the LLM to be personalised, like Google’s NotebookLM, which lets users supply their own databases of knowledge.

Amid all the focus on AI’s commercial potential, the hunt for artificial general intelligence continues. LLMs and other forms of generative AI may be a piece in the puzzle, or a step on the way, but they are probably not the final answer. As Chris Manning of Stanford University puts it: there is “no reason to believe...that this is the ultimate neural architecture, and we will never find anything better.” ■

ABBY BERTICS, Science correspondent, The Economist ■



世界展望2024

2024年值得关注的指标，从太阳能电池到超级英雄电影

有些只是好玩，而另一些则有可能改变世界

有时，跟踪趋势的最好方法是将其绘制在图表上。以下是2024年一系列值得注意的指标，从太阳能电池技术到超级英雄电影等等。有些只是好玩，而另一些则有可能改变世界。

在过去十年中，将物体发射到太空的成本大幅下降，这是马斯克创立的火箭发射公司SpaceX开发可重复使用火箭的直接结果。它的“猎鹰9号”火箭有一个可重复使用的助推器级，它可以在进入轨道的途中将有效载荷送入轨道，然后返回地球并在陆地或无人机船上着陆。这种做法没有扔掉耗资数千万美元的助推器，而是重复使用多达15次，从而降低了发射成本。如今SpaceX送入轨道的物体比世界其他地区的总和还要多。但是，如果两枚新火箭在2024年成功发射，发射成本可能很快就会进一步下降。第一个是SpaceX的“星舰”，这是有史以来最大的火箭，它可完全重复使用，能携带多达150吨的重量进入轨道，是“猎鹰9号”的十倍。但也要关注“中子号”（Neutron），这是来自竞争对手创业公司火箭实验室（Rocket Lab）的新型可重复使用火箭。它的目标是每千克成本能与“猎鹰9号”竞争，但有效载荷较小。要在太空中开辟新的机会，必须有去有回、有起有落——说的是价格。

ChatGPT在2022年11月推出后的两个月内吸引了1亿用户，但用户访问量在2023年年中达到顶峰，此后趋于平稳。这可能表明对聊天机器人的热情总体上正在减弱。或者它可能只是表明用户变得更加挑剔，并已转向其他更适合特定任务的聊天机器人。另一种可能性是，年中的下降是学校假期的结果：看看这些数字是否会在2023年底再次上升吧。

大多数光伏电池由硅制成，将太阳光转化为电能的效率约为23%。钙钛矿电池在特定的晶体结构中使用其他元素，成本更高，但效率更高：超过

25%；当与硅结合制成“串联”电池时，效率超过30%。所以额外的成本或许是值得的，尤其是在空间紧张的情况下。美国、英国、韩国和瑞典的公司计划在2024年开始销售钙钛矿电池。

根据国际能源署（IEA）的数据，太阳能和风能等可再生能源将很快超越燃煤发电站，成为世界上最大的电力来源。但这会在什么时候发生呢？国际能源署此前曾说它将在2025年发生，但现在认为，“由于可再生能源新增速度加快”和“煤炭发电进入平台期”，这有可能在2024年发生。乌克兰战争加速了欧洲可再生能源的采用：欧盟国家在2022年增加了41吉瓦的太阳能装机容量，预计2023年将增加超过50吉瓦。中国在2022年增加了107吉瓦的太阳能装机容量，大致相当于美国现有的全部装机容量，预计在2023年将增加两个美国的太阳能装机容量。与此同时，2022年煤炭发电使用量增长了1.7%，原因是天然气价格高企促使天然气转煤。但预计2023年和2024年欧洲和美国的煤炭使用量将大幅下降，远远抵消亚洲的轻微增长。

超级英雄可能遇到了对手了——说的是在票房上。2023年，超级英雄电影的风头被《芭比娃娃》和《奥本海默》盖过，前者的塑料娃娃女主角用频繁更换的服装而不是超能力与父权作斗争，后者是一部非超级（但非常聪明的）人类的传记片。业界纷纷猜测，观众对漫威及其模仿者无休止的超级英雄电影的胃口是否已经减退。2024年看来将上演一场大对决，届时上映的超级英雄电影将包括《美国队长：美丽新世界》、《死侍3》和两部蜘蛛侠衍生作品《亡灵》（El Muerto）和《蜘蛛夫人》（Madame Web）。它们面对的是奉俊昊的《寄生虫》续集《米奇17》；卢卡·瓜达尼诺（Luca Guadagnino）的网球题材正剧《挑战者》；改编自科琳·胡佛（Colleen Hoover）小说的《以我们结束》（It Ends with Us）；以及雷德利·斯科特（Ridley Scott）2000年史诗的续集《角斗士2》。让战斗开始吧。

根据国际咖啡组织的数据，咖啡的消费量现在超过了产量。这一缺口在2024年可能会扩大：2023年底巴西的极端天气可能会减少阿拉比卡咖啡豆的收成，而厄尔尼诺现象可能会压低印度尼西亚的罗布斯塔咖啡豆的产

量。随着地球变暖，咖啡生产商可能需要考虑在新的地区种植咖啡，并鼓励咖啡饮用者接受第三个更为耐热的品种“大果咖啡”（liberica）。

2024年可能是没有野生脊髓灰质炎的第一年。巴基斯坦和阿富汗是最后两个流行这种病的国家。病例数有所减少（上图显示了病例数，而单位不是千或百万），并且仅限于较小的地理区域。根除计划很有可能在未来几个月内消灭野生脊灰病毒。重点正在转向消除这种疾病的一个新形式，即疫苗衍生脊髓灰质炎，其发病数正在上升。

五年前，无人驾驶出租车的计划被炒得沸沸扬扬，但由于消除技术缺陷的难度超出预期，该计划被推迟和缩减。但自那以后，技术悄然取得了进展，发生“干预”（需要安全驾驶员做出干预的错误）的行驶里程间距普遍拉大，商业推广也打入更多城市，2024年还会有新的进展。但根据君迪（J.D. Power）的调查，美国人对无人车的信任度在2023年连续第二年下降。不过，那些已经乘坐过无人车的人群的态度更为积极。2024年的问题是：无人出租车进步的速度是否能快过人们对其看法恶化的速度？

一场利用量子物理那诡异而反直觉的定律来制造新型计算机的竞赛正在上演。在某些任务中，量子计算机的性能可能会超过任何非量子计算机，在密码学、化学和金融领域的计算中大显身手。但是，一台实用的机器何时才能出现呢？

衡量量子计算机能力的一个指标是其量子比特（quantum bits或qubits）的数量。但是，现有的机器以各种不同的方式实现量子比特，都有一个致命的缺陷：它们所依赖的微妙的量子态会在几分之一秒后“退相干”。

更好的衡量标准可能是所谓的“量子体积”（QV），它取决于计算机的“宽度”（量子比特数）和“深度”（它们在退相干之前可以执行的操作数）。一台具有14个量子比特且能够执行14次操作的计算机的QV为 2^{14} ，即16,384。

已实现的最大QV值正在稳步上升，但执行有用操作（而不仅仅是小规模测试）所需的体积仍不明确。该领域的领军企业IBM已将自己的QV目标设

定为2的100次方。就像人工智能在突然取得辉煌成功之前令人失望了几十年一样，量子计算很可能会很快从无用变为无处不在——只要研究人员弄清楚如何提高量子体积。

在经历了2010年代的平静之后，尤其是在撒哈拉以南的非洲，政变卷土重来。过去三年里发生过政变的国家可以完全从红海连接到大西洋。自2021年以来，18次尝试的政变中有9次获得成功。政变的发生往往有两个原因：一是安全局势崩溃，如尼日尔和马里，将军们声称要恢复秩序；二是不受欢迎的领导人难以为继，如加蓬。

萨赫勒地区的不稳定没有缓解的迹象，因此有可能发生更多政变。但会发生在哪呢？研究公司BMI的分析师认为，南苏丹的风险最大，其次是中非共和国，因为该国大部分地区已不再受政府控制。尼日利亚公司SBM Intelligence认为刚果民主共和国的风险最高。还要关注赤道几内亚，它由现年81岁的特奥多罗·奥比昂·恩圭马·姆巴索戈统治，他是非洲在位时间最长的领导人。继任危机可能引发政变。

向电动汽车（EV）的转变重塑了汽车行业。在许多方面，电动汽车更像车轮上的智能手机而不是内燃机汽车；它们包含的运动部件更少，机械复杂程度也低得多。擅长制造发动机和变速箱的现有制造商已经失去了竞争优势。中国制造商发现了这一商机并蜂拥而入。

在电动汽车需求的推动下，中国将在2024年的某个时候超过德国和日本，成为世界上最大的汽车出口国。诚然，中国的汽车出口包括美国的特斯拉公司在其中国工厂生产的大量汽车。但全球最大的电动汽车制造商特斯拉将被中国公司比亚迪超越，后者将在中国和全球都售出更多汽车。

由《经济学人》的吉利德·阿米特、雷切尔·劳埃德、乔纳森·罗森塔尔、汤姆·斯坦迪奇、普拉蒂巴·塔克和克里斯托弗·威尔逊编写 ■



The World Ahead 2024

Metrics to keep an eye on in 2024, from solar cells to superhero movies

Some are merely fun—while others are potentially world-changing

SOMETIMES THE best way to follow a trend is to plot it on a chart. Here is a selection of noteworthy metrics that are worth keeping an eye on in 2024, from solar-cell technology to superhero movies. Some are merely fun—while others are potentially world-changing.

The cost of launching things into space has plunged over the past decade, a direct consequence of the development of reusable rockets by SpaceX, the rocket-launch company founded by Elon Musk. Its Falcon 9 rocket has a reusable booster stage, which can send a payload on its way to orbit and then return to Earth, touching down either on land or on a drone ship. Not throwing away the booster, which costs tens of millions of dollars, but instead reusing it up to 15 times, has slashed launch costs, and SpaceX now carries more to orbit than the rest of the world combined. But launch costs could soon fall even further, if two new rockets make successful flights in 2024. The first is SpaceX's Starship, the largest rocket ever built, which is fully reusable and can carry as much as 150 tonnes into orbit, ten times more than Falcon 9. But keep an eye, too, on Neutron, a new reusable rocket from Rocket Lab, a rival startup. It aims to be competitive on a cost-per-kilogram basis with the Falcon 9, but for smaller payloads. To open up new opportunities in space, what goes up must come down—in price.

ChatGPT attracted 100m users within two months of its launch in November 2022, but user visits peaked in mid-2023 and have since levelled off. This may indicate flagging enthusiasm for chatbots in general. Or it may just signal that users have become more discerning, and have switched to other chatbots that are better suited to particular tasks. Another possibility is that

the mid-year decline is the result of school holidays: watch to see if the numbers tick up again in late 2023.

Most photovoltaic cells are made of silicon, and convert sunlight to electricity with an efficiency of about 23%. Perovskite cells, which use other elements in a particular crystal structure, cost more but offer higher efficiency: over 25%, and over 30% when combined in a “tandem” cell with silicon. So the extra expense can be worth it, particularly in situations where space is tight. Firms in America, Britain, South Korea and Sweden aim to start selling perovskite cells in 2024.

Renewable supplies of energy, such as solar and wind power, will soon overtake coal-fired power stations to become the world’s largest single source of electricity, according to the International Energy Agency (IEA). But when? Having previously said it would be in 2025, the IEA now thinks it could happen in 2024, “as a result of the accelerated pace of renewable capacity additions” and “the plateauing of electricity generation from coal”. Adoption of renewables in Europe has been accelerated by the war in Ukraine: EU countries added 41 gigawatts (GW) of solar capacity in 2022, and are expected to add more than 50GW in 2023. China added 107GW of solar capacity in 2022, roughly equivalent to all existing capacity in America, and is expected to have added two Americas’ worth of solar capacity in 2023. Meanwhile, use of coal for generation rose by 1.7% in 2022, as high natural-gas prices prompted gas-to-coal switching. But use of coal in Europe and America in 2023 and 2024 is predicted to drop sharply, more than offsetting a slight increase in Asia.

Superheroes may have met their match—at the box-office, that is. In 2023 superhero films were overshadowed by “Barbie”, whose plastic heroine battled the patriarchy with frequent wardrobe changes, rather than superhuman powers, and “Oppenheimer”, a biopic of an non-super (but very clever) human. Much speculation ensued about whether the appetite

for endless superhero flicks from Marvel, and its imitators, had cooled. The scene is thus set for a showdown in 2024, when superhero releases include “Captain America: Brave New World”, “Deadpool 3” and two Spider-Man spin-offs, “El Muerto” and “Madame Web”. They face off against “Mickey 17”, Bong Joon Ho’s follow-up to “Parasite”; “Challengers”, Luca Guadagnino’s tennis drama; “It Ends with Us”, based on Colleen Hoover’s book; and “Gladiator 2”, Ridley Scott’s follow-up to his epic of 2000. Let battle commence.

Consumption of coffee is now outstripping production, according to the International Coffee Organisation. The gap could widen in 2024: extreme weather in Brazil in late 2023 may reduce harvests of arabica beans, while El Niño threatens to depress yields of robusta beans in Indonesia. Coffee producers may need to consider cultivation in new areas as the planet warms, and encourage coffee-drinkers to embrace a third species, called liberica, which is more heat-tolerant.

2024 could be the first year without wild polio. Pakistan and Afghanistan are the last countries where the disease is endemic. Cases have dwindled (the chart shows the number of cases, not thousands or millions) and are limited to small geographical areas. Eradication programmes have a good chance of eliminating the wild virus in the coming months. The focus is shifting towards eliminating a new form of the disease, vaccine-derived polio, which is on the rise.

After much hype five years ago, plans for self-driving robotaxis were delayed and scaled back, as ironing out the bugs from the technology proved harder than expected. But they have since made quiet progress, with the distance between “disengagements” (mistakes requiring intervention by a safety driver) ticking up across the industry, and commercial roll-outs in more cities. More will follow in 2024. But Americans’ trust in self-driving cars fell for the second year running in 2023, according to a survey by J.D. Power.

People who have ridden in one, however, were more positive. The question for 2024 is: can robotaxis get better more quickly than perceptions of them get worse?

A race is under way to harness the spooky, counter-intuitive laws of quantum physics to build a new kind of computer. For some tasks a quantum computer could outperform any non-quantum machine that could ever be built, blazing through calculations in cryptography, chemistry and finance. But when will a useful machine arrive?

One measure of a quantum computer's capability is its number of quantum bits, or qubits. But existing machines, which implement qubits in various different ways, all have a fatal flaw: the delicate quantum states on which they depend "decohere" after a fraction of a second.

A better measure may be so-called "quantum volume" (QV), which depends on the "width" of a computer (its number of qubits) and its "depth" (the number of operations they can perform before decohering). A computer with 14 qubits that is able to execute 14 operations is said to have a QV of 2 to the power of 14, or 16,384.

The maximum QV achieved is rising steadily, but the volume needed to perform useful operations, not just small-scale tests, remains unclear. IBM, a leader in the field, has set itself a QV target of 2 to the power of 100. Like artificial intelligence, which disappointed for decades before its sudden, spectacular success, quantum computing is likely to go from useless to ubiquitous very quickly—just as soon as researchers figure out how to turn up the volume.

Coups are back, and in sub-Saharan Africa in particular, after a lull in the 2010s. You can walk from the Red Sea to the Atlantic entirely within countries that have had coups in the past three years. Of 18 attempted coups

since 2021, nine have succeeded. Coups tend to occur for one of two reasons: either a collapse of security, as in Niger and Mali, where generals claimed to be restoring order; or when an unpopular leader outstays his welcome, as in Gabon.

Instability in the Sahel shows no sign of abating, so further coups are possible. But where? Analysts at BMI, a research firm, reckon South Sudan is at most risk, followed by the Central African Republic, much of which is no longer under government control. SBM Intelligence, a Nigerian firm, reckons the chances are highest in the Democratic Republic of Congo. And keep an eye on Equatorial Guinea, which is ruled by Africa's longest-standing leader, Teodoro Obiang Nguema Mbasogo, now 81 years old. A succession crisis could trigger a coup.

The switch to electric vehicles (EVs) has reshaped the car industry. In many ways, EVs have more in common with smartphones on wheels than they do with combustion-engine vehicles; they contain fewer moving parts and are mechanically much less complex. Incumbent manufacturers, which excel at building engines and gearboxes, have lost their competitive advantage. Chinese manufacturers spotted an opening—and have charged into it.

Some time in 2024 China will overtake Germany and Japan to become the world's largest car exporter, driven by demand for EVs. Admittedly, Chinese car exports include a lot of vehicles made by Tesla, an American firm, in its Chinese factory. But Tesla, the world's biggest maker of EVs, will be overtaken by BYD, a Chinese firm, which will sell more vehicles, both within China and globally.

Compiled and written by GILEAD AMIT, RACHEL LLOYD, JONATHAN ROSENTHAL, TOM STANDAGE, PRATIBHA THAKER and CHRISTOPHER WILSON, The Economist



世界展望2024

对“绿色”金属的需求将重新绘制全球矿业版图

能源转型将在令人意想不到的地方创造新的财富

如果全球净零经济成为现实，那么它将不仅仅是碳中和的。它消耗的原材料也将大幅减少。然而，实现这一目标将需要很多原材料。在接下来的几十年里，供应它们将创造新的财富。

迈向清洁能源系统的地球仍然需要肮脏的燃料。即使石油消费达到顶峰，能够以低成本生产优质原油的国家也会增强实力而不是削弱，因为它们的市场份额和定价能力会同步上升。沙特阿拉伯和阿联酋等海湾大国将是明显的受益者。不太受关注的是小国圭亚那，该国最近的发现足以使其到2028年每天开采120万桶石油，占全球供应量的1.1%，这可能使其人均石油产量超过世界上任何国家。

天然气是化石燃料发电厂中煤炭的更清洁替代品，人们对天然气的需求可能会持续更长时间。随着欧洲逐渐摆脱对俄罗斯天然气的依赖，正在提高液化天然气产量的美国、澳大利亚和卡塔尔将把收益收入囊中。但阿根廷也可能如此。与此同时，到2050年，非洲国家在全球天然气市场的份额可能会翻一番。

地球建设新的低碳基础设施需要数十亿吨金属，出口这类金属或许可以赚取更持久的财富。智利和秘鲁已经供应了世界上大部分的铜；随着从电线到风力涡轮机等所有绿色产品的推出，对这种红色金属的需求将会提升，两国剩余的巨大储量将被利用起来。然而，老化的矿山中矿石的铜含量下降，这会提高成本，并将矿商推向风险更高的地域。加拿大公司巴里克黄金（Barrick Gold）公司希望投资70亿美元，在巴基斯坦和伊朗之间动荡的边境地区建设一个大型铜项目。

至于电动汽车电池中所用的钴，众所周知，刚果民主共和国是世界上最大的产地。不太为人所知的是，钴是提取其他矿物的副产品。近年来，这使

得印度尼西亚这个最大的镍（另一种电池金属）出口国也成了一个不断增长的大型钴供应国。顺便说一句，世界第四大镍生产国是新喀里多尼亞，这是一个位于太平洋的法国海外领地，有30万人口，拥有全球储量的7%。

说到电池金属之王锂，拉丁美洲、澳大利亚和中国看起来是明显的领导者（仅拉丁美洲就拥有60%的已知资源）。但它们可能会面临意想不到的竞争。今年3月，伊朗表示已发现可能是世界第二大矿床。澳大利亚公司大西洋锂业（Atlantic Lithium）正在开发加纳的第一个锂矿。9月，美国在内华达州和俄勒冈州的交界处发现了巨大的矿床。对“绿色”金属的需求将以难以预测的方式重新绘制全球采矿版图。

《经济学人》大宗商品编辑马蒂尤·法瓦斯 ■



The World Ahead 2024

Demand for “green” metals will redraw the global mining map

The energy transition will mint new fortunes in surprising places

A NET-ZERO GLOBAL economy, if it materialises, will not just be carbon-neutral. It will also consume far fewer raw materials. Going from here to there, however, will require a heap of them. In the next few decades, supplying them will create new fortunes.

A planet moving towards a cleaner energy system will still need dirty fuel. And even when oil consumption peaks, countries that can produce high-quality crude at low cost will be strengthened rather than weakened, as their market share and pricing power rise in tandem. Gulf giants such as Saudi Arabia and the UAE will be obvious beneficiaries. Less on the radar is tiny Guyana, where recent discoveries—enough for it to extract 1.2m barrels a day, or 1.1% of global supply, by 2028—could allow it to produce more oil per person than any country in the world.

Appetite for natural gas, a cleaner alternative to coal in fossil-fuel-fired power plants, may last longer still. As Europe has weaned itself off Russian gas, America, Australia and Qatar, which are cranking up output of the fuel in liquefied form, will pocket the proceeds. But so may Argentina. And African countries, meanwhile, could see their share of the global gas market double by 2050.

More durable riches may be earned through exporting the billions of tonnes of metal the planet needs to build new, low-carbon infrastructure. Chile and Peru already supply much of the world’s copper; their vast remaining reserves will be tapped as the roll-out of everything green, from wires to wind turbines, boosts demand for the red metal. Declining copper content

of ores in ageing mines is raising costs, however, and pushing miners to riskier frontiers. Barrick Gold, a Canadian firm, wants to invest \$7bn in a copper mega-project in the volatile borderlands between Pakistan and Iran.

The Democratic Republic of Congo is already well known as the world's biggest source of cobalt, used in electric-car batteries. Less well known is the fact that cobalt is a by-product of the extraction of other minerals. In recent years that has allowed Indonesia, the largest exporter of nickel, another battery metal, to become a big and growing supplier of cobalt as well. The world's fourth-largest producer of nickel, by the way, is New Caledonia, a French territory of 300,000 people in the Pacific that holds 7% of global reserves.

When it comes to lithium, the king of battery metals, Latin America, Australia and China look like the obvious champions (Latin America alone hosts 60% of known resources). But they may face unexpected competition. In March, Iran said it had discovered what may be the world's second-largest deposit. Atlantic Lithium, an Australian firm, is developing Ghana's first lithium mine. And in September a huge deposit was found in America, on the Nevada-Oregon border. Demand for "green" metals will redraw the global mining map in ways that are hard to predict. ■

MATTHIEU FAVAS, Commodities editor, The Economist ■



世界展望2024

全球平均气温可能在2024年突破阈值

厄尔尼诺的叠加效应

全球年平均气温何时将首次较工业化前水平上升超过 1.5°C ? 全球平均气温曾有个别日子超过了这一阈值, 但到目前为止, 平均而言还没有哪一年整体如此炎热。这在2024年可能会改变, 届时温室气体排放导致的持续了一个世纪的气温稳定攀升将在近十年来首次与自然周期性变暖模式同步。

气象机构收集来自全球各地的全年温度数据以确定全球年平均表面温度。这个在每年1月发布的数字自上世纪初以来不断上升, 但并不是系统有序的。这条线呈锯齿状(见图表)。这是因为由温室气体驱动的全球变暖与全球气候系统的自然变化同时发生, 导致某些年份比其他年份更热或更冷。

此类冷热循环中, 最大的一个是厄尔尼诺南方涛动(ENSO), 这一模式始于赤道太平洋水域及其上方, 影响热带地区及其他地区的天气。ENSO在三种状态之间交替: 拉尼娜、中性状态和厄尔尼诺。两个极端状态通常比平均水平更冷(拉尼娜)和更热(厄尔尼诺), 都会增加发生极端天气的概率。

从2020年中到2023年初, ENSO处于拉尼娜状态。这次异常漫长的拉尼娜现象加剧了一些重大天气事件, 包括2022年巴基斯坦破纪录的洪水, 还暂时降低了全球平均气温, 掩盖了工业排放造成的一部分变暖现象。2024年不会有这样的缓和效应了。2023年6月, ENSO已转变为姗姗来迟的厄尔尼诺状态, 这将加剧全球变暖。而预计这次厄尔尼诺将很强烈, 出现极端事件的可能性会更大。

上一次厄尔尼诺是在2015到2016年间, 它使得全球气温在2016年创下历史新高, 这一年度纪录保持至今。现在有两种可能性。厄尔尼诺是一种在年底时出现的现象, 它始于北半球夏季的后期, 在圣诞节和新年达到顶峰

（最初秘鲁的渔民以婴儿耶稣为其命名，他们注意到太平洋变暖的水温驱动凤尾鱼游向更深更冷的水域）。通常情况下，在厄尔尼诺发生后的翌年气温会打破纪录。但2023年的北半球夏季给海洋和大气都带来了严重的“高烧”。从7月开始，每日气温不断攀升新高。因此，当所有数据汇整并在2014年1月份发布时，可能会揭示2023年是有史以来最热的一年。如果不是的话，那么2024年几乎肯定会是了。

那么这两年的平均气温会超过巴黎门槛吗？巴黎协议讨论的气温上升是“高于工业化前水平”。何时超过阈值自然要取决于拿什么作为工业化前的平均值（现在测量温度的精度是蒸汽机问世前用于估计平均值的指标所无法达到的）。因此，一些人预测这将在2024年发生，另一些人预测可能需要再经历一轮厄尔尼诺周期。

不过，在严格达到超过1.5度的阈值之前，留给巴黎协议签署国的时间还要略多一点。该协议所指是一个模糊定义的长期均值，跨越数年。因此，在这个平均值超过阈值之前还会有几回起伏波动。不过也不会太多——气候模型显示这将在2030年代到头。

《经济学人》环境编辑凯瑟琳·布拉希克 ■



The World Ahead 2024

Global average temperatures may pass a threshold in 2024

El Niño won't help

WHEN WILL the annual global average temperature rise by more than 1.5°C above pre-industrial levels for the first time? There have been individual days when the global average temperature has exceeded that threshold, but so far no single year has, on average, been that hot overall. This may change in 2024, when the steady, century-long rise in temperatures driven by greenhouse-gas emissions syncs with a natural cyclical warming pattern for the first time in nearly a decade.

Meteorological agencies collect temperature data from across the globe and throughout the year to determine the annual average global surface temperature. That number, published each January, has been rising since early in the 20th century, but not systematically. The line zigzags (see chart). This is because global warming, driven by greenhouse gases, is happening at the same time as natural variations in the global climate system, which cause some years to be hotter or colder than others.

The largest such hot-and-cold cycle is the El Niño Southern Oscillation (ENSO), a pattern that begins in and above the waters of the equatorial Pacific and affects the weather in the tropics and beyond. ENSO alternates between three states: La Niña, neutral and El Niño. The two extremes are typically cooler (La Niña) and hotter (El Niño) than average; both bring enhanced probabilities of wild weather extremes.

From mid-2020 to early 2023, ENSO was in a La Niña pattern. As well as exacerbating some remarkable weather events, including record-breaking floods in Pakistan in 2022, this unusually long La Niña temporarily

depressed global average temperatures, masking some of the warming caused by industrial emissions. There will be no such reprieve in 2024. In June 2023, ENSO flipped into a much-anticipated El Niño state, which will add to global warming. And this El Niño is forecast to be a strong one, bringing a greater likelihood of extremes.

The last such event was in 2015-16. It brought record-breaking global temperatures in 2016, an annual record that still stands. There are two possibilities. El Niño is an end-of year phenomenon that starts in the later days of the boreal summer and peaks at Christmas and the new year (it was named after Baby Jesus by Peruvian fishermen who noticed the way its warmer Pacific temperatures chased anchovies into deeper, cooler waters). Typically, the year after an El Niño is the record-breaker. But the boreal summer of 2023 brought serious climate fevers in both the oceans and the atmosphere. Starting in July, daily temperatures rose to new heights. As a result, when all the data are in and published in January, it may turn out that 2023 was the hottest year ever. If it was not, then 2024 almost certainly will be.

So will either year's average exceed the Paris threshold? The Paris agreement talks of a rise in temperatures "above pre-industrial". Naturally, when the threshold is passed depends on what is used as the pre-industrial average (temperatures are now measured with a precision that is not available from the proxies used to estimate averages before the steam engine). So some predict it will happen in 2024, others that it could take one more El Niño cycle.

Paris signatories will, however, have a little longer before the overshoot of 1.5°C will technically have been reached. The deal refers to a vaguely defined long-term average, taken over several years. So there will be a few more ups and downs before that average exceeds the threshold. Not many, though—climate models suggest the game will be up in the 2030s. ■

CATHERINE BRAHIC, Environment editor, The Economist



世界展望2024

三种大宗商品可能在2024年起飞

市场已适应了乌克兰战争

在2023年的大部分时间里，大宗商品市场都停滞不前。新冠疫情造成的供应链混乱再加上俄罗斯入侵乌克兰，导致2022年原材料价格飙升。但低迷的经济前景又让繁忙的市场变得平淡。2023年末，随着油价上涨，一些兴奋情绪再次出现。但对需求的担忧使指数仍处于低位。

到了2024年，供应问题加上需求复苏可能会导致三个市场腾飞。首先是原油。大多数分析师认为，新的供应加上经济增长的缓慢会导致价格逐渐下降，从2023年9月的每桶90美元以上，降至2024年的每桶80美元或更低。但这可能会促使全球最大生产国沙特阿拉伯宣布比7月份实施的每日减产100万桶（相当于全球需求的1%）更大幅度的减产。伊朗的生产也可能因制裁或运输问题而受到影响。当经济恢复增长时，这可能会为轧空奠定基础。

一些金属市场看起来也很脆弱。钴和锂这两种在2022年受到所有人关注的绿色金属看起来供应充足。应该更关注铜。由于中国经济增长缓慢，2023年铜价下跌。所有金属市场中最热门的可能是铀的超利基市场。寻找稳定的低碳能源来源，加上乌克兰战争，使各国政府对核能更加渴望，而与此同时政变和冲突扰乱了铀生产。由于市场缺口依然存在，铀价已经达到十年来的最高水平，可能会进一步上涨。

第三个值得关注的领域是粮食市场。俄罗斯入侵乌克兰并没有对市场造成长期冲击：小麦价格在2022年3月为每蒲式耳12美元，到2023年秋季降到每蒲式耳5美元。但世界第五大谷物出口国乌克兰目前的出口量减少了35%。俄罗斯的丰收弥补了这一缺口，但恶劣的天气和不断升级的紧张局势可能会危及这一点。大型出口商的库存多年来一直在下降。抵御冲击的缓冲带很薄。

《经济学人》大宗商品编辑马蒂尤·法瓦斯 ■



The World Ahead 2024

Three commodities could take off in 2024

Markets have adjusted to the war in Ukraine

FOR MUCH of 2023 commodity markets were treading water. Russia's invasion of Ukraine, on top of supply-chain snarls from covid-19, had sent raw-material prices soaring in 2022. But a subdued economic outlook turned a busy market boring. Some excitement returned in late 2023, as oil prices perked up. But worries about demand kept indices on the floor.

In 2024 supply problems, together with resurgent demand, could cause three markets to take off. The first is crude oil. Most analysts reckon that new supply will combine with slow economic growth to cause a gradual decline in price, from more than \$90 in September 2023 to \$80 a barrel or less during 2024. But that could prompt Saudi Arabia, the world's biggest producer, to announce deeper output reductions than the 1m barrel-per-day cut—equivalent to 1% of global demand—it adopted in July. Iran's production may also be dented by sanctions or shipping problems. That could set the stage for a squeeze when economic growth returns.

Some metal markets also look vulnerable. Those for cobalt and lithium, two green metals on everyone's radar in 2022, look well supplied. Instead watch copper, prices for which fell during 2023 because of low Chinese growth. The hottest of all metal markets could be the ultra-niche one for uranium. The search for steady sources of low-carbon power and the war in Ukraine have made governments hungrier for atomic energy just as coups and conflicts have disrupted uranium production. Prices for the metal, already at their highest for a decade, could rise further as market deficits remain.

The third area to watch is the market for grain. Russia's invasion of Ukraine did not jolt the market for long: wheat prices, at \$12 a bushel in March 2022, hit \$5 in autumn 2023. But Ukraine, the world's fifth-biggest exporter of the grain, now exports 35% less. Bumper crops from Russia have made up the difference, but bad weather and escalating tensions could jeopardise that. Stocks at large exporters have been falling for years. Buffers against shocks are slim. ■

MATTHIEU FAVAS, Commodities editor, The Economist ■



世界展望2024

远程工作之争将在2024年升温

现实将摆在房东面前

新冠肺炎迫使办公室员工在自家的空房间和厨房餐桌上辛勤工作，引发了职场生活几十年来最大的转变。而且，和任何重大转变一样，其影响仍在通过公司等级制度和财务体系慢慢渗透。在2024年，对于员工、老板，还有房东来说，谜底将开始揭开。

在应该在哪里完成工作这个棘手的问题上，管理者和员工的看法并不很一致。学者研究团队WFH Research的一项调查显示，美国、英国和加拿大至少受过中学教育的全职工作者平均每周在家工作一天半。平均而言，他们希望把这一时长增加一倍。雇主们却有不同的想法。从华尔街巨头高盛到视频通话巨子Zoom，各行各业的公司都在要求它们不情不愿的员工更频繁地出现在办公室里。

没人预期或哪怕寻求回归到每周去公司五天的状态。最有可能的结果是老板和员工各退一步，而最终以远程方式完成的工作会比员工所希望的略少一些。但事情在很大程度上将取决于利率上升最终是否会削弱经济。如果失业率开始上升，员工不再短缺，那么老板们在这场谈判中就会变得更强势。

到目前为止，向远程工作的转变对商业地产的影响却出奇微弱。办公室肯定没有以前那么拥挤了：据运营办公室刷卡系统的Kastle的说法，美国的办公室占用率约是疫情前的一半。但是，由于写字楼的租赁期限长，空置率虽有所上升，仍处于相对较低水平。高盛估计，2024年将有12%的租约需要续签，是2023年的两倍多。

高盛认为，远程工作可能导致美国额外空置4600万平方英尺（430万平方米）的办公空间，相当于2022年建成的建筑面积总和。对遵循更严格环保标准的豪华办公室的需求将维持高位，位于更老旧的建筑中的办公室则最

有可能长久空置。

这一切对房东来说都不是好消息。随着利率上升，他们的再融资成本也上升了。在美国，大多数商业地产贷款都借自较小的银行，这类贷款机构在2023年3月硅谷银行倒闭后处境尤其艰难。而那些不太理想的办公空间的融资成本可能还会更高。例如，低质量写字楼的商业抵押贷款支持证券的收益率高于“优质”物业的收益率。

可以预期将有更多此类大楼会折价出售，以便被翻新或拆除。那些拥有充足的光线和恰当的管道的商业大楼可以改造成住宅。尽管对于大多数闲置的办公室来说，这在财务上不大可行，但伦敦和纽约等地的改造项目正在增加。在曼哈顿，水街25号曾有一家报纸和一家银行，现在正被改建为一个有1300套公寓、水疗中心、游泳池和联合办公空间的住宅区。疫情可能已经结束，但在2024年，远程工作革命将继续改变人们工作和娱乐的方式和地点。

《经济学人》商业编辑拉查纳·尚伯格 ■



The World Ahead 2024

The fight over remote working will heat up in 2024

And reality will set in for landlords

WHEN COVID-19 forced office workers to toil from their spare rooms and kitchen tables, it triggered the biggest shift in professional life for decades. And, as with any big shift, the consequences are still working their way through corporate hierarchies and the financial system. In 2024 reality will start to set in, for workers, bosses and landlords.

Managers and their employees do not quite see eye to eye on the vexed question of where work should be done. According to a survey by WFH Research, a group of academics, full-time workers with at least a secondary education in America, Britain and Canada work, on average, a day and a half a week from home. And, on average, they want to double their time doing so. Employers, however, have different ideas. Everyone from Goldman Sachs, a Wall Street giant, to Zoom, of video-calling fame, is asking its reluctant workers to show up to the office more often.

No one is expecting, or even looking for, a return to five days a week. The most likely outcome is that bosses and workers meet in the middle, with a little less work done remotely than employees would prefer. But a lot depends on whether rising interest rates eventually weaken the economy. If unemployment starts rising and workers are no longer in short supply, bosses will drive a harder bargain.

The shift to remote work has so far had a curiously muted effect on the commercial-property industry. Offices are certainly less busy than they used to be: according to Kastle, a firm that operates swipe-in systems for offices, occupancy in America is roughly half what it was before the pandemic. Yet

the long duration of office leases means that vacancy rates, though rising, have been relatively low. Goldman Sachs reckons that 12% of leases will come up for renewal in 2024, more than twice as many as in 2023.

The bank reckons that remote working could contribute to an extra 46m square feet (4.3m square metres) of office space lying vacant in America—equivalent to all the floor space built in 2022. Whereas swish offices that comply with tightening environmental standards will stay in high demand, the offices most likely to stay empty are in older buildings.

None of this is welcome news for landlords. Their refinancing costs have gone up as well, as interest rates have risen. In America most commercial-property loans are owed to smaller lenders, which are especially under strain after the collapse of Silicon Valley Bank in March 2023. And financing costs for less desirable office space are likely to be higher still. The yields on commercial mortgage-backed securities, for instance, are higher for low-quality offices than they are for “prime” properties.

Expect to see more of these buildings being sold at a discount, so that they can be refurbished or demolished. Those that have sufficient light and the right plumbing may be turned into homes. Though this is unlikely to be financially viable for most unwanted offices, the number of conversions in places like London and New York is growing. In Manhattan, 25 Water Street, which used to house a newspaper and a bank, is being converted into a residential block with 1,300 flats, a spa, a swimming pool—and a co-working space. The pandemic may be over, but in 2024 the remote-work revolution will continue to change how and where people work and play. ■

RACHANA SHANBHOGUE, Business affairs editor, The Economist ■



世界展望2024

不要指望世界经济软着陆

通胀已下降，但脆弱性还在

一段时间以来，世界经济似乎违反了地心引力。尽管实行了自上世纪80年代以来最快的货币紧缩，但在整个2023年美国的经济增长很可能是加速的。欧洲基本上已经摆脱了对俄罗斯天然气的依赖而没有发生经济灾难。全球通胀率下降，但失业率并未大幅上升，部分原因是到目前为止劳动力市场的降温主要是职位空缺减少而不是职位本身减少。随着2023年走到末尾，预测“软着陆”的乐观主义者正在取得胜利。

但世界经济在2024年仍将是脆弱的。尽管通胀会下降，但仍会维持在过高的水平。经济政策要兼顾各方依然叫人非常头痛。而即使美国能继续躲过经济衰退，世界其他地区看起来也很脆弱。

近期通胀下降让各国央行官员松了口气。但对于大型富裕经济体而言，除非发生经济衰退，否则通胀不太可能继续一路下滑至2%的目标。一方面，劳动力市场看起来仍然过热，名义工资增长过高。另一方面，经济将不得不应对石油价格上涨的影响。正当全球疫情和俄罗斯入侵乌克兰带来的供应冲击似乎已经消散、供应链重新畅通、经济体完成再平衡之际，沙特阿拉伯等地减产使得每桶石油价格自夏季以来已经上涨了约三分之一。哈马斯袭击以色列又打断了油价下跌之路。由此导致的更昂贵的油价可能引发对“第二波”通胀的担忧。

全球各主要央行可能不会进一步加息，而会将石油驱动的通胀反弹视为暂时波动。但它们也担心宣布胜利过早，所以也不会急着降息。近期证据表明，即使大公司要为债务再融资，而家庭在耗尽了疫情期间储蓄后开始感到压力，美国经济还是能够承受住货币紧缩的冲击。但高利率可能会让本已摇摇欲坠的欧元区经济陷入衰退，而对通胀的担忧可能会阻止其政策制定者用降息来应对。

就连美国经济的强韧也带有一个大大的注脚：它是由极高水平的政府借债支持的。在作者撰写本文时，美国联邦政府的赤字年增长率已超过GDP的7%。关于利率是否已进入“长期高企”状态的争论十分激烈。答案取决于政府这种大举借债是否会继续。很可能是会的，因为国会不会在总统选举年挑战这种做法。下一任白宫主人的首要任务将是延续特朗普2018年的减税政策，其中有许多将于2025年到期，而即使民主党人也不愿让它们完全失效。

那些政府没法随心所欲借贷的经济体看起来就更脆弱了。除了欧洲很可能出现衰退外，世界经济也受到中国增长放缓的影响。中国经济能否反弹并摆脱“日本化”将取决于其政府继续打开刺激水龙头的程度。但从近年中国经济决策变糟（从结束新冠清零到打压科技行业，等等）来看，期望它出台精准的刺激措施是不明智的。而由于地方政府负债累累，中国也面对财政约束。

与此同时，中美地缘紧张局势逐渐恶化，全球保护主义浪潮不断涌现，正让贸易的齿轮运转不灵。根据慈善机构“全球贸易警报”（Global Trade Alert）的数据，已实施的保护主义措施数量从十年前的约9000项增加到如今的约35,000项。尽管亚洲一些经济体受益于供应链转移出中国，重复投资和失去分工合作带来的收益正在严重拖累全球经济的增长潜力。即使是像快速增长的印度这样的赢家也显现出滑向本土经济的不祥势头。

没有机会从投资再分配中受益的贫穷国家正在遭受高负债、低增长和强势美元的困扰。2024年，国际货币基金组织会继续绞尽脑汁，要琢磨出如何向一些国家提供债务减免，它们对中国和其他拒绝遵循传统债务重组原则的债权人负债累累。如果美国的赤字继续推动其经济增长，而同时全球经济增长令人失望，那么可以预期美元将进一步升值，从而加剧它们的困境。

特朗普再度当选的可能性加大了所有上述趋势的可能性。特朗普的第二个任期可能会出台更大幅度的减税——从而导致更大的赤字——以及贸易战的进一步升级。与2016年时一样，如果特朗普在11月获胜，股市可能会上

涨，但这并不会是什么好消息。到了2024年底，世界经济看起来可能不再像是软着陆，而更像是另一场疯狂之旅的开始。

《经济学人》经济编辑亨利·柯尔 ■



The World Ahead 2024

Don't count on a soft landing for the world economy

Inflation has fallen, but vulnerabilities remain

FOR SOME time the world economy has seemed to defy gravity. Despite the fastest tightening of monetary policy since the 1980s, America's economic growth probably accelerated in 2023. Europe has mostly weaned itself off Russian gas without economic catastrophe. Global inflation has fallen without big surges in unemployment, in part because labour markets have so far cooled mainly by shedding job vacancies not jobs themselves. As the year ends, optimists who predicted a "soft landing" are taking victory laps.

Yet the world economy will remain fragile in 2024. Though inflation will be lower, it will remain too high. Economic policy still faces an excruciating balancing act. And even if America continues to dodge a recession, the rest of the world looks vulnerable.

Inflation's recent fall has been a relief to central bankers. But in big, rich economies it is unlikely to continue declining all the way to their 2% targets unless a recession strikes. For one thing, labour markets still look too hot and nominal wage growth too high. For another, economies will have to contend with the effects of more expensive oil. Just when it seemed as if the supply shocks of the pandemic era and Russia's invasion of Ukraine had dissipated, with supply chains unclogged and economies rebalanced, a barrel of oil has risen in price by about a third since the summer, thanks to production cuts in Saudi Arabia and elsewhere. A price fall was halted by Hamas's attack on Israel. The resulting pricier petrol could raise fears of a "second wave" of inflation.

The major central banks will probably not raise interest rates further,

instead treating any oil-driven inflation rebound as temporary. But, fearful of premature declarations of victory, they will not be keen to cut rates, either. On recent evidence America's economy can withstand tight money, even if big companies refinancing debts and households who have run down their pandemic-era savings are beginning to feel squeezed. But high interest rates may be tipping the already-wobbly euro-zone economy into recession, and fear of inflation could stop its policymakers from cutting rates in response.

Even the robustness of America's economy comes with a big asterisk: it is being supported by extraordinary levels of government borrowing. At the time of writing the federal government's deficit is running at an annual rate of over 7% of GDP. Debate rages about whether interest rates have entered a "higher-for-longer" regime. The answer depends on whether the borrowing binge continues. It probably will: Congress will not confront it in a presidential-election year. And the first order of business for the next occupant of the White House will be renewing Donald Trump's 2018 tax cuts, many of which expire in 2025 and which even Democrats will be reluctant to let lapse in full.

Economies without freely borrowing governments look more vulnerable. As well as the likely recession in Europe, the world economy is suffering from China's growth slowdown. Whether China rebounds and escapes "Japanification" will depend on the degree to which the government continues to open the stimulus taps. But the recent deterioration of China's economic policymaking—in everything from ending zero-covid to the technology crackdown—suggests it would be unwise to expect a well-calibrated stimulus. And China faces fiscal constraints owing to the indebtedness of its local governments.

All the while, the gradual worsening of geopolitical tensions between America and China, and the global tide of protectionism, are throwing sand

in the gears of trade. The number of protectionist measures in place is up from about 9,000 a decade ago to around 35,000 today, according to Global Trade Alert, a charity. Although some economies in Asia benefit from the relocation of supply chains outside China, the duplication of investment and loss of the gains from specialisation are weighing on the global economy's potential growth. Even winners, such as fast-growing India, show a worrying drift towards homeland economics.

Poor countries that are not in a position to benefit from the redistribution of investment are suffering from high indebtedness, low growth and a strong dollar. In 2024 the IMF will continue to struggle to work out how to provide debt relief to countries that are heavily in debt to China and other lenders who do not subscribe to traditional principles for debt restructuring. And if America's deficits continue to propel its economy while global growth disappoints, expect the dollar to rise still further, exacerbating their woes.

The possibility of Mr Trump's re-election to the White House brings the potential for all of these trends to be magnified. A second Trump term would probably mean even deeper tax cuts—and hence bigger deficits—and a further escalation of the trade war. As in 2016, stockmarkets might rally if Mr Trump wins in November, but it would be no good-news story. By the end of 2024 it might feel less as though the global economy has landed softly, and more like the start of another wild ride. ■

HENRY CURR, Economics editor, The Economist ■



金窝银窝，不如地球

很快搬去火星的可能性渺如冥王星

即便技术极客们听不得这个【《火星上的城市》书评】

《火星上的城市》，凯莉·维纳史密斯和扎克·维纳史密斯著。企鹅出版社；448页，32美元。Particular Books出版社；25英镑

改变信仰的人有些很狂热，有些则不大情愿。凯莉·维纳史密斯（Kelly Weinersmith）和扎克·维纳史密斯（Zach Weinersmith）肯定属于后者。正如他们不断提醒读者的那样，两人都是太空极客。但他们也是理性主义者（碰巧结婚了）。怀着对人类可能很快将能在地球之外定居的期许，他们开始写新书。写完后，他们的理性评估所得出的结论却恰恰相反。他们认为，那些像马斯克一样渴望通过殖民火星或其他地方而让智人成为双星球物种的人，是在自欺欺人。

这种观点在他们所混迹的圈子里并不讨喜。但他们拿未来星际开拓者逃避现实的幻想比对实际情形，做了清晰有力的论述。例如，人们如何养活自己？火星表面覆盖着有毒的高氯酸盐，因此火星的“土壤”很难耕种；月球上几乎没有碳，而碳是生命的基本成分。太空居民能生孩子吗？在低重力环境下，受孕和分娩可能都会很难。

人们会不会争夺地盘，去抢那几个永浴阳光的月球山顶，还有同样罕见的永远暗无天日的陨石坑底（因此可能蕴藏着宝贵的冰冻水资源）？谁将控制空气供应？（想要了解事态能发展到多严重，可以看看电影《全面回忆》[Total Recall]。）用什么做货币？上世纪90年代，航天飞机上的宇航员最喜欢用的是墨西哥卷饼的酱料包。

接下来的问题是，为什么会有想去呢？逃离环境被破坏的地球，或者甚至就只是为了加个保险，在核毁灭或是小行星撞击地球时有地方可以躲避，这听上去可能都很吸引人。但其实，相比人类家园未来可能面临的任何命运——即便是核战争，火星都可怕得多。而月球只会更糟糕。

马斯克对太空感兴趣，他可能把那里当做退休后的去处（“我想要死在火星上，不过不是在降落时摔死”这句话通常被认为是他说的）。但是，为超级富豪准备养老院是个利基市场，而不是那种能创建新国家的壮举。至于太空殖民狂热者提出的一项有可能成为现实的正经业务——在小行星上开采贵金属——则意味着摆弄干扰太空岩石，或许会增加而不是减少小行星撞击地球的可能性。

还有比这些更大的困难。一是无论人们多么渴望把地球上的烦恼抛在脑后，在其他地方重新开始，他们都做不到。任何成功的太空移民都会背负甩不掉的历史包袱，而且，至少一开始，会仅仅是地球上的地缘格局的延伸。另一个困难是，人类本身就是问题所在，就算在太阳系的其他地方出生、长大，他们也依然会成为问题。

维纳史密斯夫妇不愿永久排除在太空移民的可能性。但他们认为，要做到这一点，不应该像现在计划的这样零敲碎打。相反，人类应该等上一两个世纪，储备知识、发展技术、积累足够的资源来恰当地实现这一目标，然后在某个“大爆炸”时刻到来时迅速按计划建立一个大型前哨站。希望能有好运。耐心从来都不是人类的强项（当然也不是马斯克的强项）。长期规划也不是。 ■



There's no place like home

The likelihood of living on Mars soon is as remote as Pluto

Even if tech geeks do not want to hear that

A City on Mars. By Kelly Weinersmith and Zach Weinersmith. Penguin Press; 448 pages; \$32. Particular Books; £25

SOME CONVERTS are zealous. Some are reluctant. Kelly and Zach Weinersmith are definitely in the second camp. Both, as they constantly remind the reader, are space geeks. But they are also rationalists (who happen to be married). They began writing their new book in the expectation that off-Earth settlements would soon be on the cards. Their rational appraisal, having finished it, is the opposite. Those, such as Elon Musk, who aspire to make Homo sapiens a two-planet species by colonising Mars or somewhere else, are, they conclude, deluding themselves.

That opinion is not popular in the circles in which they move. But they argue their case cogently, contrasting the escapist fantasies of would-be planetary homesteaders with practicality. How, for example, would people feed themselves? Mars's surface is covered with toxic perchlorates, making the planet's "soil" hard to farm; the Moon's has little carbon, life's essential ingredient. Will space-dwellers be able to have babies? Both conception and birth may prove tricky in low gravity.

Will there be a land grab for the few lunar mountain tops that enjoy perpetual sunshine and the equally rare crater bottoms that never see it (and so might harbour the precious resource of frozen water)? Who will control the air supply? (For a fictional take on how this can go wrong, watch "Total Recall".) What will the currency be? Space-shuttle astronauts in the 1990s favoured packets of taco sauce.

Then there is the question of why anyone would want to go in the first place. Escaping an environmentally damaged Earth or even simply having an insurance policy against the chance of nuclear annihilation or an asteroid strike may sound attractive. But Mars is actually far more horrid than any fate likely to be awaiting humanity's home planet—even, probably, the aftermath of a nuclear exchange. And the Moon is worse even than that.

Space may appeal to Mr Musk as a retirement destination ("I'd like to die on Mars, just not on impact" is a saying often attributed to him). But nursing homes for the hyper-rich are a niche market, not the sort of enterprise on which new countries are usually founded. As to the one proper business space-colonisation enthusiasts propose that has a chance of becoming real—the mining of asteroids for precious metals—this would mean pushing space rocks around in ways that might make an asteroid strike more rather than less likely.

And there are even bigger difficulties than these. One is that, however much people might aspire to leave Earth's cares behind and start afresh elsewhere, they cannot. Any successful space settlement will carry inescapable historical baggage, and will, at least to start with, be simply an extension of terrestrial geopolitics. The other difficulty is that people themselves are the problem, and they will continue to be a problem even if they are born and raised in other parts of the solar system.

The Weinersmiths are reluctant to rule out the settlement of space for ever. But they argue that if it is to be done, it should not be piecemeal, in the way now planned. Humanity should instead wait a century or two, garner knowledge, develop technology and accumulate sufficient resources to pull it off properly—and then quickly build a large, planned outpost in a sort of "big bang". Good luck with that. Patience has never been humanity's strong suit (it certainly does not seem to be Mr Musk's). Neither has long-term planning. ■



乐观的理由

人工智能会如何影响你的薪酬？

来自经济转型前线产业的最新战报【深度】

大约十年前，经济学家卡尔·本尼迪克特·弗雷（Carl Benedikt Frey）和迈克尔·奥斯本（Michael Osborne）发表的一篇论文迅速流传开来。文中指出，美国有47%的工作岗位有被自动化取代的风险。之后大量研究涌现，称最贫穷和受教育程度最低的工人最易受到即将到来的这股变革的冲击。随着人工智能（AI）的突飞猛进，这种担忧愈演愈烈。11月2日，马斯克出席英国的AI峰会后预言道：“终有一天人们不再需要工作。”

但与此同时，经济学家们变得更乐观了。近期的研究发现，受自动化威胁的工人比例比弗雷和奥斯本推测的要少（见图表1）。2019年，当时任教于斯坦福大学的迈克尔·韦伯（Michael Webb）指出，相比软件和机器人专利，AI专利更多是针对高技能工作。新型AI似乎更擅长编程和创意而非在实体世界中劳作，表明低技能工作也许不受影响。今年3月，麻省理工学院的沙克德·诺伊（Shakked Noy）和惠特尼·张（Whitney Zhang）发表的一项实验结果表明，ChatGPT在写作任务上对能力较低的员工的帮助更甚于能力较高的员工，结果是提升了整体生产率。

尽管AI仍处于起步阶段，一些行业已迫不及待地率先采用它。仔细观察其中的三个行业——翻译、客服和销售，大体上可以明白经济学家为何态度转向乐观，即使其中也不乏复杂情况。翻译可能是首当其冲严重受语言建模影响的行业，译员已转变为文案编辑，整理润色AI生成的初稿，方便了新手入行。在客服领域，AI帮助后者提升了表现。但在销售领域，顶级销售人员会利用这项技术寻找销售机会并做笔记，从而拉开与同事的业绩差距。AI会否像互联网革命那样，更多提升了明星员工而非落后员工的收入？还是说AI会成为一个“大平衡器”，提高底层而非精英的收入？答案可能取决于所涉及的职业类型。

罗兰·霍尔（Roland Hall）从事桌游和营销资料的法译英翻译已有27年。他回忆道，早在上世纪90年代人们已经在利用软件来翻译某些单词。现在，这类工具变得更先进，让市场上的翻译任务被分成了两类。一类是不太讲究表达流畅的文本翻译。几千页的飞机操作手册可能算一例，霍尔说，其读者只需要知道“该找到哪个部件”和“是要往左扭还是往右扭”就好。另一类包括文学翻译等，最细微之处事关紧要。

前一类翻译受AI的影响最大。现在，许多译员编辑的译文都是由类似谷歌翻译服务的机器生成的。他们的每字翻译单价大大降低，但市面上的翻译任务也更多了。专事建筑和法律类翻译的斯洛伐克译员露西娅·拉蒂科娃（Lucia Ratikova）估计，现在这类工作在招聘网站上的占比过半，而几年前只占十分之一。越来越多的企业——其中有许多迫切想拓展全球市场——正在利用翻译价格下降的好处。

如果机器能够以更低的成本完成人类的工作，雇主就会转而采用计算机。但随着价格下降，对某项服务的总需求有可能上升，而且升幅可能足以抵消扩大机器应用的影响。没有什么法则可拿来判断哪种效应会占主导。目前而言，在美国，翻译队伍更壮大了，但他们的实际工资略有下降（见图表2），可能是因为现在翻译行业对技能的要求有所降低。

AI在进军客服领域时阻力更大。多年来，企业一直在试图将客服工作自动化。但到现在为止它们大多时候只是惹恼了客户。谁没试过戏弄聊天机器人只为能与真人客服对话？自2018年以来，美国客户满意度指数一直在下降，而从业者似乎也心生厌倦。去年，美国的“客服中心”员工流失率创下了38%的历史新高。

但也许仍有值得欣慰之处：这个劳动力队伍正变得更能接纳低技能员工。今年早前，斯坦福大学的埃里克·布林约尔松（Erik Brynjolfsson）联同麻省理工学院的丹妮尔·李（Danielle Li）和林赛·雷蒙德（Lindsey Raymond）研究了5000多名客服代表使用一个AI助手的情况。该AI助手向客服人员提供实时建议，使水平垫底的客服的工作效率提高了35%，而最熟练的客服的效率变化不大。

人们有理由猜想AI对销售人员的影响和对客服人员的影响差不多。但事实并非如此。Balto公司同时为销售团队和呼叫中心开发AI软件，该公司的马克·伯恩斯坦（Marc Bernstein）指出，在销售领域，“风格分”（即人格魅力和发展关系的能力）要重要得多，在客服岗位上则不然，这里更重要的事是迅速给出正确答案。

AI甚至可能造就销售明星。斯凯拉·韦尔内斯（Skylar Werneth）做销售已有八年，如今在专事销售自动化的创业公司Nooks任职。软件会分析他的电话通话，辨别哪些策略最有效。软件还能帮助他同时给很多人打电话。大多数客户不会接电话，同时拨打可以确保韦尔内斯能多和客户通话，少听拨号音。他认为，Nooks提供的工具使自己的工作效率提高至原来的三倍，收入也就大大增加。

这对劳动力市场意味着什么？销售代表的奖金是按他们在一定基数之上成交的客户计算的。当整个公司的生产率提高时，老板往往会提高这个基数。由于并非所有销售人员都能达到这个基数，业绩差的就会被挤走，毕竟对产品的需求并不会随销售业绩的上升而增加，而需求增加是留下他们的必要条件。结果只会留下为数越来越少的高生产率销售人员。考虑到销售领域员工的高流动率，向这种状态的转变就算不会导致大量销售人员被解雇，至少也可能让招聘人数减少。

假如AI的能力最终超越人类——近期英国峰会上的许多与会者认为这是可能的——那一切都好说了。而即使AI的进军没有那么颠覆时代，劳动力市场也将上演深刻变化。圣路易斯华盛顿大学（Washington University in St Louis）的回翔和奥伦·雷舍夫（Oren Reshef）以及纽约大学的周罗峰（音译，Luofeng Zhou）今年8月发表的一项研究发现，去年11月ChatGPT推出后，在自由职业者平台Upwork上，相比受AI影响较小的工作，写作、校对和文案编辑这些工作的收入下降了5%。Balto对400名呼叫中心经理的调查发现，或多或少运用了AI的人数比例从4月的59%增加到10月的90%。伯恩斯坦认为，尽管“今天AI还无法取代（呼叫中心）的人类客服……但十年后，也很可能是五年后，AI就能做到这一点”。

AI颠覆劳动力市场的另一面是在其他领域创造新的就业机会。麻省理工学院的达龙·阿西莫格鲁（Daron Acemoglu）和波士顿大学的帕斯夸尔·雷斯特雷波（Pascual Restrepo）在2019年的建模表明，当自动化对生产率提升不大时，对工人的冲击最严重。这种“一般般”的自动化创造的剩余财富很少，不足以增加经济中其他领域对工人的需求。我们对处于AI变革前沿的行业所做的调查表明，这一新技术有可能大大提升效率。它对不平等的影响则依然更不明朗。所以安全起见，最好还是争当明星，而不要沦为掉队者。 ■



Reasons to be cheerful

What will artificial intelligence mean for your pay?

A dispatch from industries on the front line of economic transformation

AROUND A DECADE ago Carl Benedikt Frey and Michael Osborne, two economists, published a paper that went viral. It argued that 47% of American jobs were at risk of automation. A deluge of research followed, which suggested the poorest and least-educated workers were most vulnerable to the coming revolution. Such fears have intensified as artificial-intelligence (AI) capabilities have leapt ahead. On November 2nd, speaking after Britain's AI summit, Elon Musk predicted: "There will come a point where no job is needed."

Yet at the same time, economists have become more optimistic. Recent studies have found that fewer workers are exposed to automation than Messrs Frey and Osborne supposed (see chart 1). In 2019 Michael Webb, then of Stanford University, showed that AI patents are more targeted at skilled jobs than those for software and robots. New AI seems better at coding and creativity than anything in the physical world, suggesting low-skilled jobs may be insulated. In March Shakked Noy and Whitney Zhang, both of the Massachusetts Institute of Technology (MIT), published an experiment showing that ChatGPT boosted the productivity when writing of lower-ability workers more than that of higher-ability workers.

Although AI is still in its infancy, some industries have been eager adopters. A close look at three of these—translation, customer service and sales—is broadly supportive of the optimistic shift among economists, though not without complications. In translation, perhaps the first industry to be heavily affected by language modelling, workers have become copy editors, tidying a first draft undertaken by AI, which eases the path of newbies into

the industry. In customer service, AI has helped raise the performance of stragglers. But in sales, top performers use the tech to find leads and take notes, pulling away from their peers. Will AI boost the incomes of superstars more than those of stragglers, much as the internet revolution did? Or will it be a “great equaliser”, raising the incomes of the worst off but not those of high flyers? The answer may depend on the type of employment in question.

Roland Hall has been translating board games and marketing material from French to English for 27 years. He recalls that even in the 1990s software was used to render specific words from one language to another. Today the tools are more advanced, meaning the types of job available have split in two. One type includes texts where fluency is less important. An example might be a several-thousand-page manual for an aircraft, says Mr Hall, where readers simply need to know “what part to look for” and “do you turn it left or right”. The other type includes literary translations, where the finest details matter.

The first type has been most affected by AI. Many workers now edit translations that have gone through a machine similar to that underlying Google’s translation service. They are paid at a steep discount per word, but more work is available. Lucia Ratikova, a Slovakian who specialises in construction and legal translations, reckons that such work now makes up more than half of listings on job sites, up from a tenth a few years ago. A larger pool of businesses, many eager to expand into global markets, are taking advantage of the drop in price.

If machines are able to do what humans do more cheaply, employers will turn to computers. But as prices fall, overall demand for a service may rise, and possibly by enough to offset the increased use of machines. There is no law to determine which effect will dominate. So far in America the number of translators has grown, yet their real wages have fallen slightly (see chart 2)—probably because the profession now requires rather less skill.

Customer service offers more difficult terrain for AI. Firms have been trying to automate it for years. Thus far they have mostly just annoyed customers. Who doesn't try to game the chatbot in order to speak to an actual human? The American Customer Satisfaction Index has been falling since 2018, and workers also appear fed up. Turnover in American "contact centres" hit a record high of 38% last year.

But there may be consolation: the workforce is becoming more welcoming to the low-skilled. Erik Brynjolfsson of Stanford, as well as Danielle Li and Lindsey Raymond of MIT, studied the roll-out of an AI assistant to more than 5,000 customer-support agents earlier this year. The assistant offered real-time suggestions to workers. This lifted the productivity of the least-skilled agents by 35%, while the most-skilled ones saw little change.

It would be reasonable to assume that the impact on salespeople would be fairly similar to the one on customer-service workers. But that is not the case. Marc Bernstein of Balto, a firm that creates AI software for both sales teams and call centres, notes that "style points" (ie, charisma and the ability to develop a relationship) matter much more in sales than in customer service, where the important thing is getting the right answer quickly.

AI might even create sales superstars. Skylar Werneth has been in the industry for eight years and is now at Nooks, a startup that automates sales. Software analyses his calls, identifying which tactics work best. It also helps him call many people at once. Most customers do not pick up; dialling in parallel ensures Mr Werneth is talking more and listening to dial-tones less. He reckons the tools Nooks offers makes him three times more productive, earning him a solid amount more than before.

What does this mean for labour markets? Sales representatives are given bonuses based on the number of clients they bring in over a threshold. When productivity grows across a firm, bosses tend to raise the threshold.

Because not everyone is able to meet it, low performers are pushed out of the workforce, since demand for products does not grow in parallel with sales performance, as would be necessary to justify retaining them. The result is a shrinking set of highly productive salespeople. At least, given high turnover in the industry, the shift to this state of affairs might mean hiring fewer people, not mass firings.

If AI eventually becomes superhuman, as many attendees at Britain's recent summit believed possible, all bets are off. Even if AI advances in a less epochal fashion, labour markets will see profound change. A study by Xiang Hui and Oren Reshef of Washington University in St Louis and Luofeng Zhou of New York University, published in August, found that earnings for writing, proofreading and copy-editing on Upwork, a freelancing platform, fell by 5% after ChatGPT was launched last November, compared with roles less affected by AI. A survey of 400 call-centre managers by Balto found that the share using at least some AI grew from 59% in April to 90% by October. Mr Bernstein thinks that although "today AI is not capable of replacing a human [in call centres]...in ten years, quite possibly five, it will be there."

The flipside of AI disruption is new jobs elsewhere. Modelling in 2019 by Daron Acemoglu of MIT and Pascual Restrepo of Boston University suggests that the impact of automation is worst for workers when productivity gains are small. Such "so-so" automation creates little surplus wealth to increase the demand for workers in other parts of the economy. Our investigation of industries at the front line of AI change suggests that the new tech has a shot at leading to much greater efficiency. The picture on inequality remains murkier. Better to be a superstar than a straggler, then, even if only to be safe. ■



气候大问题

中国会拯救地球吗？还是会毁灭它？

中国即将实现碳达峰。接下来才是大难题【深度】

尽管涂长望因脑癌而生命垂危，最后仍不忘嘱托一件事。这位受人尊敬的中国气象学家注意到气候在变暖。因此，他于1961年在党报《人民日报》上发表文章，警告气候变化可能会改变生命赖以生存的条件。不过他认为变暖是太阳活动周期的一部分，以后也可能会逆转。涂长望并没想到燃烧化石燃料正把二氧化碳排放到大气中而导致气候变化。在那一期的《人民日报》上，再往前翻几页，有一张煤矿工人咧着嘴笑的照片。那时中国正急于实现工业化，在经济上赶超西方。

今天，中国已是一个工业强国，制造业产值占世界四分之一以上，超过了美国和德国的总和。但其进步是以排放为代价的。过去三十年来，中国向大气排放的二氧化碳总量比其他任何国家都多（见图表1）。据美国研究公司荣鼎集团（Rhodium Group）称，中国现在每年排放的温室气体占全球总排放的四分之一以上，大约是排放第二多的美国的两倍（不过按人均排放来看还是美国更严重）。

因此，能否实现各国政府于2015年在巴黎举行的联合国年度气候峰会上所做的承诺，将工业革命以来的全球变暖幅度控制远低于2°C以下，很大程度上要取决于中国。今年的气候峰会（叫作COP28）于11月30日在迪拜开幕。中国既有好消息，也有坏消息带给大家。

好的一面是，中国的排放将很快停止上升。一些分析师认为，中国的排放今年就会达峰。中国明确提出要在2030年之前实现碳达峰，实现这个目标将毫无疑问。中国建设核电站的速度比任何其他国家都快。它还大量投资于可再生能源（见图表2），目前风能和太阳能发电装机容量已达到750吉瓦左右，约占全球的三分之一。政府的目标是到本十年末，风能和太阳能发电总装机容量达到1200吉瓦，超过目前欧盟的总发电容量。中国还可能

远远超出这一目标。

但帮助中国抑制排放的不仅仅是积极发展可再生能源。它的钢铁和水泥等碳密集材料的产量一直在下降。经过几十年的公路和铁路建设，政府在大型基础设施项目上的投入正在减少。房地产行业的长期扩张以楼市崩盘告终，这动摇了经济，但排放量也因此减少。展望未来，很少有分析人士预期中国的GDP增速会像上世纪末和本世纪初那样快。换句话说，中国污染最严重的发展阶段可能已经过去了。

然而，比碳达峰更重要的是下一步将会如何。中国承诺到2060年实现温室气体净零排放（即“碳中和”）。实现这个目标的难度将大得多。即使在大规模利用可再生能源之后，今天中国一大半的能源仍靠肮脏的煤炭供应。这比起2011年时70%左右的占比有所下降，但随着电力需求的增加，中国的煤炭消耗量仍在持续增加。去年，中国的煤炭开采量达到创纪录的45亿吨，平均每周批准约两个新的火电厂项目。

许多获批的火电厂可能永远不会建成。现有火电厂的利用率不断下降，削弱了进一步建设新厂的理由。但中国“减煤”的速度不像环保人士希望的那样快，也达不到分析师认为要实现2060年目标所需的速度。一部分原因是由于中国煤炭资源丰富。由于石油和天然气很少，煤炭为中国提供了有保障的能源来源。采煤可以创造就业机会。无论是否需要，建设火电厂也是地方政府拉动经济增长的常用手段。

中国的电网是围绕煤炭发电建设的。在燃煤电厂，人可以决定何时多发电，何时少发电。但在太阳能和风能上，做主的是大自然。因此电网需要变得更加灵活。当某个地方的电力过剩时，电网必须能够将其储存起来或转送到其他地方。否则，未来中国将无法消纳大量新增的风力涡轮机和太阳能电池板。

大多数国家都需要对其电网进行类似的改造。不过，能源咨询公司Lantau Group的戴维·菲什曼（David Fishman）表示，中国面临的挑战与众不同。其大部分太阳能和风能资源都在西部。但它们产生的电力主要用来供

应大城市云集的东部地区。在这么远的距离上输电并非易事。另一个问题是，各省政府对本省电网的运营有很大的发言权。他们不喜欢靠外省供应电力。例如，各省可能更愿意使用自己的火电厂发的电，而不愿意依靠来自其他地方的更清洁的能源。

那些关注中国脱碳进展的人也担心甲烷这种强大的温室气体。一些国家可以通过修复泄漏的天然气管道等简单的方法减少甲烷排放。而中国的大部分甲烷来自煤矿泄露，或者是由稻田的微生物产生。如果不关闭矿井或改变耕作方式，这个问题就很难解决。因此，在2021年的联合国气候峰会上，中国拒绝加入包括美国在内的其他100多个国家共同签署的一项倡议，该倡议承诺到2030年将全球甲烷排放量减少至少30%。不过在11月初，中国确实表示将把减少甲烷排放问题纳入2035年国家气候计划（该计划可能要到两年后才会发布）。

面对这些挑战，中国领导人必须勇往直前。但设在纽约的亚洲协会政策研究所（Asia Society Policy Institute）中国气候中心（China Climate Hub）即将上任的总监李硕表示，他们在气候问题上的抱负可能已经到顶。他认为，近年来，煤炭价格飙升，干旱扰乱了水力发电，由此造成的停电令政府惊忧。现在，官员担心气候友好型政策会损害国家的能源安全（支持绿色发展的官员则认为，提高电网灵活度等一些改革反而会加强能源安全）。李硕预计中国的排放将趋于稳定而不是下降。

不过，中国有充分的理由重视气候问题。包括上海在内的一些最大的城市位于沿海，有被上升的海平面淹没的风险。干旱的北方又缺乏饮用水。极端天气已经造成了损失。医学杂志《柳叶刀》发表的一项研究显示，去年中国因热浪造成的死亡人数比历史平均水平高出342%。今年夏季的洪涝让中国很大一部分小麦收成受损。

与此同时，中国已成为绿色能源技术的领导者。世界其他地区很大程度上都依赖中国的太阳能电池板和电池供应链。今年，中国超越日本成为全球最大的汽车出口国，这在一定程度上要归功于中国在电动汽车领域的主导地位。

因此，中国有望在迪拜的气候峰会上发挥建设性作用。怀着领导全球南方的雄心，它不会想让人觉得它在忽视许多发展中国家的官员最关心的一个问题。乐观人士还会指出，中国气候变化事务特使解振华和美国气候特使约翰·克里（John Kerry）在11月碰了面。他们就一些小举措达成了一致，例如在碳捕获项目上开展合作。

但中国也明确表示不会屈服于气候变化方面的压力。今年早些时候，中国领导人习近平重申了2030年实现碳达峰、2060年实现碳中和的目标。“但达到这一目标的路径和方式、节奏和力度则应该而且必须由我们自己作主，决不受他人左右。”他说。 ■



The big climate question

Will China save the planet or destroy it?

The country's carbon emissions will soon peak. Then comes the hard part

THOUGH HE LAY dying of brain cancer, Tu Changwang had one last thing to say. The respected Chinese meteorologist had noticed that the climate was warming. So in 1961 he warned in the People's Daily, a Communist Party mouthpiece, that this might alter the conditions that sustain life. Yet he saw the warming as part of a cycle in solar activity that would probably go into reverse at some point. Tu did not suspect that the burning of fossil fuels was pumping carbon dioxide into the atmosphere and causing the climate to change. In that issue of the People's Daily, a few pages before his paper, there was a photo of grinning coalminers. China was rushing to industrialise with the aim of catching up economically with the West.

Today China is an industrial powerhouse, home to over a quarter of the world's manufacturing—more than America and Germany combined. But its progress has come at a cost in terms of emissions. Over the past three decades China has released more carbon dioxide into the atmosphere, in total, than any other country (see chart 1). It now emits over a quarter of the world's greenhouse gases each year, according to Rhodium Group, an American research firm. That is about twice as much as America, which comes second (though on a per-person basis America is still worse).

Much, then, depends on China if the world is to keep global warming since the Industrial Revolution well below 2°C, as governments pledged at the UN's annual climate summit in Paris in 2015. This year's summit (called COP28) began on November 30th in Dubai. China has both good and bad news for those attending.

On the positive side, China's emissions will soon stop rising. Some analysts think they will top out this year. There is little doubt that the peak will come before 2030, which is the goal China has set for itself. It is building nuclear-power stations faster than any other country. It has also invested heavily in renewable energy (see chart 2), such that it now has around 750 gigawatts of wind and solar generating capacity, about a third of the world's total. By the end of the decade the government aims to have 1,200GW of such capacity, more than the total power capacity of the European Union at the moment. China will probably well exceed that target.

But it is not just China's embrace of renewable energy that is helping it curb emissions. Its production of carbon-intensive steel and cement has been dropping. After decades of building roads and railways, the government is splurging less on big infrastructure projects. A long expansion of the property sector has ended in a meltdown that has shaken the economy—but led to fewer emissions. Going forward, few analysts expect China's GDP to grow as fast as it did at the end of the last century and the beginning of this one. Put another way, China's dirtiest phase of development is probably behind it.

More important than the peak, though, is what happens next. China has pledged to eliminate net emissions of greenhouse gases (or to become “carbon neutral”) by 2060. This will be a much harder target to hit. Even after that massive injection of renewables, dirty coal still supplies well over half of China's energy. That is down from around 70% in 2011, but the amount of coal China burns continues to increase, as demand for electricity rises. Last year China mined a record 4.5bn tonnes of the black rock and approved around two new coal-fired power plants for construction every week on average.

Many of these may never be built. Declining utilisation rates of existing coal plants undermine the case for further construction. But China is not moving

away from coal as fast as environmentalists would like or analysts say is necessary to meet its 2060 target. Part of the problem is that the country has a lot of it. With little oil or gas, coal provides China a secure source of energy. Digging it up creates jobs. Building a coal plant, whether it is needed or not, is also a common way for local governments to boost economic growth.

China's power grid was built with coal in mind. At plants that burn the stuff, humans decide when to ramp things up or down. But when it comes to solar and wind power, nature is the boss. So the grid needs to be made more flexible. When there is a surplus of energy in one spot, it must be able to store it or move it elsewhere. Otherwise China will not be able to accommodate lots of new wind turbines and solar panels in the future.

Most countries need to make similar changes to their grids. The challenge facing China, though, is unique, says David Fishman of the Lantau Group, an energy consultancy. The bulk of the country's solar and wind resources are located in the west. But the power they generate is needed mostly in the east, where the country's biggest cities are to be found. Transferring it over such long distances is tricky. Another problem is that provincial governments have a lot of say over how their portion of the grid operates. They don't like depending on each other for energy. So, for example, a province might prefer to use its own coal plant rather than a cleaner energy source located elsewhere.

Those who are concerned about China's progress also worry about methane, a powerful greenhouse gas. Some countries can cut their methane emissions in simple ways, such as by repairing leaky gas pipes. But most of the methane coming from China wafts out of coal mines or is produced by microbes in rice paddies. Fixing the problem is hard without closing mines or changing farming practices. So at the UN climate summit in 2021, China refused to join more than 100 other countries, including America, which pledged to reduce global methane emissions by at least 30% by 2030. Earlier

this month, though, China did say that it would address the issue in its national climate plan for 2035 (which may not be published for another two years).

In the face of these challenges, China's leaders must be bold. But their climate ambitions may have already peaked, says Li Shuo, the incoming director of the China Climate Hub at the Asia Society Policy Institute in New York. He believes power cuts caused by surging coal prices and droughts, which disrupt hydropower, have spooked the government in recent years. Now officials worry that climate-friendly policies will undermine the country's energy security (green types argue that some reforms, such as making the grid more flexible, would have the opposite effect). Mr Li expects China's emissions to plateau rather than decline.

China, though, has good reason to prioritise the climate. Some of its biggest cities, including Shanghai, lie on the coast and could be swallowed by rising seas. The arid north lacks drinking water. And extreme weather is already taking a toll. Last year deaths associated with heatwaves in China increased by 342% compared with the historical average, according to a study published by the Lancet, a medical journal. This summer floods damaged much of China's wheat crop.

Meanwhile, China has become a leader in green-energy technology. The rest of the world depends largely on Chinese solar-panel and battery supply chains. This year China overtook Japan to become the world's largest car exporter, thanks in part to Chinese dominance in electric vehicles.

So there is some hope that China will play a productive role at the climate summit in Dubai. With ambitions to lead the global south, it will not want to look as if it is neglecting an issue that is foremost on the mind of many officials in developing countries. Optimists also point to the meeting between Xie Zhenhua, China's climate envoy, and John Kerry, his American

counterpart, in November. They agreed on some small steps, such as collaborating on carbon-capture projects.

Yet China has also made clear that it will not bow to pressure on climate change. Earlier this year Xi Jinping, its leader, reiterated his aim of reaching a carbon peak by 2030 and achieving carbon neutrality by 2060. “But the path, method, pace and intensity to achieve this goal should and must be determined by ourselves, and will never be influenced by others,” he said.





熊彼特

查理·芒格远不止是巴菲特的副手

在商界，他是尊重常识的典范

每年5月，成千上万的信徒涌向内布拉斯加州的奥马哈市，也就是伯克希尔·哈撒韦的老家，接受这家投资公司的两位领袖——亲民天才巴菲特和金句达人芒格——的光芒洗礼。但在从前的很多年里，真正的铁杆粉丝会参加一个更私密的集会，地点就在洛杉矶边上郁郁葱葱的帕萨迪纳市（Pasadena），笔者现在的住所附近。在帕萨迪纳会议中心（Pasadena Convention Centre），芒格一个人滔滔不绝，尽情发挥他的冷幽默。现场不允许录音录像，记录员们奋笔疾书，唯恐漏掉只言片语。

上一次集会是在2011年，当时芒格87岁，精神矍铄（他于11月28日在洛杉矶一家医院去世，享年99岁）。那是他最后一次作为韦斯科（Wesco）的老板主持股东大会，这家金融集团之后就被伯克希尔全盘收购，芒格也就此结束了他的独角戏。当时他讲了三个小时。和以往一样，他温和地调侃着听众，告诉他们：“你们得再找一个新偶像去崇拜了。”不过显然就如一位记录员所描述的那样，他很享受在“理性的圣堂”里的这番布道。当听众起立鼓掌时，他笑容满面。

回看那次会议的记录，那似乎是一场信马由缰的漫谈。他谈到自己能留给后世的还不够，不过他以基本道德、自律和客观等品质为傲。他给富有的父母该如何养育子女提供了些建议（不要故意制造困苦来试图激励他们，他说，因为他们日后一定会为此怨恨你）。他谈到了在各种错误偏见中保持理性的重要性（他称之为“合奏效应”[Lollapalooza effect]）。他甚至还为《经济学人》说了几句好话，从一份会议记录看，他说这是自己最喜欢的“成人杂志”。

然而这些都不是漫无目的的遐思。它们是他对生活、投资和商业文化深思熟虑得出的世界观的表达——每当不需要以“奥马哈圣人”的坏脾气副手身

份出现在聚光灯下时，他就会在著述和演讲中详细阐述这些观点。正如巴菲特所言，芒格带来的“以公道的价格购买一家好公司，好过以好价格购买一家平庸公司”的智慧，影响了伯克希尔的整个投资哲学。换句话说，这家金融集团能变为如今价值7800亿美元的巨头，他功不可没。

虽然两人离奇地长得很像（芒格更敦实些，至少在晚年），但他们在心智上各有所长。巴菲特是简洁明了风格的大师，芒格则是一位复杂思维者（“查理负责讲话，我就动动嘴唇。”巴菲特曾开玩笑说）。像那些最佳搭档一样——比如微软的盖茨和保罗·艾伦（Paul Allen）、纽约洋基棒球队的米奇·曼托（Mickey Mantle）和罗杰·马里斯（Roger Maris），还有披头士乐队的约翰·列侬和保罗·麦卡特尼——他们优势互补，产生了近乎神奇的效果。在巴菲特和芒格这对搭档身上，这种神奇效果持续了60年。在此期间，两人处得极好，从不吵架。

也和许多成功搭档一样，他们出身相像。和巴菲特一样，芒格也在奥马哈长大。他们在十几岁时先后在巴菲特家的商店里打过工。两人于1959年在奥马哈相见，在那之前不久，刚创办了一家投资公司的巴菲特听一位意向客户说他很像比他大六岁、博学多才的芒格。芒格就此取代了传奇“价值”投资者本杰明·格雷厄姆（Benjamin Graham），成了巴菲特的军师。为芒格作传的珍妮特·洛尔（Janet Lowe）说，他有四个类似格雷厄姆的特质。他诚实、现实、好奇心永无止境，思维不落窠臼。拿这些特质来概况他的经商之道也很适用。

在诚实方面，他把商业领袖的信誉和账目的准确可靠置于首位。他讨厌耍花招（他说，EBITDA这个会计术语应该被替换为“狗屁盈利”）。他公开鄙视某些投资银行家的“妄自尊大”，指责他们是2007到2009年金融危机的罪魁祸首。他在2011年的巧妙恶搞文章中把这些肇事者称为“要多多”（Wantmore），“改多多”（Tweakmore），“胡扯扯”（Totalscum）和“总算错”（Countwrong）。美国则成了傻瓜国（Boneheadia）。

至于务实，他在涉及到生意时绝非轻信的软柿子。他信仰保卫企业的品牌价值、定价权和规模的“护城河”。比如他会这样对比箭牌口香糖和一个更

低价的竞争对手。“我会把一个我一无所知的东西放进我嘴里吗？毕竟嘴巴可是自己的——就图它便宜？”对待新技术要小心谨慎，他如此教诲。了解你的“能力圈”。不要急于进入你不了解的新商业项目。

对他来说，好奇心是终身工程，他相信商业人士应该不断更新他们的知识，挑战他们的假设，更多从错误而非成功中学习。正如他在他的著作和演讲集《穷查理宝典》第一页所说：“获取世俗的智慧并相应地调整你的行为。如果你的新的行为方式让你在同辈中暂时有点不受欢迎……那让他们见鬼去吧。”

最后，思考要敢于打破常规。不要随大流。他热爱孔子，并大胆鼓励美国“与中国和睦相处”，尽管当前两国关系紧张。他说，苹果就是一个例子，它展示了与中国接触对生意和中国都好。他在今年早些时候说，任何与此背道而驰的做法都是“蠢、笨、傻”。即使按芒格的标准，这话也很直白，毕竟他通常都用幽默而非恼怒来表达自己。但这恰好概括了或许可说是他对商业思维的最大贡献。他是那种老派美德的典范——尊重常识。■



Schumpeter

Charlie Munger was a lot more than Warren Buffett's sidekick

In business, he was a paragon of common sense

EVERY MAY tens of thousands of the faithful flock to Omaha, Nebraska, hometown of Berkshire Hathaway, to bask in the presence of the investment firm's two leaders: Warren Buffett, known for his folksy genius, and Charlie Munger, for his killer zingers. But for the truly hard core, for many years a more cloistered gathering took place near Schumpeter's current abode in Pasadena, a lush city on the edge of Los Angeles. At the Pasadena Convention Centre, Mr Munger alone would hold forth, his dry wit in full flow. Recording devices were not allowed, but notetakers scribbled furiously as they tried to keep up.

The last one took place in 2011, when Mr Munger, who died in an LA hospital on November 28th aged 99, was a sprightly 87-year-old. It was his last shareholder meeting as head of Wesco, a financial conglomerate about to be wholly swallowed up by Berkshire, and hence the end of his one-man show. He spoke for three hours. As usual, he poked gentle fun at the audience, telling them, "You folks need to find a new cult hero." Yet he clearly enjoyed delivering what one scribe called his sermon from the "Church of Rationality". He beamed when they gave him a standing ovation.

Looking back through notes of that meeting, the themes he dwelt on seem random. He discussed what he felt was his inadequate legacy, though he took pride in attributes such as basic morality, self-discipline and objectivity. He advised rich parents how to look after their children (don't try to motivate them with artificial hardships, he said, because they will inevitably hate you for it). He discussed the importance of being rational amid mistaken biases (which he called the "Lollapalooza effect"). He even

put in a good word for The Economist, describing it, according to one notetaker, as his favourite “adult magazine”.

And yet those were not scattershot musings. They echoed a carefully thought out worldview on life, investment and business culture that he expounded on extensively in writings and speaking engagements whenever he was not in the spotlight as the Sage of Omaha’s curmudgeonly sidekick. As Mr Buffett put it, Mr Munger influenced Berkshire’s entire investment philosophy by introducing the wisdom that it is “better to buy a good business at a fair price than a fair business at a good price”. In other words, he deserves a big share of the credit for turning the financial conglomerate into the \$780bn powerhouse that it has become.

Though the two men bore an uncanny physical resemblance (Mr Munger, at least later in life, was more portly), intellectually they had different strengths. Mr Buffett is a master of the plain and simple; Mr Munger was a complex thinker (“Charlie does the talking, I just move my lips,” Mr Buffett once quipped). Like the best duos—think Bill Gates and Paul Allen at Microsoft, Mickey Mantle and Roger Maris at the New York Yankees, and John Lennon and Paul McCartney in The Beatles—their strengths complemented each other, producing something almost magical. In the case of Messrs Buffett and Munger the magic lasted for 60 years. During that time they famously never had a row.

As with many successful partnerships, they shared common roots. Like Mr Buffett, Mr Munger grew up in Omaha. As teenagers both worked in the Buffett family store at different times. They met in Omaha in 1959, not long after Mr Buffett, then owner of a fledgling investment firm, had been told by a potential client that he resembled the erudite Mr Munger, who was six years his senior. He came to replace Benjamin Graham, a legendary “value” investor, as Mr Buffett’s sounding board, with four qualities that Janet Lowe, Mr Munger’s biographer, said resembled Graham’s. He was honest, realistic,

profoundly curious and unfettered by conventional thinking. Those are as good traits as any to summarise his approach to business.

In terms of honesty, he put the trustworthiness of business leaders, and the soundness of their accounts, above all else. He hated gimmickry (the accounting term EBITDA, he said, should be substituted with “bullshit earnings”). He was openly scornful of the “megalomania” of some investment bankers, whom he blamed for the financial crisis of 2007-09. In a deft parody penned in 2011 he described the perpetrators as Wantmore, Tweakmore, Totalscum and Countwrong. America was Boneheadia.

As for realism, he was no softy when it came to business. He believed in “moats” that safeguarded firms’ brand value, pricing power and scale. Take Wrigley’s Chewing Gum versus a cheaper competitor, for instance. “Am I going to take something I don’t know and put it in my mouth—which is a pretty personal place, after all—for a lousy dime?” Handle new technologies with care, he preached. Know your “circle of competence”. Don’t rush into new ventures you don’t understand.

For him, curiosity was a lifelong project, and he believed that business people should constantly refresh their knowledge, challenging their assumptions and learning from mistakes more than successes. As he said on the first page of “Poor Charlie’s Almanack”, a compilation of his writings and speeches: “Acquire worldly wisdom and adjust your behaviour accordingly. If your new behaviour gives you a little temporary unpopularity with your peer group...then to hell with them.”

Finally, think unconventionally. Don’t follow the herd. He loved Confucius and boldly encouraged America to “get along with China” despite the current tensions. Apple, he said, was an example of how engaging with China was both good for business and good for China. Everything that worked in the opposite direction, he said earlier this year, was “stupid,

stupid, stupid". Even by Mr Munger's standards, that was blunt; he normally expressed himself with humour, not exasperation. But it summed up what was probably his greatest contribution to business thinking. He was a paragon of that old-style virtue—common sense. ■



另一种温室气体

政治与技术合力推动油气公司减排甲烷

在对抗气候变化上，甲烷减排最易实现

关于气候变化的讨论大多围绕二氧化碳展开。但二氧化碳并非唯一的温室气体。在各国代表齐聚迪拜参加每年一次的联合国气候变化框架公约缔约方大会（这是第28次会议，即COP28）时，关注焦点更多转向了甲烷。

二氧化碳会在空气中存留几个世纪，甲烷只存留十来年。但在存留期内，甲烷阻碍热量散发的程度是二氧化碳的80多倍。对比2010年代与19世纪下半叶的全球气温，近45%的温差是甲烷带来的变暖效应。甲烷减排往往可以低成本完成，但直到不久之前都鲜有这方面的尝试。

现在情况正在改变。甲烷是从多种源头泄漏至空气中的。其中一些是人为的，如垃圾堆填和农场作业（见图表1），还有一些是天然的，如湿地。不过，在COP28峰会上，焦点将是石油和天然气公司。这些公司被认为是最容易实现甲烷减排的，原因有三：一系列技术使得测量甲烷排放变得更容易；政客越发积极推动甲烷减排；在这样的压力和可能性的交汇之下，连油企老板们也已开始改变想法。COP28主席是来自阿联酋的苏丹·贾比尔（Sultan al-Jaber），他希望在美国和欧盟的助力下，在主要议题之外能就甲烷问题达成一项宏大的协议。

要了解这次峰会可能达成的成果，不妨把目光投向古雅木屋遍布的斯塔万格（Stavanger）——挪威的石油天然气工业之都。挪威与英国、丹麦和荷兰同为北海沿岸国家，这片海域拥有丰富的油气资源。但挪威的油气业温室气体排放量仅为英国的三分之一。

1971年，挪威政府禁止在北海地区的钻井平台上例行“燃除”主要成分为甲烷的天然气。尽管甲烷燃烧会转化为二氧化碳和水，但在燃除时有大量甲烷并未真正燃烧就逃逸到大气中，因此上述禁令实际上是减少了两种气体的排放。

再往后的新规定迫使挪威国家石油公司（Equinor）继续减排（见图表2）。其部分海上钻油平台现在从陆地获取电力，也就无需在平台上燃烧天然气来供电。该公司甚至正在开发专门的海上风电场来为钻井平台供电。半官方机构国际能源署（IEA）认为，假如所有国家的减排强度降低到挪威的水平，那么石油和天然气开采所产生的甲烷排放将减少90%。

其他国家也终于开始跟上。甲烷排放居全球之首的中国于11月7日表示将把甲烷管控纳入国家应对气候变化的规划中。煤炭开采会从煤层释放甲烷，是中国第二大甲烷排放源，仅次于农业。在美国，石油和天然气生产同样是仅次于农业的第二大甲烷排放源。美国已把甲烷监管作为一项优先工作，并呼吁其他国家向一个全球甲烷减排基金捐款，帮助贫穷国家减少甲烷排放。11月15日，欧盟通过了一系列雄心勃勃的甲烷排放标准，覆盖本地及进口能源，被倡导团体美国环保协会（Environmental Defence Fund）的马克·布朗斯坦（Mark Brownstein）誉为“一项突破”。

技术的发展令监督这些承诺的履行变得更容易，环境情报公司Kayrros的创始人安托万·哈尔夫（Antoine Halff）指出。甲烷排放可通过卫星、飞机以至地面传感器等各种方式追踪，海量数据可使用人工智能辅助分析。去年在《科学》上发表的一篇论文分析了来自欧洲航天局一颗卫星的数据。该卫星在2019年和2020年发现了1800个“超级排放源”，即每小时向大气中排放超过25吨甲烷的排放源。这些排放源加起来占石油天然气行业甲烷排放总量的8%到12%。其中大部分集中在阿尔及利亚、美国、伊朗、哈萨克斯坦、俄罗斯和土库曼斯坦这六个国家。

这是个好消息，有两方面原因。几个大污染源比许多小污染源更容易整治，而且也让油气行业更难否认问题的严重性。国际能源署认为，该行业的甲烷真实排放量可能比官方数字高70%。

这已促使西方大企业承认有必要解决甲烷排放的问题。一些石油公司担心监管变严，另一些则看中了亚洲和欧洲的新兴市场，那里也许愿意为经认证的低甲烷排放天然气支付溢价。自2017年以来，美国埃克森美孚和英国壳牌等十几家公司已将甲烷排放强度降低了一半。这些公司既使用了空中

监测等高科技方法，也运用了更换漏气阀门等低科技方法来减排，目前每家公司的甲烷排放量已低于其天然气销售总量的0.2%。

但是，油气行业大部分甲烷排放并非来自私营石油巨头，而是来自数十家国家石油公司，它们坐拥全球大部分油气资源。在COP28峰会上达成的任何协议要取得实质成效，就必须把这些公司纳入其中。峰会主席贾比尔的另一身份是阿布扎比国家石油公司（ADNOC）的老板。在峰会召开前，他就已在会见私营油企和其他国家石油公司的领导。参与这些会议的某位知情人士表示，贾比尔一直在大力敦促其他石油公司老板，希望达成一项协议。

能否达成协议还是个未知数。但不乏好兆头。美国非常希望各国政府和慈善机构出手帮助穷国进行必要的投资。西方大型油企通常与贫穷国家的国家石油公司联合经营油田。经过一番迟疑后，前者现在看似愿意提供技术和资金援助来减少甲烷泄漏。毕竟，未放空或燃除的甲烷可以作为燃料出售，贴补捕集这些甲烷所需的投资。

随着监测技术改进，落后者将承受压力。今年早前，哈尔夫的公司利用卫星数据揭露了土库曼斯坦的油气田泄漏大量甲烷的事件。负面报道促使土库曼斯坦与美国加快了封堵泄漏的谈判。很快，天空中还将出现更多“眼睛”。美国环保协会已经建造了一颗自己的甲烷监测卫星，将于明年发射。用不了多久，无良排放者就将无处藏身。■



The other greenhouse gas

Politics and technology are pushing oil firms to cut methane

When it comes to climate change, methane is low-hanging fruit

MOST DISCUSSIONS about climate change revolve around carbon dioxide. But that is not the only greenhouse gas. As delegates gather in Dubai for the COP28 summit, an annual UN-sponsored climate chinwag, much attention will be focused on methane instead.

Unlike carbon dioxide, which lingers in the air for centuries, methane hangs around for only a decade or so. But during that time it prevents more than 80 times as much heat from escaping. Nearly 45% of the difference between the world's temperature in the 2010s and its temperature in the second half of the 19th century was due to methane's warming effects. Methane emissions can often be cut cheaply. But until recently few have bothered to try.

That is changing. Methane leaks into the air from many sources. Some, such as landfills and farming, are man-made (see chart 1). Others, such as wetlands, are natural. At COP28, though, the focus will be on oil-and-gas companies. Their methane emissions are seen as some of the lowest-hanging fruit, for three reasons. A clutch of technologies have made it easier to measure them. Politicians are increasingly keen to cut them. And that combination of pressure and possibility has begun to change minds even among oil-industry bosses. With help from America and the EU Sultan al-Jaber, COP28's Emirati president, hopes to forge an ambitious deal on methane on the sidelines of the main talks.

To see what might be possible, look to Stavanger, a city of quaint wooden houses that is the capital of Norway's oil-and-gas industry. The country shares the hydrocarbon-rich North Sea with Britain, Denmark and the

Netherlands. Yet greenhouse-gas emissions from Norwegian oil and gas are only a third of what they are in Britain.

In 1971 Norway's government banned the routine "flaring"—or burning—of natural gas, which is mostly methane, from rigs in its area of the North Sea. Although burning methane turns it into carbon dioxide and water, a good deal of flared methane escape unburned, meaning the ban drove down emissions of both gases.

Newer rules have forced Equinor, Norway's state-owned oil company, to continue cleaning up (see chart 2). Some of its offshore platforms receive electricity from land, removing the need to burn gas onboard to provide it. The firm is even developing dedicated offshore wind-farms to power its rigs. The International Energy Agency (IEA), a quasi-official entity, reckons that if all countries reduced the intensity of emissions to Norwegian levels, methane emissions from oil and gas extraction would fall by 90%.

Other countries are making belated efforts to follow suit. China, the world's biggest methane emitter, said on November 7th that it would include the gas in its national climate plan. Coal mining, which liberates the stuff from coal seams, is the second-biggest source of Chinese methane after agriculture. Oil-and-gas production is likewise, after farming, the second-largest source of American methane. It has made regulation of the gas a priority, and has called on other countries to chip in to a global methane-reduction fund to help poor countries lower methane emissions. On November 15th the EU approved an ambitious set of standards on methane emissions covering both domestic and imported energy, which Mark Brownstein of the Environmental Defence Fund (EDF), an advocacy group, calls "a breakthrough".

Policing such promises has been made easier by technology, says Antoine Halff, a founder of Kayrros, an environmental-intelligence firm. Methane

emissions can be tracked by everything from satellites and aeroplanes to ground-based sensors, with artificial intelligence helping analyse the deluge of data. A paper published last year in *Science* analysed data from a satellite run by the European Space Agency. It identified 1,800 “ultra emitters”—methane sources that send more than 25 tonnes per hour into the air—in 2019 and 2020. Together those added up to between 8% and 12% of the oil-and-gas industry’s total methane emissions. Most were found in just six countries—Algeria, America, Iran, Kazakhstan, Russia and Turkmenistan.

That is good news, for two reasons. A few big sources are easier to tackle than lots of tiny ones. And it makes it harder for the industry to deny the scale of the problem. The IEA thinks the true quantity of methane produced by the sector might be 70% higher than the official figure.

That has helped prod big Western firms to acknowledge the need to tackle methane. Some oilmen worry about regulation. Others are eyeing nascent markets in Asia and Europe that may be willing to pay a premium for natural gas certified as having low methane emissions. A group of a dozen companies, including ExxonMobil, an American firm, and Shell, a British one, have cut the intensity of their methane emissions by half since 2017. They have used high-tech methods, such as airborne monitoring, and low-tech ones, like replacing leaky valves. Methane emissions now stand below 0.2% of the total volume of natural gas that each firm sells.

But most methane emissions in the oil-and-gas industry come not from Big Oil but from dozens of national oil companies (NOCs) that sit on top of most of the world’s hydrocarbons. Any deal done at COP-28 will have to include such firms if it is to make much difference. Besides his job running the conference, Mr al-Jaber is the boss of ADNOC, Abu Dhabi’s NOC. He has been meeting leaders of both private sector firms and other NOCs in the run-up to the summit. According to someone involved in those meetings, he has been

pressing his fellow oil bosses hard to agree to a deal.

An agreement is not certain. But there are good omens. America is keen that governments and philanthropic organisations should help poor countries make the needed investments. Big Western oil firms often run oilfields jointly with poor-country NOCs. After some reluctance, they are now thought to be ready to offer technical and financial assistance to cut methane leaks. After all, methane that is not vented or flared can be sold as fuel, helping pay for the investments needed to capture it.

Laggards will be squeezed as monitoring technology improves. Mr Halff's firm earlier this year used satellite data to expose big methane leaks from oil- and gas-fields in Turkmenistan. The bad publicity intensified negotiations between Turkmenistan and America on ways to plug them. And there will soon be even more eyes in the sky. The EDF has built a methane-monitoring satellite of its own. It is due to be launched next year. Soon there will be nowhere for rogue emitters to hide. ■



另一方面.....

二氧化碳的多种价格

此吨不同彼吨

问经济学家某种稀缺品应该卖多少钱，他们通常会说，有人愿意出多少钱就卖多少钱。他们接着会说，确认这种意愿的最佳途径就是市场。目前有各种如这般给二氧化碳定价的体系。但它们给出的答案各不相同，与经济学家认为应该符合实际的正确答案也不吻合。

在大多数人看来，排放一吨二氧化碳似乎没有任何成本。燃料要花钱，烧燃料的设备要花钱，但燃烧产生的废气可以直接排放掉。在少数情况下甚至可以找到买家，例如汽水制造商，或者想要干冰的DJ。

也许排放者不用为排废气花费任何钱，但经济学家坚持认为废气依然是有价值的，而且是负价值。因为被排放的二氧化碳会对环境造成危害，几乎都是由排放者之外的其他人承受。要计入这些外部性，就意味着要把沿海房产和农场生产率受损、热浪导致的死亡（以及因寒潮减少的这类死亡）等方方面面都考虑在内。

这种“碳社会成本”是通过建模估算的。这类模型必须做假设，例如未来损失的影响应该贴现多少，以及如何处理气候损害估算固有的不确定性。不同假设会得出截然不同的成本。

许多地方会运用这些模型的结果来指导政策。例如，在美国，有关燃料标准的决策是以运用碳社会成本的成本效益分析为依据的。根据美国政府目前的估算，每吨二氧化碳（或产生同等升温效果的一定量其他温室气体）的社会成本为51美元。假如该政府听从自家环境保护局的建议，改以不同方式建模，成本将增加至190美元。在特朗普执政期间，因为只考虑对其他美国人影响，成本降至五美元。

碳社会成本也许有时意义重大，但毕竟是个名义概念。碳定价机制所收取

的价格才是实实在在的。这种机制通常会对某个行业的排放设定上限，然后分配（通常通过拍卖）与该上限相当的排放许可证。企业随后在“合规市场”上交易许可证。

经济学家喜欢这类基于市场的“总量控制与交易”机制，因为这样能发现最愿意削减排放的企业。这能有效分散负担，降低把排放控制在上限以下的总成本。但即使成本得到有效分摊，大多数试行此类机制的政府还是希望把总成本保持在低水平：全球排放交易机制的平均价格约为20美元。据国际货币基金组织（IMF）估计，要实现符合《巴黎协定》目标的减排，到2050年，所有排放的价格必须达到每吨280美元。IMF冷冷地指出：“但这在许多国家可能难过政治关，尽管碳定价确有效果。”

定价的第三种方法是找到愿意用不排放换钱的企业，“抵消”排放者的排放。这种方法执行起来有各种弊端和两个根本缺陷。一是这种抵消是自愿的，没有人必须这样做。第二，被抵消的排放仍然是排放，还是会使地球变暖。

碳清除避免了上述第二个问题。假如在一个地方排放了一吨二氧化碳，就从另一个地方的大气中清除一吨二氧化碳，那么对环境造成危害几乎为零。

遗憾的是，目前碳清除的成本远高于政府乐于采用的碳社会成本估算数字，也高于总量控制与交易机制中的价格——比抵消价格高出百倍。如果在一个市场中你排放二氧化碳的花费就是你要将它从大气中清除掉所需支付的价格，这听起来就很有吸引力。但要真正建立这样一个市场将非常困难。 ■



On the other hand...

The many prices of carbon dioxide

Not all tonnes are created equal

ASK AN ECONOMIST what something scarce should cost and they will normally say whatever someone is willing to pay for it. They will go on to say that the best way to establish that willingness is through markets. There are various systems that price carbon dioxide that way. But they do not provide the same answers. And nor do they tally with what economists think might actually be the right answer.

To most people the cost of emitting a tonne of carbon dioxide appears to be nothing. They have to pay for fuel, they have to pay for whatever burns it, but once it is an exhaust gas they can just let it go. In a few cases, they might even find someone to buy it—a fizzy-drink maker, say, or a DJ who wants dry ice.

But though the emissions may not cost the emitter anything, economists insist that they still have a value, and that it is a negative one. This is because the emitted carbon dioxide does harm to the environment, almost all of which is felt by people other than the emitter. To take into account those externalities means taking into account everything from the loss of seafront property and farm productivity to deaths caused by heatwaves (as well as those avoided in cold snaps).

This “social cost of carbon” is estimated through modelling. Those models must make assumptions, such as how much the effects of a future loss should be discounted and what to do about the uncertainty inherent to estimates of climate damage. Different assumptions yield wildly different costs.

In many places the outputs of such models are used to guide policy. In America, for example, cost-benefit analyses which make use of the social cost of carbon feed into decisions about fuel standards. The government currently estimates the social cost at \$51 for every tonne of carbon dioxide (or for an amount of some other greenhouse gas which provides the same warming). If the administration heeded the advice of its own Environmental Protection Agency, which approaches modelling in a different way, the cost would increase to \$190. During Donald Trump's administration, when only costs on other Americans were considered, it fell to \$5.

The social cost of carbon is notional, if sometimes consequential. The costs charged in carbon-pricing schemes are real. Such systems typically place a cap on emissions from a certain sector, and then distribute (often by auction) permits to emit that are equal to that cap. Firms then trade permits in a “compliance market”.

Economists like these market-based “cap and trade” schemes because they discover the firms most willing to make cuts. That spreads the burden in an efficient way and lowers the total cost of keeping emissions below the cap. But even when efficiently spread, the total cost is something which most of the governments experimenting with such schemes have wanted to keep low: the average price charged in the world’s emissions-trading systems is about \$20. The IMF estimates that for Paris-compliant decarbonisation the price per tonne would have to reach \$280 on all emissions by 2050. That, the fund drily notes, “might be politically unpalatable in many countries, despite carbon pricing’s effectiveness”.

A third way to establish a price is to find people willing to be paid not to emit, thus “offsetting” the emissions of those who do. This has various practical drawbacks and two fundamental flaws. One is that offsetting is voluntary; no one has to do it. The second is that offset emissions are still emissions. They still warm the planet.

CDR avoids the second problem. If a tonne of carbon dioxide is removed from the atmosphere in one place at the same time as another is emitted somewhere else, the harm done is pretty much zero.

Unfortunately, the costs of removal are currently a lot higher than the estimates of the social cost of carbon favoured by governments or the prices charged in cap-and-trade schemes; they outstrip offset prices over a hundred-fold. The idea of a market where the cost of emitting carbon dioxide is the price you have to pay to have it removed is very appealing. Actually creating one will be very hard. ■



碳经济

实现全球净零排放需要新市场和新机构

它们某天有望建成

太阳是地球各大循环的主要驱动力。水在阳光的照射下蒸发，形成降雨，从而驱动水循环；阳光让热带地区的温度高于两极地区，从而驱动了大洋环流；植物和藻类利用阳光将二氧化碳转化为树木和叶子、养料和纤维素、覆盖物和腐烂物，形成了生物圈的碳循环。板块运动是一个大大的例外，它由地球内部的热量驱动。

除了刚提到的那些大循环，任何人类活动的循环也需要驱动力，最直接的驱动力就是金钱。目前，用于推动持久性碳移除的资金主要来自愿意为企业研发技术和建立业务提供所需资金的投资者，还有愿意花大价钱购买目前供应量还很小的碳移除服务的财力雄厚的企业和个人。

在过去五年里，这些资金刺激了该行业的繁荣——尽管由于起点很低，这繁荣也没有多大。但从中期来看，那些想要投身碳清除业务的人们会发现自己面对的不确定性正从技术层面转向更基本的层面。原本面对的问题是：有哪些可行的方法？不同方法的成本能降到多低？此后问题会变成：需求在哪里？谁会愿意或是被要求来购买自己的服务？出价又会是多少？

有些政府正在给出支持。其中最慷慨的显然是美国——2032年底前，它为正在运营的直接空气碳捕获项目提供每吨碳180美元的税收抵免；此外，它还支持建立多个碳储存中心和一个直接购买碳清除的小型项目。但“税收抵免不是长久之计，不足以实现我们要移除大气中的二氧化碳并实现净零目标所需的碳清除水平，”美国能源部负责化石能源和碳管理的助理部长布拉德·克拉布特里（Brad Crabtree）表示，“需要有更长期的政策来奖励市场上的那些行动。”

最显而易见的市场是总量控制与交易机制的市场。将碳清除纳入这类市场后，排放者在偿还碳债务时既可以交易该机制下发放的碳配额，也可以交

易因持久性碳清除获得的碳信用。而达到净零时，将不再发放排放许可，所有的排放都用碳清除解决。

一些排放交易计划（ETS）对于纳入碳清除信用的想法持开放态度。但现实中的政治经济变幻莫测。要让此类计划在净排放方面发挥作用，配额之外的任何碳信用都必须能真正对空气成分产生影响。要让在ETS下运营的行业欣然接受这些计划，需要向它们提供廉价且充足的碳信用，而经验表明这容易有问题。16世纪的商人托马斯·格雷沙姆（Thomas Gresham）认为劣币驱逐良币。碳信用也会如此。

欧盟拥有最成熟的ETS，目前未接受任何外部碳信用纳入。它已表示会在2026年之前将碳清除整合进该机制，而作为此举的第一步，它正集中精力制定一个官方的碳清除认证计划。加州的ETS允许企业使用官方认可的碳抵消（绝大多数基于森林碳储存）来履行一小部分减排义务。韩国的ETS和哥伦比亚的碳税也有类似的条款。

如果得到有效监管，这些条款可能会成就一些声誉良好的“基于自然”的碳排放机制，充分利用森林和沿海红树林等资源。但是总量控制与交易市场上的碳配额价格似乎太低，不足以支付更持久的碳清除方法。因此，创建一个独立的碳清除机制（至少作为一种临时措施）就变得很有吸引力。

一种选择是反向拍卖：政府设定碳清除目标，然后与出价最低的公司签订合同。瑞典正是通过这种途径来发展具有碳捕获和储存功能的生物能源；英国正在考虑采用“差价合约”拍卖机制，它在促进离岸风能和核能时已经采用了这种做法：政府不会为全部的碳清除买单，但会支付碳清除价格与碳价格之间的差价。

这样的拍卖系统可能会逐渐发展成一个与碳排放市场并行的碳清除市场。某些行业的企业将被要求购买碳清除，以抵消一部分碳排放。其中一种由牛津大学的迈尔斯·艾伦（Myles Allen）及其同事倡导的做法叫作“碳回收义务”，它要求化石燃料产业必须用等量的碳清除越来越多地抵消其产生的碳排放。当抵消的碳排放达到100%时——可能在2050年——该行业就会

实现碳中和。这种可预见的长期需求增长将会激励创新。

难点在于信任。是否可以信赖政府会逐步加码购买碳清除的义务？化石燃料行业在减排问题上惯于两面三刀，很不可靠；该行业规模庞大，因而对政府有很大的影响力，而其擅长游说又进一步加大了这种影响力。不难想象，化石燃料行业一方面想方设法将自己的碳清除义务冻结在相当低的水平，一方面又让自己可以继续排放大量二氧化碳，这令人不安。

因而就有必要建立一些能建立多方互信的机构。德国经济学家奥特马尔·埃登霍夫（Ottmar Edenhofer）及其同事建议欧盟可以创建一个碳央行来监督碳清除的利用，防止政客让碳货币贬值或者违背承诺。大多数欧盟成员国已经将本国的货币政策交付给了一家独立的银行，或许它们可以在碳政策上如法炮制。但是还有哪些别的国家或国家集团也会这么做呢？

孤零零的古老地球让万物循环往复。它同时也创造了很多新鲜事物，比如类人猿，他们的聪明才智重构了物质和能量在全球范围内的基本流动。很难想象，那些建立在共识和信任基础上的机构会以类似的巨大规模运行。但是能源转型表明这类事情是可以做到的，尽管进展太慢、起步也太迟。如果能源转型以应有的方式继续下去，那么从中获得的经验和全球视角就可能为齐心协力修复碳循环中尚存的泄露打下基础。■



The carbon economy

A net-zero world needs new markets and institutions

It is just possible they will be built in time

THE EARTH'S great cycles are mostly driven by the sun. Sunlight evaporates water to create rain, thus powering the water cycle; it heats the tropics more than the poles, thus driving the ocean's gyres; it is used by plants and algae to turn carbon dioxide into wood and frond, food and fibre, mulch and decay, spinning the biological carbon cycle. Plate tectonics is the great exception, driven instead by the heat of the inner Earth.

Any anthropogenic addition to the roster of great recyclings will have to be driven, too, and the immediate motive force will be money. At the moment, the money driving durable carbon removals is coming mostly from investors willing to provide companies with the money needed to develop their technology and build their businesses and from rich firms and people willing to pay handsomely for the so far small amounts of removal on offer.

Over the past five years that money has spurred a boom in the sector, albeit from a base so low that even the boom is small. But in the medium term would-be carbon removers will find themselves moving beyond technological uncertainties—what methods are viable? how low can costs for different methods get?—to more fundamental ones. Where is the demand? Who will actually be willing, or required, to buy their services, and for how much?

Some governments are helping. By far the most generous is America's, offering a \$180-a-tonne tax credit for direct-air-capture projects under way by the end of 2032; there is also support for carbon-storage hubs and a small programme for buying removals directly. But “tax credits are not a long-term

policy for the level of CDR deployment we'll need to remove carbon dioxide from the atmosphere and meet our net-zero targets," says Brad Crabtree, the assistant secretary for fossil energy and carbon management at the Department of Energy. "There will need to be longer-term policies that reward those actions in the marketplace."

The obvious marketplaces are those of cap-and-trade systems. The inclusion of removals in such markets would mean that emitters could mix allowances issued under the scheme and credits for durable CDR when working off their carbon debt. Net zero would be the point where permits were no longer issued, and removals did all the work.

Some emissions-trading schemes (ETS) are open to the idea of allowing carbon-removal credits. But the political economy is treacherous. For such schemes to work in terms of net emissions, any credits added to the allowances must have a real effect on what is in the atmosphere. For schemes to be palatable to the industries operating under them, the credits need to be cheap and plentiful, which experience suggests means dodgy. Thomas Gresham, a 16th-century merchant, held that bad money drives out good. The same would prove true of carbon credits.

The European Union, which has the most advanced ETS, currently allows no outside credits into its workings. It has said that by 2026 it will have reached a position on integrating removals into the scheme; first, it is concentrating its efforts on an official carbon-removal certification scheme. The California ETS allows companies to meet a small portion of their obligation with officially sanctioned offsets that are overwhelmingly based on storing carbon in forests. The South Korean ETS and the Colombian carbon tax have similar provisions.

If well monitored, these provisions may bring in some reputable "nature-based" schemes that make use of forestry, coastal mangroves and the like.

But the price of the allowances in cap-and-trade markets looks far too low to cover more durable forms of CDR. Hence the attraction of creating a separate mechanism for removals, at least as an interim measure.

One option is a reverse auction: the government sets a target for removals and awards contracts for the companies with the cheapest bids. Sweden is taking this route for bioenergy with carbon capture and storage; Britain is thinking about auctions with a “contract for difference” mechanism like the one it uses to encourage offshore wind and nuclear power: the government would pay not for the whole removal, but for the difference between the price of the removal and the carbon price.

Such an auction system could, in time, develop into a market for removals that operated in parallel with a market for emissions. Companies in some sectors would be required to buy removals to cover a fraction of their emissions. One version of this, championed by Myles Allen of Oxford University and his colleagues, would be a “carbon take-back obligation” under which the fossil-fuel industry would be required to cover an increasing fraction of its production with an equivalent amount of removals. When the fraction reached 100%—perhaps in 2050—the industry would be carbon-neutral. Such a predictable long-term increase in demand would motivate innovation.

The problem is trust. Could governments be relied on to ratchet up the obligation to buy removals? The fossil-fuel industry has a record of being duplicitous and unreliable when it comes to emissions reduction; its sheer size makes it a big influence on governments and its well-oiled lobbying operations amplify that. It is disturbingly easy to imagine the fossil-fuel industry contriving to have its removal obligations frozen at a fairly low level while continuing to make possible a lot of emissions.

That makes the case for institutions which build trust. Ottmar Edenhofer, a

German economist, and colleagues have suggested that the EU might create a central bank for carbon to supervise the use of removals, preventing politicians from debasing the currency or breaking commitments. Most of the EU's members have surrendered monetary policy to an independent bank. Perhaps they could do the same for carbon policy. But what other states, or groups of states, might do the same?

The Earth, isolated and ancient, recycles everything. It also brings forth novelties, such as apes ingenious enough to replumb fundamental flows of matter and energy at the level of the planet itself. It is strange to imagine institutions based on agreement and trust acting on a similar giga-scale. But the energy transition is showing that such things can be done, albeit too slowly and too late. If that transition continues in the way it needs to, the experience and planetary perspective gained could be the basis for concerted efforts to fix the remaining leaks in the carbon cycle. ■



个人财务

年轻一代该如何投资

市场给他们发了一手烂牌。他们可以打得更好【深度】

年轻投资者以及每个开始储蓄的人都不乏值得学习的教训。主要的教训都很经典。投资要趁早，让时间这个带来复合增长的因素发挥魔法。削减成本以防止这一奇效被抵消。投资要多元化。不要试图择时入市，除非这就是你的工作。即使价格暴跌，感觉天要塌下来了，也要坚守你的策略。不要在市场飞涨、看着别人发财眼红就去追逐热门资产而毁了你的策略。

在这个历经时间考验的教训清单上，还可以专为当今年轻人再加上一条更令人沮丧的教训，那就是他们根本得不到父母辈当年那么高的回报。即使算上2007年至2009年全球金融危机那段时间，2021年之前的四十年对于投资者来说仍然堪称黄金时代。一个全球股票广泛指数的年化实际回报率为7.4%。这不仅远高于之前80年的4.3%，而且还伴随着债券市场的大幅上涨。同期，全球债券的年化实际回报率为6.3%，远好于之前80年的0%。

那个黄金时代现在几乎肯定已经结束了。它最初是由全球化、通货膨胀平稳以及利率长期下降造成的，最后一个因素尤为重要。这些趋势现在都已发生逆转。因此，年轻人必须面对一系列更加困难的投资选择——该存多少钱、如何充分利用回报更少的市场，以及如何调和道德观与寻求回报。到目前为止，许多人都做出了错误的选择。

资产管理行业有一句老话——历史表现并不能保证未来回报，这说得再贴切不过了。如果市场回报恢复到更长期跨度的平均水平，对于当今的年轻投资者（40岁以下）来说，回报差异将是巨大的。算上20世纪80年代之前的低迷年份和之后的丰收年份，股票和债券的长期平均年投资回报分别为5%和1.7%。这种平均回报维持四十年之后，投资1美元股票的实际价值将为7.04美元，投资1美元债券的实际价值为1.96美元。对在2021年前的40

年间持续投资的人来说，相应数字分别为17.38美元和11.52美元。

这给现在刚起步的投资者带来了两个危险源。首先，回顾近年的历史之后，他们对市场回报的期望会远高于根据更长期分析得出的期望。这样的结果就是他们最终为退休准备的储蓄太少，以为投资回报能补足退休所需。第二个更令人沮丧的危险是，多年来异常丰厚的回报不仅给投资者带来了不切实际的高期望，还使得未来更有可能出现低回报。

对冲基金AQR的安蒂·伊尔曼宁（Antti Ilmanen）在去年出版的《在低预期回报环境下投资》（Investing Amid Low Expected Returns）一书中陈述了这一观点。20世纪80年代开始的债券收益率长期下降最容易让人理解这一点。由于价格与收益率成反比，这种下跌为债券持有人带来了巨额资本收益，也是他们在此期间所享受的高回报的来源。然而，收益率越接近零，未来资本收益的空间就越小。近年来，尤其是近几个月来，收益率大幅攀升，十年期美国国债名义收益率从2020年的0.5%升至如今的4.5%。但由此造就的未来资本收益空间仍然远不及20世纪80年代初收益率接近16%时那么大。

同样的逻辑也适用于股票，股息和收益率（股票回报的主要来源）随着利率同步下降。同样，这产生的一个结果就是股东获得了意外的估值收益。同样，这些收益本质上是透支未来的回报——股价提高，这也就降低了后进入市场的投资者从股息和企业利润中可预期的收益。这样的代价便是年轻一代投资者的回报前景更乏善可陈。

去年几乎所有资产类别的价格都在跌，这似乎有一个好处，那就是由此带来的收益率上升将改善回报前景。对实际收益率由负转正的大量政府债券来说就是这样。对于公司债券和其他形式债务的投资者来说也是如此，但需要注意的是，借贷成本上升会增加公司违约的风险。“如果在行情特别好的时候，你能通过优先担保银行债务赚到12%、甚至13%的回报，那还有什么不知足的？”私人投资公司黑石集团（Blackstone）的老板苏世民（Steve Schwarzman）最近发问。

尽管如此，过去一直是投资者收益的主要收益来源的股票的长期前景并不乐观。虽然去年股价下跌，但今年大部分时间股价都在强劲复苏。这导致收益率再度受压，预期回报率也就相应下降。对美国标普500指数中的大型股票来说，这种受压已经非常严重。股票风险溢价——即投资高风险股票获得的高于“安全”政府债券的预期回报——已降至数十年来最低水平（见图表1）。除非有超高且持续的盈利增长，否则唯一可能出现的结果就是股价大幅下跌，或是未来多年里回报令人失望。

对年轻的储蓄者来说，这些都让做出明智的投资决策变得异常重要。面对不理想的市场条件，他们比以往任何一代人都更有必要充分利用有限的机会。好消息是，如今的年轻人比以往任何一代人都更容易获取金融信息、接触易于使用的投资平台和低成本指数基金。坏消息是，太多年轻人正陷入会削减他们本就已微薄的预期回报的陷阱之中。

第一个陷阱是持有过多现金，这是一个老问题，但年轻人特别容易犯这个错误。资产管理巨头先锋领航（Vanguard）在2022年底分析了700万个散户账户后发现，年轻人比前几代人的现金配置更多（见图表2）。Z世代（1996年后出生）的平均投资组合中，29%是现金，而婴儿潮一代为19%。

这可能是因为在各类资产价格普遍下跌的一年结束时，年轻投资者更有可能选择保留现金。他们也可能受到了几个月里有关央行加息的头条新闻的诱惑，而对于那些有更久远记忆的人来说，这并不是什么新鲜事。先锋领航的安迪·里德（Andy Reed）提出了另一种可能的解释。年轻人换工作并将养老金储蓄转入新账户时，往往会将其投资组合切换为默认选择现金。然后，出于惯性或忘记了这回事，绝大多数人最终没有切换回原本很可能在长期内为他们赚取更多回报的投资方式。

无论动机如何，年轻投资者对现金的偏好让他们容易受到通胀的影响，还会承担因错失其他投资回报而造成的机会成本。在先锋领航这项2022年底的调查过后的几个月里发生的情况就是一个很好的例子。当时股价飙升，那些之前将股票出手的人就错过了这些收益。更广泛地来看，自1900年以来

来，短期国债（短期政府债务，实际收益率与现金类似）的长期实际回报率仅为每年0.4%。尽管央行多次加息，但在现代投资平台上持有的现金的典型回报率甚至低于短期国债。现金连维持投资者的购买力都难，更不用说增加了。

第二个陷阱是第一个陷阱的镜像：不愿拥有债券。债券是现金之外的另一种“安全”资产类别。它仅占Z世代典型投资组合的5%，而婴儿潮一代的比例为20%，而且每一代人投资债券的可能性都低于上一代。再加上年轻投资者的现金持有比例高，这导致不同代际的投资组合中这两种资产类别的比例存在显著差异。婴儿潮一代持有的债券高于现金，而在典型的千禧一代的投资组合中，两者之比为1:4。Z世代的这个比例是1:6。

考虑到年轻投资者成长过程中的市场状况，这可能并不奇怪。全球金融危机之后的那些年里，许多富裕国家的政府债券收益很少甚至根本没有。再后来，随着去年利率飙升，债券损失惨重，没法再被视为真正的“安全”资产。

但即使可以理解年轻人为什么看不上债券，这种鄙视也是不明智的。债券现在的收益率比2010年代更高。更重要的是，债券往往能跑赢通胀而现金不能。自1900年以来，美国债券的长期实际回报率为每年1.7%，与股票相比并不高，但比现金高得多。

第三个陷阱叫什么，不同的人有不同的说法。对于资产管理行业来说，这个陷阱叫“主题投资”。说得不客气点，这是一种通过销售定制产品来招揽生意的做法，目的是跟上最新的市场潮流，并让投资者忘乎所以，觉得自己足够精明，能够击败市场。

如今，专业押注主要通过交易所交易基金（ETF）进行，这些基金管理的资产在全球范围内飙升至超过10万亿美元。有些ETF专门押注波动性、大麻股票以及与美国电视名人吉姆·克莱默（Jim Cramer）的建议相反的头寸。更体面一些的ETF会试图从人口老龄化和人工智能等可能真正带来回报的大主题上获利。一个巨大的子类别包括根据环境、社会和治理

(ESG) 因素进行的策略投资。

利基策略并不新鲜，人们对它们的缺陷也不会陌生。使用利基策略的投资者面临更大的波动性、更小的流动性和高额的费用。与那些专注于整体市场的投资者相比，利基策略投资者要承受更大的投资潮流改变的风险。即使是那些选择明智主题的人也要和专业基金经理竞争。

然而，只需在手机屏幕上点击几下即可轻松定制、宣传和销售的ETF是前几代投资者不必考虑的事情。同样不需要他们考虑的还有ETF营销中的道德诉求。ESG投资工具作为道德中立的选择摆在了年轻人面前。如果有一些投资可以拯救社会和地球，同时又能增加个人积蓄，那什么样的恶人还会去买那些普通且肮脏的投资工具呢？

这既夸大了ESG基金与“普通”基金之间的差异，又掩盖了它们对成本和回报的影响。根据哈佛商学院最近的一项研究，按照ESG标准投资的基金收取的费用比非ESG基金要高得多。此外，尽管ESG基金投资组合收取的费用更高，其68%的投资资产与非ESG基金完全相同。此类基金还会回避化石燃料开采商等“肮脏”资产，而如果这种回避迫使这类资产价格下降，它们的利润可能会生成更高的投资收益率。

与当今年轻人和其父辈巨大的投资前景差异相比，避免这些陷阱所获得的好处似乎不大。而事实上，正是因为市场看起来特别缺乏吸引力，年轻投资者才必须收获回报。与此同时，他们正在形成的投资习惯很可能会持续一段时间。先锋领航的里德指出，有证据表明，投资者的早期市场经历会在未来多年影响他们的资金配置。

里德的团队按照先锋领航的散户的开户年份对其投资组合进行排序，计算出了每个年份的中位股票配置（见图表3）。结果显示，那些在行情好的年份开户的投资者即使在几十年后也仍然保持着较高的股权配置。那些在互联网泡沫膨胀的1999年开户的投资者中，在2022年的中位投资组合中股票仍占86%。而在那些2004年开户的投资者中，相应的数字仅为72%，那时他们对互联网泡沫破裂仍然记忆犹新。

因此，今天的年轻投资者所选的策略很有可能将在未来数十年延续下去。伊尔曼宁关于低预期收益率的论述以“宁静祷文”开篇，祈求“赐我宁静，去接受我无法改变的一切；赐我勇气，去改变我所能改变的一切；并赐我智慧，去分辨二者的不同”。这可能是最好的投资建议了。■



Personal finance

How the young should invest

Markets have dealt them a bad hand. They could be playing it better

YOUNG INVESTORS, as well as everyone starting to save, have no shortage of lessons to learn. The main ones are classics. Begin early to give the magic of compounding time to work. Cut costs to stop that magic from being undone. Diversify. Do not try to time the market unless it is your job to do so. Stick to your strategy even when prices plummet and the sky seems to be falling in. Do not ruin it by chasing hot assets when the market is soaring, others are getting rich and you are getting jealous.

To this time-worn list, add an altogether more dispiriting lesson specific to today's youngsters: you will not enjoy anything like the returns your parents made. Even accounting for the global financial crisis of 2007-09, the four decades to 2021 were a golden age for investors. A broad index of global shares posted an annualised real return of 7.4%. Not only was this well above the figure of 4.3% for the preceding eight decades, but it was accompanied by a blistering run in the bond market. Over the same period, global bonds posted annualised real returns of 6.3%—a vastly better result than the 0% of the preceding 80 years.

That golden age is now almost certainly over. It was brought about in the first place by globalisation, quiescent inflation and, most of all, a long decline in interest rates. Each of these trends has now kicked into reverse. As a consequence, youngsters must confront a more difficult set of investment choices—on how much to save, how to make the most out of markets that offer less and how to square their moral values with the search for returns. So far, many are choosing badly.

The constant refrain of the asset-management industry—that past performance is no guarantee of future returns—has rarely been more apt. Should market returns revert to longer-run averages, the difference for today's young investors (defined as under-40s) would be huge. Including both the lacklustre years before the 1980s and the bumper ones thereafter, these long-run averages are 5% and 1.7% a year for stocks and bonds respectively. After 40 years of such returns, the real value of \$1 invested in stocks would be \$7.04, and in bonds \$1.96. For those investing across the 40 years to 2021, the equivalent figures were \$17.38 and \$11.52.

This creates two sources of danger for investors now starting out. The first is that they look at recent history and conclude markets are likely to contribute far more to their wealth than a longer view would suggest. A corollary is that they end up saving too little for retirement, assuming that investment returns will make up the rest. The second is even more demoralising: that years of unusually juicy returns have not merely given investors unrealistically high hopes, but have made it more likely that low returns lie ahead.

Antti Ilmanen of AQR, a hedge fund, sets out this case in “Investing Amid Low Expected Returns”, a book published last year. It is most easily understood by considering the long decline in bond yields that began in the 1980s. Since prices move inversely to yields, this decline led to large capital gains for bondholders—the source of the high returns they enjoyed over this period. Yet the closer yields came to zero, the less scope there was for capital gains in the future. In recent years, and especially recent months, yields have climbed sharply, with the nominal ten-year American Treasury yield rising from 0.5% in 2020 to 4.5% today. This still leaves nowhere near as much room for future capital gains as the close-to-16% yield of the early 1980s.

The same logic applies to stocks, where dividend and earnings yields (the

main sources of equity returns) fell alongside interest rates. Again, one result was the windfall valuation gains enjoyed by shareholders. Also again, these gains came, in essence, from bringing forward future returns—raising prices and thereby lowering the yields later investors could expect from dividend payouts and corporate profits. The cost was therefore more modest prospects for the next generation.

As the prices of virtually every asset class fell last year, one silver lining appeared to be that the resulting rise in yields would improve these prospects. This is true for the swathe of government bonds where real yields moved from negative to positive. It is also true for investors in corporate bonds and other forms of debt, subject to the caveat that rising borrowing costs raise the risk of companies defaulting. “If you can earn 12%, maybe 13%, on a really good day in senior secured bank debt, what else do you want to do in life?” Steve Schwarzman, boss of Blackstone, a private-investment firm, recently asked.

Even so, the long-term outlook for stocks, which have historically been the main source of investors’ returns, remains dim. Although prices dropped last year, they have spent most of this one staging a strong recovery. The result is a renewed squeeze on earnings yields, and hence on expected returns. For America’s S&P 500 index of large stocks, this squeeze is painfully tight. The equity risk premium, or the expected reward for investing in risky stocks over “safe” government bonds, has fallen to its lowest level in decades (see chart 1). Without improbably high and sustained earnings growth, the only possible outcomes are a significant crash in prices or years of disappointing returns.

All this makes it unusually important for young savers to make sensible investment decisions. Faced with an unenviable set of market conditions, they have a stronger imperative than ever to make the most of what little is on offer. The good news is that today’s youngsters have better access

to financial information, easy-to-use investment platforms and low-cost index funds than any generation before them. The bad news is that too many are falling victim to traps that will crimp their already meagre expected returns.

The first trap—holding too much cash—is an old one. Yet youngsters are particularly vulnerable. Analysis of 7m retail accounts by Vanguard, an asset-management giant, at the end of 2022 found that younger generations allocate more to cash than older ones (see chart 2). The average portfolio for Generation Z (born after 1996) was 29% cash, compared with baby-boomers' 19%.

It could be that, at the end of a year during which asset prices dropped across the board, young investors were more likely to have taken shelter in cash. They may also have been tempted by months of headlines about central bankers raising interest rates—which, for those with longer memories, were less of a novelty. Andy Reed of Vanguard offers another possibility: that youngsters changing jobs and rolling their pension savings into a new account tend to have their portfolios switched into cash as a default option. Then, through inertia or forgetfulness, the vast majority never end up switching back to investments likely to earn them more in the long run.

Whatever its motivation, young investors' preference for cash leaves them exposed to inflation and the opportunity cost of missing out on returns elsewhere. The months following Vanguard's survey at the end of 2022 provide a case in point. Share prices surged, making gains that those who had sold up would have missed. More broadly, the long-run real return on Treasury bills (short-term government debt yielding similar rates to cash) since 1900 has been only 0.4% per year. In spite of central banks' rate rises, for cash held on modern investment platforms the typical return is even lower than that on bills. Cash will struggle to maintain investors' purchasing power, let alone increase it.

The second trap is the mirror image of the first: a reluctance to own bonds, the other “safe” asset class after cash. They make up just 5% of the typical Gen Z portfolio, compared with 20% for baby-boomers, and each generation is less likely to invest in them than the previous one. Combined with young investors’ cash holdings, this gives rise to a striking difference in the ratio between the two asset classes in generations’ portfolios. Whereas baby-boomers hold more bonds than cash, the ratio between the two in the typical millennial’s portfolio is 1:4. For Gen Z it is 1:6.

Given the markets with which younger investors grew up, this may not be surprising. For years after the global financial crisis, government bonds across much of the rich world yielded little or even less than nothing. Then, as interest rates shot up last year, they took losses far too great to be considered properly “safe” assets.

But even if disdain for bonds is understandable, it is not wise. They now offer higher yields than in the 2010s. More important, they have a tendency to outpace inflation that cash does not. The long-run real return on American bonds since 1900 has been 1.7% a year—not much compared with equities, but a lot more than cash.

The name of the third trap depends on who is describing it. To the asset-management industry, it is “thematic investing”. Less politely, it is the practice of drumming up business by selling customised products in order to capture the latest market fad and flatter investors that they are canny enough to beat the market.

Today’s specialised bets are largely placed via exchange-traded funds (ETFs), which have seen their assets under management soar to more than \$10trn globally. There are ETFs betting on volatility, cannabis stocks and against the positions taken by Jim Cramer, an American television personality. More respectably, there are those seeking to profit from mega-themes that might

actually drive returns, such as ageing populations and artificial intelligence. An enormous subcategory comprises strategies investing according to environmental, social and governance (ESG) factors.

Niche strategies are nothing new, and nor are their deficiencies. Investors who use them face more volatility, less liquidity and chunky fees. Compared with those focused on the overall market, they take a greater risk that fashions will change. Even those who pick sensible themes are competing with professional money managers.

However the ease with which ETFs can be customised, advertised and sold with a few taps on a phone screen is something that previous generations of investors did not have to reckon with. So is the appeal to morality accompanying their marketing. ESG vehicles are presented to youngsters as the ethically neutral option. If there are investments that will save society and the planet while growing your savings at the same time, what kind of monster would buy the ordinary, dirty kind?

This both overstates the difference between ESG and “normal” funds, and papers over their impact on costs and returns. According to a recent study by the Harvard Business School, funds investing along ESG criteria charged substantially higher fees than the non-ESG kind. Moreover, the ESG funds had 68% of their assets invested in exactly the same holdings as the non-ESG ones, despite charging higher fees across their portfolios. Such funds also shun “dirty” assets, including fossil-fuel miners, whose profits are likely to generate higher investment yields if this shunning forces down their prices.

Next to the vast difference between the investment prospects of today's youngsters and those of their parents, the benefits to be gained by avoiding these traps may seem small. In fact, it is precisely because markets look so unappealing that young investors must harvest returns. Meanwhile, the

investment habits they are forming may well last for some time. Vanguard's Mr Reed points to evidence that investors' early experiences of markets shape their allocations over many years.

Ordering the portfolios of Vanguard's retail investors by the year their accounts were opened, his team has calculated the median equity allocation for each vintage (see chart 3). The results show that investors who opened accounts during a boom retain significantly higher equity allocations even decades later. The median investor who started out in 1999, as the dotcom bubble swelled, still held 86% of their portfolio in stocks in 2022. For those who began in 2004, when memories of the bubble bursting were still fresh, the equivalent figure was just 72%.

Therefore it is very possible today's young investors are choosing strategies they will follow for decades to come. Mr Ilmanen's treatise on low expected returns opens with the "serenity prayer", which asks for "the serenity to accept the things I cannot change, the courage to change the things I can, and the wisdom to know the difference". It might be the best investment advice out there. ■



玩得漂亮

数学如何帮你赢下你最爱的游戏

一部寓教于乐且提供大量实用技巧的全球游戏史【《环“游”世界八十题》书评】

《环“游”世界八十题》，马库斯·杜·索托伊著。Basic Books出版社；384页；30美元。Fourth Estate出版社；16.99英镑。

玩《大富翁》时，哪些地皮最值得买？该在这些地皮上建多少房子？玩《征服世界》（Risk）时，应该首先攻下哪个大洲？玩西洋双陆棋时，用倍数骰子的最佳策略是什么？这些都是英国数学家、牛津大学教授马库斯·杜·索托伊（Marcus du Sautoy）在一本轻松愉快的游戏史著作中思考并回答的问题。

从中东的古代游戏（西洋双陆棋、乌尔皇室博奕棋[Royal Game of Ur]、埃及的塞尼特棋戏[Egyptian game of senet]）开始，以欧洲的现代游戏（如《瘟疫危机》[Pandemic]、《嗒宝》[Dobble]）结束，本书按地理位置布局，恰似一趟环球之旅。一路上，作者探讨了许多以前的热门游戏（《妙探寻凶》[Cluedo]、《拼字游戏》[Scrabble]、《战国风云》[Risk]）、近期流行的游戏（填字游戏《Worldle》、桌游《卡坦岛》[Settlers of Catan]），还有来自各自不同文化和历史时期的不那么知名的游戏，比如非洲的播棋（mancala）和印度圆扑克（ganjifa），在这些游戏中入夜后规则会有所改变。

这不是一份巨细靡遗的清单，甚至在种类上也不全面。它是作者本人私藏的展示。其中包括一些电子游戏（《波斯王子》[Prince of Persia]、《生命游戏》[Game of Life]）和一款体育游戏（玛雅的球类游戏pitz）。

当然，所有这些游戏为杜·索托伊提供了一个机会，让他在书中穿插了大量的数学解释，他称之为“在我喜爱的许多游戏的表面之下流淌着的诱人的数学盛宴”。他写道，玩游戏“和我对数学的钟爱正好重合”：要在一套规则的范畴里解开一个问题，需要克服障碍，以及最终迎来恍然大悟、找

到破题口的胜利时刻。

除了运用概率和博弈论，他还用马尔可夫链解释了《大富翁》游戏中的掷骰子，还解释了《太空战争》（Spacewar!）等电子游戏的圆环形场地，以及有限射影平面的几何形状怎样支撑起乍看以为简单的《嗒宝》桌游。在很多游戏中，这些解释给玩家提供了具体的建议。

杜·索托伊说，在《大富翁》里，最值得买的地皮是橙色的，其次是红色的（然后在上面盖三座房子）。玩《战国风云》时，控制北美洲的风险回报率最高，既能获得额外奖励的数目可观的部队，也易于防御。在西洋双陆棋中，如果你认为自己有超过20%的胜算，那就答应玩倍数骰子；如果你认为自己的胜算超过80%，就问对方玩不玩倍数骰子。对了，“TALES”是玩《Wordle》最好的起始词。

这种混合了历史和旅行日志的写法有时显得笨拙，而且有些日志根本不是游戏，而是游戏相关主题的小文章，涉及从传记到心理学的内容。尽管这本书有着鲜明的结构框架，但几乎可以按任意顺序阅读，作者甚至还提出了一个随机安排章节顺序的游戏。（他在附录中给出了有多少种可能顺序的答案，这同时也是用归纳法证明的一个范例。）

有趣、意想不到、在随意设定的固定规则下操作，产生各种复杂的结果，并且提供可用于日常生活的见解——一款优秀的游戏融合了所有这些元素。可以说这本书也是如此。 ■



Well played

How maths can help you win your favourite games

A global history of gaming is educational and filled with practical tips

Around the World in 80 Games. By Marcus du Sautoy. Basic Books; 384 pages; \$30. Fourth Estate; £16.99

WHICH ARE the best properties to buy when playing Monopoly, and how many houses should you build on them? Which continent should you aim to take over first in Risk? And what is the best strategy when using the doubling cube in backgammon? These are some of the questions considered and answered by Marcus du Sautoy, a British mathematician and Oxford professor, in his sprightly, light-hearted history of games and gaming.

The narrative is organised geographically as a trip around the world, starting with ancient games from the Middle East—backgammon, the Royal Game of Ur, the Egyptian game of senet—and ending up in Europe with modern games such as Pandemic and Dobble. Along the way the author considers many old favourites (Cluedo, Scrabble, Risk), recent arrivals (Wordle, Settlers of Catan) and less familiar games from a wide range of cultures and historical periods, such as the African game of mancala and the Indian card game of ganjifa, whose rules change at night.

The list is not exhaustive or comprehensive but reflects his own collection. It includes a handful of video games (Prince of Persia, Game of Life) and one sport (the Mayan ball game of pitz).

All this is, of course, really an opportunity for Mr du Sautoy to sprinkle in plenty of mathematical explanations, to provide what he calls “a celebration of the mathematics that swims seductively just below the surface of many of the games I love”. Playing games, he writes, “overlaps with what I enjoy

about mathematics”: the challenge of solving a problem within a set of rules, the need to overcome obstacles and the victorious “aha” moment when a solution is found.

As well as forays into probability and game theory, he explains dice rolls in Monopoly using Markov chains; the torus-shaped playing field of video games like Spacewar!; and how the geometries of finite projective planes underpin the deceptively simple game of Dobble. And in many cases these explanations provide concrete advice to players.

In Monopoly, says Mr du Sautoy, the best properties to buy are the orange ones, followed by the red ones (and build three houses on them). In Risk, control of North America has the best risk-reward ratio, generating a good supply of bonus armies while being easy to defend. In backgammon, accept a double if you think you have more than a 20% chance of winning; offer one if you think you have more than an 80% chance of winning. Oh, and “TALES” is the best starting word in Wordle.

The hybrid history-travelogue approach is clunky at times, and some of the entries are not games at all, but mini-essays on game-related topics, from biography to psychology. And despite its high-concept framing, the book can be read in pretty much any order; indeed, the author suggests a game to randomise the order of the chapters. (In an appendix, he then works out how many possible options there are, which doubles as an illustration of the technique of proof by induction.)

Fun, unexpected, operating within fixed but arbitrary rules, producing a range of complex outcomes and offering insights that can be applied to everyday life—a good game combines all these elements. The same can also be said of this book. ■



【首文】膨胀的希望

日本会重新焕发活力吗？

价格上涨和“动物精神”给了它期待已久的机会

全球投资者再次为日本心醉神迷。今年春天，沃伦·巴菲特十多年来首次访问东京。他已积累了五大商社的大量股份，覆盖日本商业的广泛领域。上个月，全球最大资产管理公司贝莱德（BlackRock）的首席执行官拉里·芬克（Larry Fink）也加入前往日本首都的朝圣之旅。“历史正在重演。”他对日本首相岸田文雄说。他将眼下与日本上世纪80年代的“经济奇迹”相提并论。即使是11月15日公布的令人失望的GDP数据也不会削弱投资者的乐观情绪。

怀疑论者会说，唯一重演的历史是外人又一次被日本虚幻的曙光迷惑。80年代的奇迹以资产泡沫破裂告终，此后日本陷入了数十年的通缩（或过低通胀）和经济停滞。从那以后，差不多每过十年，包括本刊在内的观察者们就会对新一任首相产生兴趣，发现变革的可喜迹象，进而声称看到地平线上曙光乍现。外国投资者纷纷回流。几年后，他们又心灰意冷地打道回府。最新的这次破晓在望会不会有所不同呢？

真的有这种可能。两道外部冲击和两种内部转变同时发生，改变了日本经济的图景。最明显的冲击与价格有关。近年来，大多数国家都在竭力控制通胀，日本却希望通胀最终可能回升并不再下降。全球供应紧缩和疲软的汇率适时实现了大胆的货币宽松政策多年都无法实现的目标，推高总体通胀率突破了日本央行2%的目标。诚然，这不是日本央行希望看到的需求驱动型通胀。即便如此，它改变了企业、工人和消费者对价格的看法，以及最关键的一——对工资的看法。一条通往更健康的工资和消费增长周期的道路得以铺就，尽管不是一条宽阔坦途。

另一道冲击来自地缘局势。乌克兰战争和中美之间的超级大国对峙刺激了对关键行业的新一波投资，并重新配置了区域供应链，令日本有可能从中

受益。

内部的变化更微妙，但同样重要。在前任首相安倍晋三领导下开启的公司治理改革已经深深扎根。事实上，这些改革已经进入了一个充满希望的新阶段，因为日本的机构投资者——甚至东京证券交易所——正在向大公司施加更大的压力，以提升它们的价值。

这个故事中另一个被低估的环节是代际变化。在老公司里，那些因循1980年代辉煌时期经营方式的老板们正在退出舞台。年轻的企业家想要建立一个崭新的“日本公司”。

然而，日本经济的许多方面仍未改变，也没有改变的迹象。日本要兑现目前的承诺，其政策制定者、高管和政客必须采取更多措施，悉心培育经济活力的萌芽。首先，日本央行必须在未来一年跳好复杂的舞步。它必须在不扼杀刚刚萌发的通胀势头的情况下，解除已经失去效用的非正统货币政策，比如收益率曲线控制。一段时间后，债台高筑的政府可能需要想办法应对上升的利率。

企业改革也必须继续推进。日本公司现在精于良好治理的形式，但需要改进实效。东证500指数中约有40%的公司股价低于账面价值。在一个不稳定的世界里，企业领导人仅仅维持现状是不够的，必须要做得更多。幸好，多年来他们的资产负债表上囤积了不少现金，让他们有足够的操作空间。

岸田文雄已承诺会专注于“经济、经济、经济”。与前任们相比，他更多谈到支持创业公司。然而，他在上月早些时候宣布的最新的经济一揽子计划着重于一次性减税和刺激措施，似乎意在提高他本人的支持率而非长期增长。要做到言行合一，他可以修改税法来奖励敢于冒险的投资者和企业家，而撤回对僵尸企业的支持。他宣扬创立新公司的必要性是正确的，但他也需要承担角色，清理企业枯木。 ■



Inflated hopes

Will Japan rediscover its dynamism?

Rising prices and animal spirits give it a long-awaited opportunity

GLOBAL INVESTORS are giddy about Japan again. Warren Buffett made his first visit to Tokyo in more than a decade this spring; he has built up big holdings in five trading houses that offer exposure to a cross-section of Japan Inc. Last month Larry Fink, CEO of BlackRock, the world's biggest asset manager, joined the pilgrimage to Japan's capital. "History is repeating itself," he told Kishida Fumio, the prime minister. He likened the moment to Japan's "economic miracle" of the 1980s. Even disappointing GDP figures released on November 15th will not dent investors' optimism.

Sceptics would say that the only history repeating itself is outsiders falling for yet another Japanese false dawn. The miracle of the 1980s ended with an asset bubble bursting and the country sliding into decades of deflation, or excessively low inflation, and stagnation. Every ten years or so since then, observers, this newspaper among them, have warmed to a new prime minister, identified promising signs of change and claimed to see the sun peeping over the horizon. Foreign investors flood back. Then a few years later they retreat, cold and disappointed. Is this latest promised dawn any different?

It really could be. Two external shocks and two internal shifts have coincided to change the landscape for the Japanese economy. The most palpable shock has to do with prices. Whereas most countries have been obsessed with keeping inflation down in recent years, Japan has been hoping it might finally pick up—and stay up. Global supply squeezes and a weak exchange rate have duly done what years of audacious monetary easing could not achieve, and pushed the headline inflation rate over the

Bank of Japan's 2% target. Admittedly, that is not the demand-driven inflation that the BoJ would like to see. Even so, it has changed how firms, workers and consumers think about prices and, crucially, wages. A path, albeit a narrow one, has opened to a healthier cycle of wage and consumption growth.

The other shock is geopolitical. The war in Ukraine and the superpower stand-off between America and China have spurred a new wave of investment in critical industries and a reconfiguration of regional supply chains that Japan could benefit from.

The internal shifts are subtler, but no less important. Corporate-governance reforms that began under a previous prime minister, Abe Shinzo, have become entrenched. Indeed, they have entered a promising new phase, as Japanese institutional investors—and even the Tokyo Stock Exchange—are putting more pressure on big companies to enhance their value.

Another underappreciated part of the story is generational change. At old firms, bosses attached to ways of doing business that worked during the glory days of the 1980s are exiting the scene. Young entrepreneurs want to build a new Japan Inc.

Yet much in the Japanese economy remains unchanged and unchanging. For Japan to make good on the promise of the moment, policymakers, executives and politicians must do more to nurture the green shoots of dynamism. For a start, the BoJ must execute a complex dance in the coming year. It must unwind unorthodox monetary policies that have outlived their usefulness, such as its yield-curve control, without suffocating the nascent inflation. In time the highly indebted government will probably have to find a way to cope with rising interest rates.

The process of corporate reform must also continue. Japanese firms are now

well versed in the forms of good governance, but they need to get better at the substance. Around 40% of companies in the TOPIX 500 trade below book value. In an unstable world corporate leaders must do more than just preserve the status quo. Luckily they have plenty of room for manoeuvre, after years of hoarding cash on their balance-sheets.

Mr Kishida has promised to focus on “economy, economy, economy”. Compared with his predecessors, he has spoken more about supporting startups. Yet his latest economic package, announced earlier last month, is heavy on one-off tax cuts and stimulus measures that seem designed to boost his popularity, rather than long-term growth. He could turn words into deeds by revising tax codes to reward risk-taking investors and entrepreneurs and by withdrawing support for zombie incumbents. The prime minister is right to trumpet the need for new-company formation. But he also needs to play his part in clearing away corporate dead wood. ■



肠里乾坤

粪菌移植只是一种新型疗法的开始

微生物组疗法正在兴起【新知】

在伦敦的盖伊和圣托马斯医院（Guy's and St Thomas'）的一个小型实验室里，德西里·普罗索马里蒂（Désirée Prossomariti）正在处理捐献物。它们每一份都要经过称重、病原体检测、过滤、离心等步骤，然后冷冻干燥，再制成粉末、装入胶囊，最后送到患者手里。这个过程需要很强的忍耐力，因为捐献物是新鲜粪便。“现在我已经闻不出它的味道了。”普罗索马里蒂说。

实验人员感兴趣的并不是粪便本身，而是它们所携带的微生物。科学家们早就知道，包括人类在内的动物的肠道中充满了细菌、病毒和其他微生物。但直到不久前，科学家们才意识到它们的重要性。肠道微生物组绝不是些碌碌无为的寄生物，而是健康身体不可或缺的一部分。其成员帮助分解食物、生成能调节宿主身体机能的化学物质，以及抑制其他有害细菌的生长等。

普罗索马里蒂制备的胶囊就是用来抑制这些有害细菌中的一种，所采用的工艺叫作“粪菌移植”（FMT）。五粒胶囊（实验人员通常叫它们“便便胶囊”）可以治疗复发性艰难梭菌感染——这种细菌对许多种抗生素都产生了抗药性。粪菌移植，顾名思义就是要复制一个健康人的肠道生态系统，再移植到一个微生物组失调的人身上。

这种方法也确实行之有效。在英国，FMT是治疗艰难梭菌感染的常规方法，目前人们正在研究用它来治疗肠易激综合征、多发性硬化症等多种疾病。但FMT仅仅是微生物疗法革命的开始。研究人员认为，这场革命的前途在于对微生物组进行调整，以满足特定患者的需求，而不是像目前这样相对简单粗暴地照搬一整套微生物组。芝加哥大学的微生物学家埃里克·帕默（Eric Pamer）表示，FMT是一种权宜之计。

除了“让人恶心”之外（不过研究人员表示，当疗效实实在在摆在患者面前时，他们的恶心感往往就消失了），FMT还有几个问题。比如，捐粪便的人也不会觉得捐献过程多愉悦身心；粪便本身无法标准化——不同捐献者、甚至同一捐献者不同批次的粪便都存在差异。

这就难以做到一致的监管。美国和加拿大将FMT胶囊视为研究性药物。在意大利、荷兰和比利时，FMT被视作组织移植。而英国则认为它是一种药品，对它的监管相对也就更加灵活。

这一切严重限制了FMT的供应。据普罗索马里蒂所在实验室的负责人西蒙·戈登伯格（Simon Goldenberg）估计，英国每年有一千名复发性艰难梭菌感染的患者，其中只有几百人接受了FMT治疗。还有一个问题尚无定论，那就是FMT是否真的可以治疗慢性疾病。加州大学圣地亚哥分校的胃肠病学家贝恩德·施纳布尔（Bernd Schnabl）表示，如果不能治本，就算所有微生物组都被替换掉，疗效也只是暂时的。

因此就需要寻求更精准的疗法。举例来说，施纳布尔重点研究的不是调整患者体内微生物组中某些种类细菌的数量，而是它们产生的代谢物。以与肝硬化有关的氨为例。要减少肠道以及随后的血液循环中氨的存在，一种方法是对氨周围的细菌进行基因改造，提高它清除氨的能力。另一种方法是培养叫作噬菌体的能杀菌的病毒，它可以减少生成氨的微生物的数量。施纳布尔希望明年能够开始对这种噬菌体进行酒精肝方面的试验。

与此同时，由于生产不出那么多符合足够高的安全标准的细菌，那些要使用细菌的试验难以进行。为此，帕默正在研发一些符合严格规定（即GMP——“良好生产规范”，适用于临床试验中使用的各种物质）的生产方法。目前帕默的实验室可以批量生产50升细菌，他希望在11月底前能获得GMP认证。帕默表示，如果认证通过，那么据他所知，该实验室将成为第一个能够足量生产高质量临床试验用细菌的学术机构。他希望明年初能够开展用微生物组疗法治疗肝病的临床试验。

业界对此也很感兴趣。Seres Therapeutics是一家位于马萨诸塞州剑桥市

(Cambridge) 的生物技术公司。它的理念涉及细菌群落设计——将这些细菌群落送入失调肠道的不良环境中，可以让肠道功能恢复正常。Seres的首席科学官马修·海恩 (Matthew Henn) 表示，这里的思路是将细菌本身用作药物，这种药物拥有进化而来的本领，能够去往它该去的地点，并且因其由多种菌株组成，所以可能同时发挥多种功效。

今年4月，美国监管机构食品和药物管理局 (FDA) 批准了一款名为 SER-109 的产品。它是首个使用微生物组疗法的口服药，用于治疗复发性艰难梭菌感染。Seres目前正在用一种叫作SER-155的16联菌种微生物组疗法，对接受异体造血干细胞移植的患者进行试验。异体造血干细胞移植是一种治疗白血病等疾病的方法，通过移植骨髓干细胞来增强患者的免疫系统。其治疗过程中常常大量使用抗生素，有可能严重破坏微生物组，让患者更难抵抗危险的感染。

5月发布的早期试验结果显示，该疗法具有良好的耐受性，而且在接受 SER-155 疗法的九名患者中，在30天内只有一人受到了新的感染；而在未接受该疗法的情况下，一般会有六人受到新的感染。另一项安慰剂对照试验的结果预计将于2024年底公布。

Seres的研究小组已经选定了一些其他类型的易受细菌感染的免疫功能低下的患者，并希望很快开始另外的试验。同时他们也面临竞争。另一家同样位于剑桥市的生物技术公司Vedanta Biosciences生产的VE303由八种无害的艰难梭菌亲缘菌株组成，今年早些时候在79名反复感染有害的艰难梭菌的患者的临床试验中表现良好。八周后的试验结果表明，相比于服用安慰剂的受试者，服用高剂量VE303的受试者患复发性艰难梭菌感染的几率要低。Vedanta Biosciences已经获得了FDA授予的“快速通道”资格，公司希望很快启动一项更大规模的临床试验。

换句话说，微生物组疗法的新时代——比简单粗暴但也有效的FMT更精密复杂——仍处于起步阶段。但它看起来将大有所为。“我们的药物正是这样，”Seres的海恩说，“它们是新一代。”■



Gut feelings

Faecal transplants are just the start of a new sort of medicine

Microbiome treatments are taking off

IN A SMALL laboratory at Guy's and St Thomas' hospital in London, Désirée Prossomariti is processing donations. Each is weighed, tested for pathogens, filtered, centrifuged and then freeze-dried, before being turned into a powder to be encapsulated and given to patients. The process takes a strong stomach, for the donations are of fresh faecal matter. "I don't smell it any more," says Dr Prossomariti.

The lab workers are not interested in the faeces themselves, but the tiny organisms they carry. Scientists have long known that the guts of animals, including humans, are full of bacteria, viruses and other micro-organisms. But it is only recently that they have come to understand just how important they are. Far from a collection of mere passengers, the microbiome is a vital part of a healthy body. Its members help break down food, produce chemicals that regulate the body within which they live, and repress the growth of other, harmful species of bacteria.

It is one of those harmful bacterial species that Dr Prossomariti's pills are designed to repress, through a process known as a "faecal microbiota transplantation" (FMT). Five pills (or "crapsules", as the lab workers like to call them) can overcome a recurrent infection of Clostridium difficile, a bacterium which has evolved resistance to many antibiotics. As its name suggests, the idea is to copy a healthy person's gut ecosystem and reproduce it in someone whose microbiome is out-of-kilter.

It works, too. FMT is a standard remedy for C. difficile infections in Britain, and is being investigated for diseases from irritable bowel syndrome to

multiple sclerosis. But FMT is only the beginning of the microbial-medicine revolution. Researchers believe that, rather than the relatively blunt approach of copying over a microbiome in toto, the future lies in tweaking microbiomes to meet a specific patient's needs. FMT is a stopgap, says Eric Pamer, a microbiologist at the University of Chicago.

Besides the "yuck" factor—which, say researchers, tends to evaporate when patients are presented with the evidence—FMT suffers from several problems. Those who donate the stool find the process off-putting. The stool itself is impossible to standardise, varying across donors and even across donations.

That makes it hard to regulate consistently. America and Canada regard FMT pills as investigational drugs. In Italy, the Netherlands and Belgium, FMT is viewed as a tissue transplant. Britain, meanwhile, considers it a medicinal product, which allows for more flexible regulation.

All this strongly limits supply. Simon Goldenberg, who runs the laboratory where Dr Prossomariti works, reckons that of a thousand patients with recurrent *C. difficile* infections in Britain each year, only a few hundred get the treatment. There is also an open question as to whether chronic conditions could ever be reliably treated with FMT. Even if the entire microbiome is replaced, says Bernd Schnabl, a gastroenterologist at the University of California, San Diego, the benefits will be temporary if the root cause is untreated.

Hence the push for finer-tuned treatments. Rather than tweaking the populations of individual species of bacteria in a patient's microbiome, for instance, Dr Schnabl is focused on the metabolites that they produce. Take ammonia, which is linked to cirrhosis of the liver. One approach to limiting its presence in the gut (and, subsequently, the bloodstream) is to genetically engineer neighbouring bacteria to be better ammonia-eaters. Another is

to grow bacteria-killing viruses, known as phages, which can reduce the number of ammonia-producing microbes. Dr Schnabl hopes to begin a trial of such phages for alcohol-related hepatitis next year.

Trials with bacteria, meanwhile, are hampered by a shortage of bacteria produced to sufficiently high safety standards. Dr Pamer is therefore developing manufacturing methods that meet the stringent regulations—known as Good Manufacturing Practice—that apply to substances used in clinical trials. Dr Pamer hopes his facility, which can churn out bacteria in 50-litre batches, will receive its certification by the end of the month. If it gets it, says Dr Pamer, then to the best of his knowledge that would make it the first academic site capable of producing enough high-quality bacteria to supply trials. He hopes to run clinical trials on microbiome manipulation for liver disease early next year.

Industry is interested, too. Seres Therapeutics is a biotech firm based in Cambridge, Massachusetts. Its philosophy involves designing communities of bacteria that, when parachuted into the hostile environment of a malfunctioning gut, can restore order. Matthew Henn, the firm's chief scientific officer, says the idea is to use the bacteria themselves as a drug; one that has an evolved ability to get to where it needs to go, and whose diversity of constituent species endows it with many possible simultaneous effects.

In April, the Food and Drug Administration (FDA), an American regulator, approved a product called SER-109—the first oral microbiome therapeutic—for use against recurrent *C. difficile* infections. The company is now testing a cluster of 16 bacteria they call SER-155 in patients who have undergone an allogeneic haematopoietic stem-cell transplant, a treatment for diseases such as leukaemia in which bone-marrow stem cells are transplanted in order to strengthen the patient's immune system. This process, which often includes high antibiotic doses, can severely damage

the microbiome, making a dangerous infection harder to fight off.

Early results released in May showed that the treatment was well-tolerated and that, over 30 days, only one new infection occurred in nine patients given SER-155, compared with six that might have been expected without treatment. Additional results from a placebo-controlled trial are expected in late 2024.

The team at Seres have identified other types of immunocompromised patients that are susceptible to bacterial infections, and hope to begin other trials soon. And they have competition, too. Vedanta Biosciences is another biotech company also based in Cambridge. Earlier this year VE303, a product it produces that contains a mixture of eight strains of harmless *C. difficile* relatives, did well in clinical trials on 79 individuals with recurrent infections of the hostile version of the bacterium. After eight weeks, subjects who had taken high doses of the treatment were less likely to get a recurrent *C. difficile* infection than those on the placebo. The company has “fast track” designation from the FDA, and hopes to begin a larger trial soon.

It is early days, in other words, but the prospects for a new era of microbiome medicine, more sophisticated than crude-but-effective FMTs, look promising. “Our drugs are just that,” says Dr Henn, at Seres. “They are the next generation.” ■



【首文】攀登高峰

如何在一个分裂的世界里蒸蒸日上

阿联酋强势崛起的经验教训

未来几周的迪拜将热闹非凡。数以万计的外交官、活动家和商界人士将飞抵那里，参加联合国年度气候变化大会。阿联酋将充分展示它如何在利益截然不同的各个国家与行业间斡旋，以期世界在应对气候变化的问题上取得进一步进展。但这并不是阿联酋值得关注的唯一原因。这个国家也展示了如何在多极时代蒸蒸日上。

阿联酋仅占世界人口的0.1%，也只占世界GDP的0.5%，却坐拥全球石油储量的近10%，这一财富帮助它发挥了超越其体量的影响力。和当今许多新兴国家一样，它在政治和经济分歧中左右逢源。它是一个封闭式专制政体，却又是世界最开放的经济体之一。它是美国的亲密盟友，但它最大的贸易伙伴是中国。虽然其人均GDP超过了英国或法国，但却常常被视为全球南方的一员，它是印度和非洲商业的枢纽，使其成为中东的新加坡。2020年，它是首批与以色列关系正常化的海湾国家之一。

其结果是，就在中东战火肆虐、超级大国对抗使世界分裂之际，阿联酋却欣欣向荣。非油经济每年增长近6%，这样的增速目前只有印度达到，而西方国家——甚至如今的中国——都不可企及。随着中国商人、印度大亨、俄罗斯巨富和西方银行家纷纷寻求稳定和成功，人才和财富正涌入这个国家。去年，该国吸引的外国投资新建项目仅次于美国、英国和印度。

与新加坡一样，阿联酋也是本地区的避风港。然而，新加坡的崛起恰逢全球化的黄金时代，而阿联酋却在混乱无序的时代抓住了机遇。它不仅想实现经济繁荣，更危险的是，还想在海外施加政治影响力。对于其他在分裂的世界中寻找方向的中等强国来说，阿联酋的成功和失败都提供了经验教训。

一个经验是要发挥自身的经济优势。阿联酋也经历过经济上的窘境，尤其

是迪拜由债务推动的建设狂潮，最终导致了危机和2009年的紧急救助。对区块链的痴迷也已消退。但在其他领域，它充分利用自己的优势，取得了令人瞩目的成果。其大型港口的运营商如今在世界各地运作，从伦敦和罗安达，到孟买和马尼拉。迪拜环球港务集团（DP World）就是这样一家公司，其处理的集装箱运输量约占全球的十分之一。马斯达尔（Masdar）是世界最大的清洁能源开发商之一，从得克萨斯州的风力发电场到乌兹别克斯坦的太阳能发电厂，该公司均投下了巨额资金。总体而言，阿联酋现在是非洲最大的投资者之一，帮助这个资本匮乏的大陆在各地建设关键的基础设施。

与此同时，大量的资金、算力和数据帮助阿布扎比的人工智能（AI）研究人员训练出了Falcon——这个开源的大语言模型在某些方面已经胜过了Meta的模型。有专家认为，阿联酋很可能是AI领域里第三重要的国家，仅次于美国和中国。而自始至终，其统治者通过建立良好的经济治理和技术官僚制度，加倍押注于该国作为亚非欧交汇处转口港的价值。

另一条经验是欢迎外国人才。阿联酋本国人口仅100万，需要大量移民，无论技能高低。而世界上到处都是充满干劲、梦想致富的人。沙特阿拉伯在吸引专业人才方面采取严格措施，例如要求在该国设立地区办事处，而阿联酋则专注于成为更有吸引力的居住和经商之地。2019年设立的黄金签证计划为专业人士提供了长期居留权，少数人甚至可以申请公民身份，这在海湾地区闻所未闻。随着时间的推移，刚刚开始摆脱对石油经济依赖的沙特可能会成为劲敌。尽管阿联酋严格限制政治自由，人权记录也不佳，但竞争的威胁正促使它在社会和经济上变得更加自由。

阿联酋也没有忘记贸易的好处。当其他国家纷纷采取产业政策和保护主义时，阿联酋却一直在签署贸易协定。长期警惕自由贸易的印度与阿联酋签署了十年来的首个自贸协定；自那以后，两国的名义贸易额跃升了16%。与以色列的协定则为阿联酋带来了宝贵的技术知识，以色列公司则得到了接触雄厚资金池和进入更大的海湾市场的机会。加沙爆发战争后，西方航空公司停飞了前往特拉维夫的航班。两家阿联酋航空公司——阿提哈德航空（Etihad）和迪拜航空（Flydubai）——还在执行定期航班。

然而，一些机会最终却成了陷阱。随着美国的影响力减弱，雄心勃勃的其他大国都将试图为自己在海外积累影响力。阿联酋的统治者穆罕默德·本·扎耶德适时地掌握了主动权。这个国家的实用主义有时非常好用。在非洲大部分地区，它是受欢迎的商业伙伴，且没有西方的帝国主义包袱；在联合国气候会议上，它希望成为富国和穷国之间的中间人。但阿联酋也犯下了可怕的错误。

由于担心政治伊斯兰在其后院作祟，并希望保护贸易流动，阿联酋正在武装快速支援部队（Rapid Support Forces），这是一支在达尔富尔（Darfur）实施种族灭绝的苏丹民兵。在过去，这种做法遭遇了惨败。在利比亚，阿联酋曾支持一名军阀，他试图在2019年进军的黎波里但失败了。在也门，它曾加入沙特阿拉伯对胡塞叛军的长期战争，直到2019年部分撤军。

多年来，阿联酋的统治者建立起各种机制来确保国内商业环境的稳定，因为他们也知道，内部的失败会很快招致国民的愤怒。但该政权在国外却没有这样的顾虑，这使得它可以随心所欲地维护自己的利益，而不顾这会在其他地方造成什么后果。在一个支离破碎的世界里，许多国家都将寻找新的路径在全球舞台上博弈。阿联酋展现了未来的机遇——还有危险。■



Climbing high

How to thrive in a fractured world

Lessons from the ambitious ascent of the United Arab Emirates

OVER THE next few weeks Dubai will be abuzz. Tens of thousands of diplomats, activists and business folk are due to fly in to join the UN's annual climate pow-wow. The United Arab Emirates' skill at wrangling countries and industries with vastly disparate interests, in the hope of making further progress on tackling climate change, will be on full display. But that is not the only reason to pay attention to the UAE. It also shows how to thrive in the multipolar age.

The country is home to just over 0.1% of the world's people and produces only 0.5% of its GDP, but it contains nearly 10% of the world's oil reserves, and this wealth helps it punch above its weight. Like many emerging countries today, it straddles political and economic divisions. It is a closed autocracy, yet one of the world's most open economies. It is a close ally of America, but its biggest trading partner is China. Although its GDP per person exceeds that of Britain or France, it is often seen as part of the global south and is a hub for Indian and African businesses, making it the Singapore of the Middle East. And in 2020 it was one of the first Gulf countries to normalise relations with Israel.

As a consequence, the UAE is prospering even as war rages in the Middle East and superpower rivalry unravels the world. The non-oil economy is growing at nearly 6% a year, a rate that India is enjoying but that the West—and these days even China—can only dream of. Talent and wealth are flocking to the country, as Chinese traders, Indian tycoons, Russian billionaires and Western bankers alike seek stability and success. Last year it attracted more foreign investment for greenfield projects than anywhere

except America, Britain and India.

Like Singapore, the UAE is a haven for its region. But whereas Singapore's ascent coincided with a golden age of globalisation, the UAE is seizing opportunity in a time of chaos and disorder. It wants not just to thrive economically but, more dangerously, to exert its political influence abroad. Both its successes and its failures hold lessons for middling powers as they navigate a fragmenting world.

One lesson is to play to your economic strengths. The UAE has had its share of economic embarrassments, notably Dubai's debt-fuelled construction binge, which ended in crisis and a bail-out in 2009. An obsession with the blockchain has faded. But in other areas it has made the most of its advantages, to impressive effect. The operators of its vast ports now run sites from London and Luanda to Mumbai and Manila. DP World, one such firm, handles roughly a tenth of all global shipping-container traffic. Masdar, one of the world's biggest clean-energy developers, has ploughed money into everything from wind farms in Texas to solar plants in Uzbekistan. All told, the UAE is now one of the biggest investors in Africa, helping build vital infrastructure across the capital-starved continent.

Meanwhile, access to lots of capital, computing power and data has helped artificial-intelligence researchers in Abu Dhabi train up Falcon, an open-source large language model that in some ways beats Meta's. Some experts reckon that the UAE may well be the third-most-important country for AI, after America and China. And throughout, its rulers have doubled down on the utility of the country's position as an entrepot at the crossroads of Africa, Asia and Europe, by building institutions for good economic governance and technocracy.

Another lesson is to welcome foreign talent. With just 1m locals, the UAE needs lots of both highly skilled and low-skilled migrants. And the world is

full of go-ahead people hoping to make their fortunes. Whereas Saudi Arabia is resorting to heavy-handed measures to attract expertise, such as requiring regional offices to be set up in the country, the UAE focuses on making itself a more attractive place to live and do business. A golden-visa scheme set up in 2019 offers professionals long-term residency; a select few can even apply for citizenship, once unheard of in the Gulf. In time Saudi Arabia, which is just starting to wean its economy off oil, may become a serious rival. Although the UAE severely restricts political freedoms and has a bad record on human rights, the threat of competition is spurring it to become more socially and economically liberal.

Nor has the UAE forgotten the gains from trade. Other countries have favoured industrial policy and protectionism, but it has been doing deals. India, wary of free trade, signed its first such deal in a decade with the UAE; commerce between the two has since leapt by 16% in nominal terms. An agreement with Israel has given the UAE precious tech know-how and Israeli firms access to deep pools of capital and the bigger Gulf market. Western airlines stopped flying to Tel Aviv after the war in Gaza began. Etihad and Flydubai, two Emirati carriers, still make regular flights there.

Yet some opportunities are turning out to be pitfalls. As America's influence wanes, enterprising powers everywhere will be tempted to amass influence abroad for themselves. Muhammad bin Zayed, the UAE's ruler, has duly seized the initiative. The country's pragmatism has sometimes served it well. In much of Africa it is a welcome business partner, without the imperial baggage of the West; at the UN climate meeting, it hopes to be a broker between rich and poor. But the UAE has also made terrible mistakes.

Fearing the influence of political Islam in its backyard, and wanting to protect trade flows, the UAE is arming the Rapid Support Forces, a Sudanese militia that is committing genocide in Darfur. In the past that approach has failed miserably. In Libya the UAE backed a warlord who tried to march on

Tripoli in 2019 and lost. In Yemen it joined Saudi Arabia in a long war against the Houthi rebels, before partially withdrawing in 2019.

Over the years the UAE's rulers have built mechanisms to ensure a stable business environment at home; they know, too, that domestic failures would quickly incur the ire of their citizens. But the regime faces no such constraints abroad, allowing it to indulge its whims and protect its interests, no matter the consequences elsewhere. In a fragmented world, many countries will be looking for new ways to play on the global stage. The UAE shows the promise that lies ahead—and the perils, too. ■



海湾鸿沟？

三场气候争论将成为COP28的重头戏

此次峰会的成败取决于一个人【深度】

联合国气候变化框架公约第28次缔约方大会（COP28）将于11月30日开幕，阿联酋被选为会议举办国引发了各方争议。届时将有大约七万名气候问题倡议者、外交官及其他随从队伍前往迪拜参会。化石燃料给海湾地区带来了巨大财富，很多光鲜亮丽的城市应运而生，迪拜便是其中之一。全球最重要的气候峰会将由一个产油大国主办，这让环保人士群情激愤。而此次会议的主席苏丹·贾比尔（Sultan Al Jabe）正是阿联酋国有石油公司阿布扎比国家石油公司（ADNOC）的掌舵人。阴谋论者私底下议论说，这足以证明一切早安排好了要为石油巨头谋利益。

然而，从波斯湾的阿布扎比（Abu Dhabi）这个从世界上储油最集中的地区通往全球各地市场的航道，到阿曼湾的富查伊拉（Fujairah）这个转运港口——装载着绕开西方制裁的俄罗斯石油的油轮让这里熙熙攘攘——都能感受到面对气候变化的脆弱性。这一地区水资源匮乏，粮食也无法自给。夏季越来越高的气温开始让人难以忍受。建在这些沙漠上的城市要承受海平面上升的危险。事实是阿联酋同样面对全球气温不断上升的威胁，此次会议的忧虑气氛并不会淡一些。

鉴于很多与会代表之间的信任度之低，会谈可能会破裂。这令人担忧。联合国的一份报告分析了COP198个缔约方的国家气候行动计划后指出，它们在限制温室气体排放（见图表1）上的作为远远不够，因此也就难以实现2015年的COP21上通过的《巴黎协定》所提出的限制全球升温的目标。简而言之，此次会议成败与否事关重大。在此次峰会设定的五花八门的技术层面和程序层面的目标中，有三大议题急需采取行动。

一是严格控制甲烷排放，甲烷是一种被忽视的温室气体。二是需要填补气候金融中巨大的资金缺口。三是就如何以及多快停用化石燃料展开一场意

见斗争。而这三项在此次峰会上取得重大进展的前景可以分别用“好”、“坏”和“糟糕透顶”来概括。

好消息来自甲烷，尽管这种温室气体在大气中存留的时间比二氧化碳短得多，但它对全球变暖至少也有四分之一的贡献。环保组织美国环保协会（EDF）的负责人弗雷德·克虏伯（Fred Krupp）坚称，解决甲烷排放问题“是现有的减缓全球变暖速度的唯一最快机会”。

鉴于甲烷是天然气的主要成分，解决能源行业的甲烷排放问题将产生重大影响（见图表2）。而由于天然气开采过程中未被放空或燃除的甲烷可以出售，回报往往会很快，油气行业气候倡议组织（Oil and Gas Climate Initiative，简称OGCI）的比约恩·斯韦德鲁普（Bjorn Sverdrup）表示。该组织是由12家主要的石油和天然气公司组成的联盟，自2017年以来，其成员公司使用监测泄漏以及改进操作的技术，将甲烷排放量减少了大约一半，泄漏率从占天然气总销量的0.3%降至2022年的0.15%。它们承诺将把这一水平保持在0.2%以下。

有传言称许多国有石油公司对此态度抵触，但斯韦德鲁普表示，“在COP上行动的势头在加强”，就连这些国有公司也是如此。作为本月稍早时与美国达成协议的一部分，中国（世界上最大的甲烷排放国）首次表示，将把甲烷问题纳入其国家气候计划。欧盟也刚刚同意严格控制化石燃料的甲烷排放，包括进口的化石燃料。克虏伯认为，一份有许多大型石油公司参与的可信的附带协议，会比官方公布的“措辞雄心勃勃的外交公报更有意义”。贾比尔一直在私下大力督促大型油气公司承诺大幅减排甲烷。

相比于甲烷排放，改善气候金融的希望就比较渺茫了。新兴经济体抱怨发达国家没有履行承诺。富裕国家本应在2020年前提供的1000亿美元至今还未全部到位。去年在埃及举行的COP27上，各方原则上同意设立一个“损失与损害”基金，以补偿易受气候变化影响的国家（这些国家往往排放最少）。经过激烈的谈判，代表们不久前同意将该基金暂时交由世界银行代管，但未能就其资金来源达成一致。欧盟可能会在COP28上宣布为该基金提供部分资金。

环境组织CATF的负责人阿蒙德·科恩（Armond Cohen）认为，相比到2030年及以后每年需要在能源系统改造上花费的数万亿美元，1000亿美元只是“杯水车薪”，而能源系统改造的主体主要是发展中世界需要大量能源的经济体（见图表3）。金融数据公司标普全球（S&P Global）的卡洛斯·帕斯卡尔（Carlos Pascual）坚称“这数万亿美元不会来自公共部门，所以我们必须充分调动私营部门的力量。”有传言称，阿联酋希望发挥推动作用，以自己的石油财富为种子资本，发起一个250亿美元的全球气候基金。

第三个战场最为血雨腥风。应该“逐步减少”还是“逐步淘汰”化石燃料，以及“消减”技术（能够捕获和储存能源使用过程中产生的温室气体）的应用是否可以让化石燃料被继续使用，这两个问题将引发唇枪舌战。

协议很难达成，因为尽快停用化石燃料这一合理的气候目标遭遇到了依赖化石燃料这一同样合理的现实（见图表4）。正如科恩所言：“你可以希望化石燃料消失，但现实是，它们仍然占到世界能源供应的80%，而且还在增长。”全球预测机构国际能源署（IEA）提出的实现净零排放的新构想认为，即使到2050年，化石燃料的使用量也会很大（尽管远低于目前的水平），这让尽快淘汰化石燃料的说法成为笑料。

如果说速度很难讲，至少行进的方向是明确的——随着能效提高、可再生能源以及清洁替代燃料的流行，化石燃料需求很可能会在未来几十年达到峰值，然后开始减少。但是，对于碳捕获与封存（CCS）等消减技术，某些群体深表怀疑，包括那些希望尽快停用化石燃料的国家，它们认为这会成为使用肮脏能源的“免死金牌”。

如果谈判代表能一致同意在有效监测的情况下使用消减技术，那么就能逐步有序地停用化石燃料而让消费者免受供应危机之苦。联合国官方气候科学机构政府间气候变化专门委员会（IPCC）明确表示，本世纪下半叶可能迫切需要大规模使用“负”排放技术，这意味着现在就需要大力推动新兴的消减技术。

阿联酋也希望在气候创新方面扮演领导角色。它已经在大力投资脱碳技

术。今年9月，阿联酋公布了一个大型碳捕获与封存项目，预计消除的温室气体相当于50万辆汽油车的年排放量。ADNOC不久前将其温室气体净零排放目标提前至2045年，比原计划提前了五年。它还大大早于同行，率先停止了甲烷的常规放空和燃除。如今该公司正斥资近40亿美元铺设海底电缆，将无碳电力输送到海上钻井平台，以取代燃烧天然气。

阿联酋的马斯达尔可再生能源公司（Masdar）经营的大型太阳能发电厂生产了世界上最便宜的可再生能源。这家清洁能源巨头是全球第二大清洁能源开发商，ADNOC持有其股份。它承诺到2030年在全球安装100吉瓦的可再生能源容量，而2021年这一数字为15吉瓦。这个绿色的庞然大物是如何在一片盛产石油的土地上冒头的？它创建于2006年，当时太阳能革命尚未兴起，气候技术尚未流行，而创建人正是贾比尔。 ■



A gulf between them?

Three climate fights will dominate COP28

Whether the summit ends in breakdown or breakthrough depends on one man

THE UNITED ARAB EMIRATES, venue for COP28, the latest climate summit convened by the United Nations, is a controversial choice. Some 70,000 climate advocates, diplomats and other hangers-on will attend an event that begins on November 30th in Dubai, one of the gleaming cities built on wealth that fossil fuels have brought to the region. The fact that the world's most important climate gathering will be hosted by a leading oil producer has sparked outrage among environmentalists. That the summit's president, Sultan Al Jaber, runs ADNOC, the UAE's national oil company (NOC), is proof, whisper conspiracists, that the fix is in on behalf of Big Oil.

Yet from Abu Dhabi on the Persian Gulf, the shipping route to global markets for the world's greatest concentration of oil reserves, to Fujairah on the Gulf of Oman, an entrepot abuzz with tankers carrying Russian oil evading Western sanctions, comes a sense of vulnerability to climate change. The region is short on water and home-grown food. The rising heat of summer is becoming inhumane. The cities built on these desert sands are at risk from a rising sea level. That the UAE shares the threat from increasing global temperatures makes the gathering no less fraught.

So low is trust among many delegates that the talks may break down. That would be alarming. A UN report analysing the national climate-action plans of the 198 parties to the COP found them woefully inadequate for tackling emissions (see chart 1) and hence achieving the goal of limiting the global temperature rise called for in the Paris agreement of COP21 in 2015. In short, the stakes are high. Amid the summit's myriad technical and procedural goals, three big topics cry out for action.

The first is the task of cracking down on emissions of methane, an overlooked greenhouse gas (GHG). The second is the need to fill massive shortfalls in climate finance. And the third is an ideological battle over how and how fast to end the use of fossil fuels. The outlook for meaningful progress can be summed up as good, bad and ugly, respectively.

The good news surrounds methane, a GHG that is much shorter-lived in the atmosphere than carbon dioxide but causes at least a quarter of atmospheric warming. Fred Krupp, head of EDF, an environmental group, insists that addressing methane “is the single fastest opportunity available to slow the rate of global warming”.

As methane is the main component of natural gas, tackling emissions from the energy industry would have a significant impact (see chart 2). And often the payback is quick since methane neither vented nor flared during gas extraction can be sold, says Bjorn Sverdrup of the Oil and Gas Climate Initiative (OGCI), a consortium of a dozen leading oil and gas firms. Its members have reduced their methane emissions roughly by half since 2017, from a leakage rate of 0.3% of total marketed gas to 0.15% in 2022, using technologies that monitor leaks and improve operations. They have pledged to keep that level below 0.2%.

Rumours suggest that many NOCs are resistant but Mr Sverdrup reports that “momentum is building for action at COP” even among those companies. As part of a deal struck earlier this month with America, China (the world’s largest methane emitter) says it will, for the first time, include the gas in its national climate plan. The EU has also just agreed strict curbs on methane emissions from fossil fuels, including imports. A credible side deal involving many big oil companies “would mean more than an ambitiously worded diplomatic communiqué” from official proceedings, reckons Mr Krupp. Mr Al Jaber has been pressing big oil and gas firms hard in private to commit to slash methane emissions.

The prospects for improved climate finance are gloomier. Emerging economies will complain about the failure of the rich world to keep its promises. The \$100bn that was due to have been provided by 2020 by rich countries has yet to turn up in full. At COP27 in Egypt last year a “loss and damage” fund was agreed in principle, to compensate vulnerable countries (which often contribute the least emissions). After an acrimonious process, negotiators recently agreed to give the World Bank a temporary role in hosting this new facility but failed to agree to fund it. The EU may announce some funding for it at COP28.

Armond Cohen, head of CATF, an environmental group, calls \$100bn “the tip of the iceberg” compared with the trillions of dollars needed annually by 2030 and beyond to transform energy systems, mostly in energy-hungry economies of the developing world (see chart 3). Carlos Pascual of S&P Global, a financial-data firm, insists “those trillions of dollars will not come from the public sector, so we have to leverage the private sector.” Rumours suggest that the UAE wants to play a catalytic role by launching a \$25bn global climate-finance fund seeded with its own oil riches.

The third arena of battle is the ugliest. Much blood will be spilt over the question of whether fossil fuels should be “phased down” or “phased out” and whether the use of “abatement” technologies (which enable the capture and storage of GHG emissions from energy use) should permit the continued use of fossil fuels.

A deal is hard to reach because the legitimate climate ambition of a rapid end to burning fossil fuel runs into the equally legitimate reality of fossil dependence (see chart 4). As Mr Cohen observes, “You can wish fossil fuels away, but they still comprise 80% of world energy supply and are growing.” A new scenario from the IEA, a global forecaster, for achieving net-zero emissions envisions a significant amount of fossil-fuel use even in 2050 (albeit at much lower levels than today), making a mockery of talk of rapid

phase-out.

At least the direction of travel is clear if not the pace, with fossil fuels likely to peak and decline in coming decades as efficiency, renewables and alternative clean fuels take off. But when it comes to technologies for abatement of emissions like carbon capture and sequestration (CCS), scepticism runs deep in some quarters, including countries that want a fast end to fossil fuel and which think this will be a “get-out-of-jail-free card” for dirty energy.

If negotiators can agree to allow well-monitored use of abatement, it would permit a managed end to fossil-fuel use that spares consumers painful supply shocks. The IPCC, the UN’s official climate-science body, makes clear that technologies for “negative” emissions could well be needed at massive scale in the second half of the century, which means nascent abatement technologies need a big push now.

The UAE wants to play a leading role on climate innovation, too. It has been investing heavily in decarbonisation. A big CCS project capable of removing GHGs equivalent to the annual emissions of half a million petrol-powered cars was unveiled in September. ADNOC recently brought forward its net-zero GHG target for its operations by five years to 2045. It stopped routine methane venting and flaring long before its peers. The company is spending nearly \$4bn on undersea cables to ship carbon-free electricity to offshore rigs to replace burning natural gas.

Huge solar farms run by Masdar produce the world’s cheapest renewable energy. This Emirati clean-energy giant, in which ADNOC has a stake, is the world’s second-biggest developer of clean energy. It has committed to installing 100 gigawatts of renewable-energy capacity globally by 2030, up from 15 gigawatts in 2021. How did this green behemoth emerge in a land flush with oil riches? It was started back in 2006, before the solar revolution

took off and climate tech became fashionable—by Mr Al Jaber. ■



熊彼特

矛盾体山姆·阿尔特曼

OpenAI的老板是天才还是机会主义者？

就叫它科技业的“火人节”理论吧。时不时地，科技先行者的希望与梦想就几乎被身边的人付之一炬。1985年，乔布斯被他一手创立的苹果公司解雇，11年后才回归。2000年，身为X.com（数字支付平台PayPal的前身）CEO的马斯克被他的联合创始人赶走。2008年，杰克·多尔西（Jack Dorsey）就任推特首席执行官不久，被当初一同创建该社交媒体应用的同僚逼下台。11月17日，山姆·阿尔特曼（Sam Altman）眼看着要成为旧金山湾区下一个被点燃的“火人”。他在2015年与人共同创立的人工智能公司OpenAI的董事会指责他不够坦诚，把他扫地出门。但在11月21日，在他本人和他的员工以及OpenAI的投资者（例如微软）为他的复职疯狂争吵四天之后，他又重新执掌这家公司。大戏如火如荼展开之时，有人在推特上打趣说：“哇，耶稣复活都要花三天呀。”这次最终惹火上身的不是阿尔特曼，而是赶他下台的四位董事中的三人。

在他38年的人生历程中，这不是阿尔特曼头一回陷入这样的漩涡中心。他是个极度自信的人，人们往往视其为天才或机会主义者（后者往往是私下的态度）。与乔布斯一样，他有一种救世主般启迪他人的能力，尽管他没有这位iPhone创造者在设计上的上帝视角。与马斯克一样，阿尔特曼对自己的未来愿景抱有坚定的信念，尽管他缺乏这位特斯拉老板传奇的工程本领。与多尔西一样，他推出的产品ChatGPT不仅引发了全球热议，也引发了恐慌。

然而，一路走来，他惹恼了不少人。这始于创业孵化器Y Combinator（以下简称YC）。他从2014年开始执掌YC，直到2019年因引领它扩张过快和分心忙于OpenAI等副业而被赶走。在OpenAI，他与马斯克、另一位联合创始人以及几位举足轻重的AI研究人员闹翻，这些研究人员负气出走。最新证据来自笨手笨脚想要解雇他的四位董事。他们做此决定的具体原因尚

不清楚。但如果阿尔特曼无节制的雄心是一个原因，也并不让人意外。

假如说在阿尔特曼的生命中有什么是不变的，那就是他那份传教士般的狂热，即使以硅谷的标准来看也是惊人的。有些企业家是在追逐名利。而阿尔特曼的目标似乎是追求“技术全能”。YC的联合创始人保罗·格雷厄姆（Paul Graham）这样评价当时仅20岁出头的阿尔特曼：“你可以把他空降到一个满是食人族的小岛上，五年后你再去看，他是那里的王了。”

别说小岛了。现在全世界都是他的领地。2021年，他写下名为《万物摩尔定律》（Moore's Law for Everything）的一份乌托邦宣言，预言AI革命（他在领导）将泽被地球——创造惊人的财富，改变工作的性质，减少贫困。他是核聚变的狂热支持者，认为它将与ChatGPT这类“生成式”AI一道，令知识和能源成本的下降呈现一条“漂亮的指数曲线”。这是令人激动上头的东西，更何况推出这种颠覆世界的技术时尤其需要谨慎平衡速度和安全。阿尔特曼在这一光谱中更偏向哪一端难以判断。

阿尔特曼是个充满矛盾的人。2016年，他还是YC的老板时，亿万富翁风投家彼得·蒂尔（Peter Thiel）曾向《纽约客》表示阿尔特曼“不是特别笃信宗教，但……他在文化上的犹太教色彩非常浓——是乐观主义者，但又是生存主义者”（当时，阿尔特曼在加州大苏尔地区有一栋避难屋，里面备有枪支和黄金，以备流氓AI、大流行病和其他灾难侵袭）。至于他一直以来的乐观性格，在他全无预警的OpenAI董事会“政变”前两天录制的一次采访中清晰显露。“我和大多数AI公司的不同之处在于，我认为AI是好的，”他对播客《Hard Fork》说，“我不会私底下怨恨自己的事业。我认为它会很棒。”

在管理OpenAI时，他也想两全其美。阿尔特曼设计的古怪公司架构是最近这起戏剧性事件的核心所在。OpenAI当初是作为非营利机构成立的，目的是推动AI的前沿发展，让计算机能超越人类思维而不损害人类的主导地位。但公司也需要资金。为此，OpenAI成立了一家营利性子公司，为投资者提供有上限的回报，但他们对公司的运营没有决定权。没有OpenAI股份的阿尔特曼曾为这种模式辩护。今年3月，他对一位采访者

称，把这样的技术交到一家想创造无限价值的公司手中会让他“有点害怕”。

然而，他似乎也对这种模式的限制感到厌烦。和在YC时一样，他一直忙于其他副业，包括寻找投资者制造生成式AI设备和半导体，这些东西可能带来巨额利润。董事会正在换血，新的董事会可能不会那么坚持OpenAI安全至上的宗旨。新任董事长布雷特·泰勒（Bret Taylor）之前是软件巨头Salesforce的CEO。在他的监督下，这家创业公司可能会变得更像一家快速扩张的传统科技公司。阿尔特曼也可能乐见这种变化。

如果真会这样，OpenAI可能还会变得更炙手可热。凭借其最新版本的AI模型GPT-5和即将推出的其他产品，OpenAI已是一马当先。阿尔特曼在筹集资金和招募人才方面有着独门本领，有了更常规的公司架构后，他的工作还会变得更轻松。但他暧昧不明的特性值得警醒，尤其是在速度与安全的平衡点设在哪里的问题上。虽然阿尔特曼被迎入世界各地的权力机构为AI监管提供指导，但他仍未完全确立自己的信念。这就更需要政府给AI安全确立基调，而不是指望反复无常的技术远见者。■



Schumpeter

The many contradictions of Sam Altman

Is the boss of OpenAI a genius or an opportunist?

CALL IT THE “Burning Man” theory of tech. Every so often, the hopes and dreams of a technological visionary are almost torched by those who surround them. In 1985 Steve Jobs was fired from Apple, the company he fathered, and did not return for 11 years. In 2000 Elon Musk’s co-founders ousted him as CEO of X.com, the firm that went on to become PayPal, a digital-payments platform. In 2008 Jack Dorsey’s fellow creators of Twitter ended his short reign as chief executive of the social-media app. On November 17th Sam Altman looked like he would become the Bay Area’s next burnt effigy, ousted from OpenAI, the artificial-intelligence (AI) firm he co-founded in 2015, by a board that accused him of lacking candour. But on November 21st, after four days in which he, his employees and OpenAI’S investors, such as Microsoft, wrangled feverishly for his reinstatement, he was back in control of the firm. “Wow it even took Jesus three days,” one wag tweeted in the midst of the drama. Instead of Mr Altman, three of the four board members who gave him the boot are toast.

It is not the first time in his 38 years on Earth that Mr Altman has been at the centre of such an imbroglio. He is a man of such supreme self-confidence that people tend to treat him as either genius or opportunist—the latter usually in private. Like Jobs, he has a messianic ability to inspire people, even if he doesn’t have the iPhone creator’s God-like eye for design. Like Mr Musk, he has ironclad faith in his vision for the future, even if he lacks the Tesla boss’s legendary engineering skills. Like Mr Dorsey, he has shipped a product, ChatGPT, that has become a worldwide topic of conversation—and consternation.

Yet along the way he has irked people. This started at Y Combinator (YC), a hothouse for entrepreneurs, which he led from 2014 until he was pushed out in 2019 for scaling it up too fast and getting distracted by side hustles such as OpenAI. At OpenAI, he fell out with Mr Musk, another co-founder, and some influential AI researchers who left in a huff. The latest evidence comes from the four board members who clumsily sought to fire him. The specific reasons for their decision remain unclear. But it would not be a surprise if Mr Altman's unbridled ambition played a role.

If there is one constant in Mr Altman's life, it is a missionary zeal that even by Silicon Valley standards is striking. Some entrepreneurs are motivated by fame and fortune. His goal appears to be techno-omnipotence. Paul Graham, co-founder of YC, said of Mr Altman, then still in his early 20s: "You could parachute him into an island full of cannibals and come back in five years and he'd be the king."

Forget the island. The world is now his domain. In 2021 he penned a Utopian manifesto called "Moore's Law for Everything", predicting that the AI revolution (which he was leading) would shower benefits on Earth—creating phenomenal wealth, changing the nature of work, reducing poverty. He is an ardent proponent of nuclear fusion, arguing that coupled with ChatGPT-like "generative" AI, falling costs of knowledge and energy will create a "beautiful exponential curve". This is heady stuff, all the more so given the need to strike a careful balance between speed and safety when rolling out such world-changing technologies. Where Mr Altman sits on that spectrum is hard to gauge.

Mr Altman is a man of contradictions. In 2016, when he still led YC, Peter Thiel, a billionaire venture capitalist, described him to the New Yorker as "not particularly religious but...culturally very Jewish—an optimist yet a survivalist" (back then Mr Altman had a bolthole in Big Sur, stocked with guns and gold, in preparation for rogue AIs, pandemics and other disasters).

As for his enduring optimism, it rang out clearly during an interview he recorded just two days before OpenAI's boardroom coup, which he did not see coming. "What differentiates me [from] most of the AI companies is I think AI is good," he told "Hard Fork", a podcast. "I don't secretly hate what I do all day. I think it's going to be awesome."

He has sought to have it both ways when it comes to OpenAI's governance, too. Mr Altman devised the wacky corporate structure at the heart of the latest drama. OpenAI was founded as a non-profit, in order to push the frontiers of AI to a point where computers can out-think people, yet without sacrificing human pre-eminence. But it also needed money. For that it established a for-profit subsidiary that offered investors capped rewards but no say in the running of the company. Mr Altman, who owns no shares in OpenAI, has defended the model. In March he told one interviewer that putting such technologies into the hands of a company that sought to create unlimited value left him "a little afraid".

And yet he also appears to chafe against its constraints. As he did at YC, he has pursued side projects, including seeking investors to make generative-AI devices and semiconductors, which could potentially be hugely lucrative. The old board is being replaced by a new one that may turn out to be less wedded to OpenAI's safety-above-all-else charter. The incoming chairman, Bret Taylor, used to run Salesforce, a software giant. On his watch the startup could come to resemble a more conventional, fast-scaling tech company. Mr Altman will probably be happy with that, too.

If that happens, OpenAI may become an even hotter ticket. With the latest version of its AI model, GPT-5, and other products on the way, it is ahead of the pack. Mr Altman has a unique knack for raising money and recruiting talented individuals, and his task would be all the easier with a more normal corporate structure. But his ambiguities, especially over where to strike the balance between speed and safety, are a lesson. Though Mr Altman has been

welcomed into the world's corridors of power to provide guidance on AI regulation, his own convictions are still not set in stone. That is all the more reason for governments to set the tone on AI safety, not mercurial tech visionaries. ■



软币实力

人民币在贬值，地位却提升

低利率产生矛盾的效果

外资对中国的贡献很大。早在富士康开始为苹果生产iPhone前很久，香港制造商就偷偷越过边境前往广东寻找廉价劳动力。据莎拉·蒙克斯（Sarah Monks）所著的《玩具城》（Toy Town）一书记载，1982年，玩具制造商镇泰在附近的东莞荔枝园里开设了一家喷漆厂。当时洗澡水用铁锅烧，工厂就是一个铁皮屋。蒙克斯说，在另一家公司，工人们认为米老鼠的鼻子应该是红色的，而不是黑色的。

截至去年底，中国的外商直接投资（FDI）存量达到近3.5万亿美元。但是，在今年第三季度出现了某种显著的变化。FDI流量自1998年开始发布季度数据以来首次出现负值（见图表1）。外国投资者通过汇回利润、偿还公司内部贷款和出售资产等方式从中国撤出资金，多于他们投入的资金。

这种逆转可能反映了外国对中国的经济前景和政策制定不再抱有幻想。尽管中国今年很可能实现官方5%的增长目标，但根据国际货币基金组织的最新预测，以美元计算的GDP可能会出现萎缩。中国政府对疫情的专横应对、对科技公司的监管打压，以及对贝恩（Bain）、凯盛（Capvision）和Mintz等外国尽职调查公司的调查，令许多投资者感到不安。

地缘竞争加剧是另一个因素。外国投资者越来越难找到既有商业前景又在本国和东道国具政治可行性的机会。中国美国商会（American Chamber of Commerce in China）3月发布的对会员公司的调查发现，24%的公司正在考虑将制造业迁出中国，或已经开始这样做了，而去年这一比例仅为14%。

但三季度的大幅逆转或许也反映出了技术面的考量。由于美国利率保持高位，而中国利率在下降，跨国公司有动力将闲置资金转移出中国，并解除

子公司既有的任何可以用中国的融资替代的贷款。研究公司凯投宏观（Capital Economics）的朱利安·埃文斯-普里查德（Julian Evans-Pritchard）指出：“许多公司现在可以在中国以更低的成本贷款，而且几乎所有公司都可以通过将资金储备转移到海外来获得更高的回报。”

这样下来，利率差和地缘分歧相结合损害了一种全球化的发展。但它可能有助于另一种全球化：接受中国的人民币（国外有时称之为“红币”[Redback]）。

中国人民银行在10月的一份报告中指出，相对于其他大型经济体，人民币借贷成本已经下降。因此，今年前八个月，外国公司在中国发行了价值1060亿元的以人民币计价的“熊猫债”，与2022年同期相比增长了58%。事实上，根据支付信息传输组织SWIFT的数据，9月，人民币超越欧元，成为贸易融资中第二受欢迎的货币，占贷款金额的6%。

美国大学威廉玛丽学院（William and Mary）的AidData项目发布的一份新报告详尽整理了中国的对外贷款，也显示出国有贷款机构在向中低收入国家提供贷款时已做出了“战略转向”，不再以美元为主（见图表2）。新贷款中人民币贷款所占份额从2013年的6%飙升至2021年的50%。

其中许多贷款是人行向陷入债务困境的国家提供的。借债国收到贷款后就能够用人民币偿还中国债权人和国际货币基金组织的债务，留下自己手上不多的美元储备以满足其他需求。AidData报告的作者认为中国当局可能看到了“一石多鸟”的机会——既能防止违约，同时又能促进人民币在国际上的使用。

毕竟，以人民币借款的国家更有可能使用人民币进行国际支付，伦敦大学学院（University College London）的萨利姆·巴哈吉（Saleem Bahaj）和伦敦政治经济学院（London School of Economics）的里卡多·雷斯（Ricardo Reis）的研究显示。目前已有四十个经济体与人行签署了双边本币互换协议，根据协议，人行要在一定期限内以人民币交换协议国的等值货币。两位研究人员发现，签署这样的协议将让人民币在一国国际支付

中的份额增加1.3个百分点。

美国和欧洲对俄罗斯的制裁也推了人民币一把。埃文斯-普里查德指出，事实上，中国大陆与世界其他地区一半以上的交易现在都是以人民币结算的。在先行省份广东，这一比例更高，今年前三季度已超过54%。广东的工人从没能让米老鼠变成红鼻子，但该省至少说服了一些外国人接受红币。 ■



Soft-currency power

The Chinese yuan is losing value, yet gaining ground

Low interest rates have a paradoxical effect

CHINA OWES a lot to foreign investment. Long before Foxconn started making iPhones for Apple, manufacturers from Hong Kong tiptoed across the border to Guangdong in search of cheap labour. In 1982 Jetta, a toymaker, opened a spray-painting plant among the nearby lychee orchards of Dongguan, according to “Toy Town”, a book by Sarah Monks. Water for a shower was boiled in a wok; the plant was in a tin shack. At another firm, Ms Monks reports, the workers decided that Mickey Mouse’s nose should be red, not black.

By the end of last year, the accumulated stock of direct investment in China amounted to almost \$3.5trn. But in the third quarter of this year, something remarkable happened. The flow of FDI turned negative, for the first time since quarterly data began in 1998 (see chart 1). Foreign investors removed more money from the country than they put in, through a mixture of repatriated profits, repaid intra-firm loans and asset sales.

This reversal may reflect foreign disillusionment with China’s economic prospects and policymaking. Although the country will most probably meet its official growth target of 5% this year, it could shrink in dollar terms, according to the IMF’s latest forecasts. China’s government has unnerved many investors with its overbearing reaction to the covid-19 pandemic, its regulatory crackdown on technology companies and its investigations of foreign due-diligence firms, including Bain, Capvision and Mintz.

Intensifying geopolitical rivalry has not helped either. It is becoming harder for foreign investors to find opportunities that are both commercially

exciting and politically palatable in their home and host countries. In a survey of its members published in March, the American Chamber of Commerce in China found that 24% were considering relocating manufacturing out of China or had already begun to do so, up from only 14% the year before.

But the sharp reversal in the third quarter may also reflect a technical calculation. As interest rates remain high in America and fall in China, multinational companies have an incentive to spirit spare cash out of the country and unwind any loans to their subsidiaries that can be replaced with Chinese funding. “Many firms can now borrow more cheaply in China and nearly all can earn a higher return on their financial reserves by moving them offshore,” points out Julian Evans-Pritchard of Capital Economics, a research firm.

The combination of an interest-rate gap and a geopolitical gulf has, then, hurt one kind of globalisation. But it may be helping another kind: the embrace of China’s currency, the yuan (or “redback”, as it is sometimes called outside the country).

In a report last month, China’s central bank pointed out that the cost of borrowing in yuan had fallen relative to other big economies. As a result, foreign firms had issued 106bn yuan (\$15bn) worth of yuan-denominated “Panda bonds” in China during the first eight months of the year, an increase of 58% compared with the same period in 2022. Indeed, in September the yuan surpassed the euro to become the second-most-popular currency for trade financing, with 6% of lending, according to SWIFT, a payments-messaging firm.

A meticulous new report on China’s overseas lending by AidData at William and Mary, an American university, also shows how government-owned lenders have made a “strategic pivot” away from the dollar in their lending

to low- and middle-income countries (see chart 2). The share of new commitments in yuan soared from 6% in 2013 to 50% in 2021.

Many of these loans were made by China's central bank to countries that are in debt distress. The recipients were then able to use the yuan to repay Chinese creditors and the IMF, preserving their scarce dollar reserves for other needs. The authors of the AidData report wonder if China's rulers saw a chance to "kill several birds with one stone"—preventing defaults and encouraging the international use of the yuan at the same time.

After all, countries that borrow in the yuan are more likely to use the currency for international payments, according to work by Saleem Bahaj of University College London and Ricardo Reis of the London School of Economics. Forty economies have now signed a swap agreement with China's central bank, which obliges it to temporarily exchange yuan for an equivalent amount of the other party's currency. Signing such an agreement increases the yuan's share in a country's international payments by 1.3 percentage points, they find.

The sanctions imposed on Russia by America and Europe have also helped the yuan. Indeed, more than half of mainland China's transactions with the rest of the world are now settled in its own currency, points out Mr Evans-Pritchard. In the pioneering province of Guangdong the share is even higher, at over 54% in the first three quarters of this year. Guangdong's workers never got Mickey to embrace a red nose. But the province has at least persuaded some foreigners to embrace the redback. ■



梧桐

忘了标普500指数吧。标普493了解一下

这个替代基准可以更好地反映美国股市

试想一下美国的股市，你脑海中第一个蹦出来的公司是哪个？也许是一家让你赚到了钱的公司，或者是你正在考虑购买它的股票的那家。如果都不是，那么你很可能想到了某个大牌公司，而再大也大不过“七巨头”。

Alphabet、亚马逊、苹果、Meta、微软、英伟达和特斯拉是华尔街的超级明星，确实也都实至名归。它们都是在过去50年里成立的，其中五个成立不超过30年。每家公司的市值都超过了1万亿美元（尽管Meta和特斯拉的市值后来分别跌至8000亿和7000亿）。如此活力充沛，也难怪美国股市把其他股市都甩在后面。欧洲股市从来没有产生过价值1万亿美元的公司，而且在过去的30年里，连市值1000亿美元的公司也没产生过。在过去的十年里，美国基准指数标普500的平均年回报率是欧洲斯托克600指数（Stoxx 600）的1.5倍，也就不足为奇了。

只不过这样的讲述存在一个问题，那就是笔者就这么把七巨头描绘成整个美国股市的象征，经不起推敲。如此划等号很容易，也常有人这么做。这在一定程度上倒也说得通，因为七巨头如今构成了标普500指数的巨大份额：以市值衡量，它们占该指数的29%，自然也就占了股价行情的29%。然而，它们仍不过是500家公司中的七家而已。事实证明，这七个快速行动、打破常规、在短短几十年内征服世界的科技骄子并不足以代表剩下的98.6%的公司。因此，在此特奉上一份标普493指南。

剔除科技巨头后，最明显的变化是新指数看起来年长了不少。来看其中最大的公司。排在最前的是伯克希尔哈撒韦（Berkshire Hathaway），一家由两位九旬老人领导的投资公司，以及礼来（Eli Lilly），一家由一位美国内战老兵于19世纪创立的制药公司。再往下是摩根大通，这家银行在美联储成立之前就已扬名。这并不表示这些公司就不创新。它们显然全都保

持着高度成功，即使没有一家跨过了市值1万亿美元的门槛。不过，它们也确实不是轻狂少年了。

由于这份成熟老道，标普493指数不太容易受市场情绪波动的影响（见图表）。这是一把双刃剑。好的一面是这在2022年的股市暴跌期提供了保护。去年年初，标普493的成分股公司更为成熟的商业模式远未像七巨头那样掀起狂潮，等到热潮自然而然消退时也就没那么脆弱。与此同时，这些公司的价值中有赖遥远未来收益的那部分占比更小——随着利率预期飙升，这部分收益的现值急剧下降。最终的结果是，虽然七巨头的市值总共下跌了41%，但标普493仅下跌了12%。

然而，今年形势发生了逆转。从表面上看，老前辈们应该表现不俗，因为美国经济仍旧相当活跃。再加上人们强烈看好人工智能提升利润的潜力，七巨头上演了亮眼的复苏。今年前10个月，它们的股价上涨了52%，几乎填平了2022年的损失。相比之下，标普493下跌了2%。

该如何看待这样的分化呢？一个结论是，美国的科技巨头先前被高估了，最终必然会面临重创。另一个结论是，就像股价出现分化一样，这些公司的销售额和利润也会分化，这意味着七巨头真的要把那些老古董甩在身后了。投资者在这两种假设中选哪一种似乎主要由他们自己的性情决定，因为两者都能从传统的估值指标（如市盈率）中找到依据。七巨头的市盈率大约是标普493的两倍。

现在日益流行的第三个结论是，标普500由七只股票主导，而且它们与其余的成分股殊为不同，因而已不再是一个好的基准。这么说并不完全正确。许多人之所以投资于跟踪该指数的基金，恰恰是为了从赢家的收益中分一杯羹，而不必关心指数的构成。不过，如果你想知道美国股市的真实情况，还是避开整体指数，看看标普493吧。 ■



Buttonwood

Forget the S&P 500. Pay attention to the S&P 493

The alternative benchmark offers a better view of America's stockmarket

THINK OF AMERICA'S stockmarket. What is the first firm that springs to mind? Perhaps it is one that made you money, or maybe one whose shares you are considering buying. If not, chances are you are thinking of one of the big hitters—and they don't come much bigger than the “magnificent seven”.

Alphabet, Amazon, Apple, Meta, Microsoft, Nvidia and Tesla are Wall Street's superstars, and deservedly so. Each was established in the past 50 years, and five of them in the past 30. Each has seen its market value exceed \$1trn (although those of Meta and Tesla have since fallen, to \$800bn and \$700bn respectively). Thanks to this dynamism, it is little wonder that America's stockmarket has raced ahead of others. Those in Europe have never produced a \$1trn company and—in the past three decades—have failed to spawn one worth even a tenth as much. Hardly surprising that the average annual return on America's benchmark S&P 500 index in the past decade has been one-and-a-half times that on Europe's Stoxx 600.

There is just one problem with this story. It is the hand-waving with which your columnist cast the magnificent seven as being somehow emblematic of America's entire stockmarket. This conflation is made easily and often. It is partly justified by the huge chunk of the S&P 500 that the magnificent seven now comprise: measured by market value, they account for 29% of the index, and hence of its performance. Yet they are still just seven firms out of 500. And the remaining 98.6% of companies, it turns out, are not well characterised by seven tech prodigies that have moved fast, broken things and conquered the world in a matter of decades. Here, then, is your guide to

the S&P 493.

Most obviously, having discarded the tech behemoths, our new index now looks substantially older. Consider its biggest companies. At the top of the list is Berkshire Hathaway, an investment firm led by two nonagenarians, and Eli Lilly, a pharmaceuticals-maker established in the 19th century by a veteran of America's civil war. Further down is JPMorgan Chase, a bank that made its name before the founding of the Federal Reserve. That is not to suggest that these firms do not innovate. All of them, by definition, have remained highly successful, even if none has crossed the \$1trn threshold. Whippersnappers, though, they are not.

As a result of this maturity, the S&P 493 is less susceptible to the market's changing mood (see chart). This is a double-edged sword. On the plus side, it offered protection during the crash of 2022. The more established business models of S&P 493 companies started the year with less hype than those of the magnificent seven, leaving them less vulnerable when the hype duly evaporated. Meanwhile, a smaller proportion of their value came from the promise of distant future earnings—the present value of which fell dramatically as interest-rate expectations soared. The net effect was that, while the magnificent seven together lost 41% of their value, the S&P 493 lost just 12%.

This year, however, the tables have turned. On the face of it, the old-timers ought to have done well, since the American economy has remained remarkably buoyant. This, combined with enthusiasm concerning the potential of artificial intelligence to juice their profits, led to a stellar recovery for the magnificent seven. In the first ten months of the year their share prices rose by 52%, nearly erasing the losses of 2022. By contrast, the value of the S&P 493 fell by 2%.

What to make of this bifurcation? One conclusion is that America's tech

giants have become overvalued and must eventually face a crash. Another is that, just as share prices have diverged, so too will the companies' sales and profits, meaning that the magnificent seven really are about to leave the dinosaurs in the dust. Investors seem to choose between these hypotheses largely according to their own temperament, since traditional valuation measures such as the price-to-earnings ratio, which for the magnificent seven is roughly double that for the S&P 493, lend support to both camps.

A third conclusion, now aired increasingly often, is that the S&P 500's domination by seven stocks which are so different from the rest means it is no longer a good benchmark. That is not quite right. Many people invest in funds tracking the index precisely so they can capture the gains of the winners without having to care about its composition. Still, if you want to know what America's stockmarket really looks like, avoid the headline index. Look at the S&P 493. ■



创新者的困境

创始人何时该退位？

随着投资者更看重利润而非扩张，老板们需要掌握新技能

“我是企业家。我是创始人。我的思维和大脑就是这么运转的。”11月6日，惠特尼·沃尔夫·赫德（Whitney Wolfe Herd）在接受《财富》杂志采访时若有所思地说。当天她宣布将辞去Bumble首席执行官一职。Bumble是她于2014年创立的约会应用，她此前还曾与人共同创立了竞争对手应用Tinder。她承认自己对经营一家上市公司这种繁重又无聊的差事没什么热情。她将转而担任董事会执行主席，将在这个职位上花时间“展望爱和连结的未来”。

莉迪亚恩·琼斯（Lidiane Jones）将接替她的职位，她目前执掌Slack，这家聊天平台于2021年被科技巨头Salesforce收购。Slack自家的创始人斯图尔特·巴特菲尔德（Stewart Butterfield）于今年年初辞去了公司老板的职务。投资者希望琼斯少花点时间展望未来，多花点时间关注当下：自Bumble于2021年上市以来，公司股价已经跌去了82%。沃尔夫·赫德的宏伟愿景是把Bumble打造成一个更广阔的平台，供女性交友和建立职业人际关系，但遭遇滑铁卢。与此同时，它还陷入了与头号劲敌Match Group的扩张之争。Match Group拥有Tinder和Hinge等多款约会应用。Bumble的成本增加了。

投资者早就发现了由创始人领导公司的优势。事实上，在沃尔夫·赫德宣布管理层洗牌的当天，Bumble的股价下跌了4%。风投大亨本·霍洛维茨（Ben Horowitz）认为，创始人老板比后来请来的老板更能察觉技术的变迁。而因为公司是他们毕生的心血，他们通常能抱之以更长远的眼光，押注于可能需要好些年才有回报的创新想法。

不过，有迹象表明，在一个资本不再便宜、投资者更喜欢一鸟在手而不是双鸟在林的世界里，所谓的“创始人溢价”可能正在减弱。本刊分析了由风

投机构Bessemer Venture Partners发布的纳斯达克新兴云指数中上市软件公司的表现。从2018年到2021年底，这一指数中由创始人领导的公司的股价比其他公司高出一半（见图表1）。但从2022年开始，这一差距消失了。

要理解其中缘由，需要想到的是这批创始人老板在研发上投入的资金更多，招兵买马更快，实现的收入增长更高，但带来的现金却更少（见图表2）。在过去十年的科技繁荣时期，创始人的成功主要依靠他们能够做大胆设想、从风险投资家那里融资、大举吸纳人才，以及赶在潜在对手前行动，获取先发优势。投资者现在要求更多地关注成本，更快地盈利。

创始人该怎么做？选择之一是收一收雄心壮志，变身一丝不苟的资本管家。在点燃了投资者的怒火之后，科技巨头Meta的创始人扎克伯格言语间淡化了他建立元宇宙的宏伟计划，在2月宣布2023年将是“效率年”——这听起来令人舒心。Meta的股票已经收复了去年的大部分失地。

11月2日，电子商务平台Shopify公布了从7月到9月的季度业绩。投资者因它恢复盈利而欢欣鼓舞，其股价当日上涨了22%。今年5月，该公司裁员20%，并剥离了物流部门。联合创始人兼老板托比亚斯·吕特克（Tobias Lütke）承认，公司被“支线任务”分散了精力，而且在疫情期间发展过快。由联合创始人马克·贝尼奥夫（Marc Benioff）执掌的Salesforce提供了又一个例子。多年来，公司将扩张置于利润之上，并斥巨资进行收购，包括以280亿美元收购Slack。去年科技行业低迷，维权投资者围攻该公司。作为回应，Salesforce裁掉了一成员工，暂停收购并且提高了价格。它的这番努力也得到了投资者的嘉奖。

不过，正如沃尔夫·赫德的一席话暗示的那样，对有的创始人来说，这一切听起来也许实在太乏味了。有些人可能会彻底退出——巴特菲尔德现在把时间花在园艺和购置豪宅上。其他人，比如沃尔夫·赫德，会选择创造一个更合自己口味的角色，把创造利润的无趣工作留给别人。这样的安排能否奏效可能还是得看相关人物的个性。北卡罗来纳大学的布拉德利·亨德里克斯（Bradley Hendricks）指出，尽管创业者比资深专业人士更需要

建议，但他们也更有可能不把这些建议当回事。如果创始人的宏伟愿景和他们请来的老板的务实优先项之间起了冲突，可能免不了要火花四溅。■



An innovator's dilemma

When should a founder step down?

With investors prizing profits over growth, new skills are required of bosses

"I'M AN ENTREPRENEUR. I'm a founder. That's the way my mind and brain works," mused Whitney Wolfe Herd in an interview with Fortune magazine on November 6th, the day she announced she would be stepping down as chief executive of Bumble, a dating app she founded in 2014. Ms Wolfe Herd, who had previously co-founded Tinder, a rival app, confessed to her lack of enthusiasm for the drudgery of running a public company. She will move to the role of executive chairwoman, where she will spend her time "looking at the future of love and connection".

Into her place will step Lidiane Jones, who currently runs Slack, a chat platform bought by Salesforce, a tech giant, in 2021. Slack's own founder, Stewart Butterfield, stepped down as its boss at the start of the year. Investors will be hoping that Ms Jones will spend less of her time looking at the future and more at the present; shares in Bumble have lost 82% of their value since the company listed on the stockmarket in 2021. Ms Wolfe Herd's grand vision of turning Bumble into a wider platform for women to make friends and professional connections has been a flop. Meanwhile, it has been caught in a tussle for growth with arch-rival Match Group, which owns Tinder and various other dating apps including Hinge. Costs have risen.

Investors have long found merit in founder-led companies. Indeed, Bumble's share price dropped by 4% on the day Ms Wolfe Herd announced the reshuffle. Ben Horowitz, a venture-capital (VC) titan, believes that founder-bosses can spot shifts in technology better than imported ones. And since the company is their life's work, they are often able to take a longer-term view and bet on innovative ideas that may take years to pay off.

Yet there are signs that the so-called “founder premium” may be waning in a world in which capital is no longer cheap and investors prefer jam today to jam tomorrow. The Economist has analysed the performance of the publicly listed software firms in the Nasdaq Emerging Cloud index produced by Bessemer Venture Partners, a VC outfit. From 2018 until the end of 2021, the share prices of founder-led firms in the index outperformed the rest by a half (see chart 1). Beginning in 2022, however, that gap disappeared.

To understand why, consider that founder-bosses in the index invest more money in research and development, expand their teams faster, deliver higher revenue growth—but generate less cash (see chart 2). During the tech boom of the past decade, a founder’s success depended chiefly on their ability to set a bold vision, raise funding from venture capitalists, gobble up talent and get a head start on possible rivals. Investors now demand greater attention to costs and a speedier path to profits.

What are founders to do? One option is to temper their lofty ambitions and reinvent themselves as fastidious stewards of capital. After incurring the wrath of investors, Mark Zuckerberg, the founder of Meta, a tech titan, toned down his grandiose plan to build a metaverse, declaring in February that 2023 would be the jolly-sounding “year of efficiency”. Its shares have regained most of the value they lost last year.

On November 2nd Shopify, an e-commerce platform, reported its results for the quarter from July to September. Investors were cheered by a return to profitability; its share price rose by 22% on the day. In May the firm cut its workforce by 20% and offloaded its logistics arm. Tobias Lütke, its co-founder and boss, admitted that the company had become distracted by “side quests” and grew too quickly during the pandemic. Salesforce, run by its co-founder Marc Benioff, offers one more example. For years it prioritised growth over margins and splurged on acquisitions, including the \$28bn it paid for Slack. As the tech industry sank last year, activist

investors circled the firm. In response, it shed 10% of its workforce, paused acquisitions and raised prices. It, too, has been rewarded by investors for its efforts.

As Ms Wolfe Herd's remarks suggest, however, all this may sound terribly dull to some founders. Some may bow out altogether—Mr Butterfield now spends his time gardening and buying luxury properties. Others, like Ms Wolfe Herd, will choose to carve out a role more to their liking, leaving the tedious job of generating profits to others. Whether such an arrangement works may come down to the personalities involved. Bradley Hendricks of the University of North Carolina notes that although founders are in greater need of advice than seasoned professionals, they are also more likely to ignore it. If tensions emerge between the grand hopes of a founder and the pragmatic priorities of the boss they bring in, sparks may fly. ■



孙正义的大起大落

WeWork倒下之后，软银将何去何从？

孙正义将再有大动作

“他的眼神非常坚定。坚定的、发着光的眼神。”在回顾自己2000年为什么决定向马云新创的中国电子商务公司阿里巴巴投资2000万美元时，孙正义这样解释道。今年稍早时，孙正义的投资集团软银（SoftBank）卖掉了持有的大部分阿里巴巴股份，至此它已经从这个投资赌局中获利650亿美元。不过，这位日本亿万富翁的另一场押注就没那么成功了——11月6日，魅力十足的亚当·诺伊曼（Adam Neumann）创立的办公室租赁公司WeWork宣布破产。据估计，软银已经在这家公司上烧掉了约140亿美元。

孙正义的事业一直随着科技行业的技术成熟度曲线而大起大落。大举投资热门公司的策略在曲线上扬期让软银收获颇丰，但在下落期却让它表现惨淡。如今，在经历了一年的坎坷之后，不服输的孙正义正投身于科技界新一轮“万物皆可AI”的热潮。这应该会是一段剧烈动荡的狂野之旅。

软银最初是日本的一家软件分销商，在上世纪90年代的互联网泡沫中，它转型为一家投资机构，购入了数百家创业公司的股份，包括当时很受欢迎的搜索引擎雅虎。在那次互联网热潮的高峰期，孙正义还曾短暂登上世界首富的宝座。泡沫破裂后，他将软银重新定位为移动互联网公司，并于2005年在日本推出电信业务，2013年买入美国通讯公司Sprint的大部分股份，2016年收购了英国智能手机芯片设计公司安谋（Arm）。

一年后，孙正义成立了1000亿美元的软银愿景基金，其中部分资金来自沙特阿拉伯的主权财富基金，并开始向亏损的创业公司注资。尽管有WeWork等显著的失败案例，但到2021年夏天，这轮大手笔投资似乎取得了巨大成功，愿景基金及其后来成立的几只基金累计获利660亿美元。但此后，由于科技企业估值暴跌，这些浮盈变成了60亿美元的亏损（见图表）。

利率上升给软银带来了双倍风险：一方面降低了利润主要有待未来实现的创业公司的价值；另一方面加大了本来就负债累累的软银的债务成本。今年5月，评级机构标普全球（S&P Global）将软银的信用评级进一步下调至垃圾级。为了安抚惊受怕的投资者，软银出售了部分资产，从而将现金储备从两年前的250亿美元增加到340亿美元，相当于其有息债务的四分之一。此外，软银在安谋上市后仍然持有其90%的股份，这也让软银的投资组合更具流动性。

孙正义现在跃跃欲试要开写新支票，他此前已宣布软银即将切换回“进攻模式”。数据提供商PitchBook称，今年截至目前，软银只完成了23笔投资，而去年和2021年分别为125笔和251笔。孙正义盯上了AI，他预测AI将“在十年后超出人类智能总和十倍”。

危险在于，这家投资巨头进入AI市场之际，正是泡沫最严重之时。近几个月来，随着投资者蜂拥加入融资争夺战，AI公司的估值飙升。因此，软银集团愿景基金联席负责人亚历克斯·克拉维尔（Alex Clavel）表示，软银也在寻求为自己开拓全新的投资机会。

他以GreenBox为例。GreenBox是软银和机器人公司Symbotic合资组建的新公司，将要开发和出租自动化仓库。据称，今年9月软银还与开发了ChatGPT的创业公司OpenAI以及曾担任iPhone设计师的乔尼·艾夫（Jony Ive）商谈，计划为一款由安谋芯片驱动的AI设备的研发提供资金。

不过，软银将继续保持它投资方式中的其他一些特点。克拉维尔表示：“我们通常会把鸡蛋放在较少的篮子里。”他预期这种模式会持续下去。孙正义愿意相信自己的直觉，这一点也不太可能改变。

十年后，当孙正义对AI的预言得到验证时，他将76岁。这意味着软银还面临另一个问题——接班人。孙正义希望这家企业至少能存续300年，他从2015年开始公开谈论交棒的话题。但此后，一些潜在接班人都相继离开，而软银则继续以这位高深莫测的创始人为中心。如果想让软银长久存在下去，孙正义就必须让公司为一个没有他的未来做好准备。 ■



Son rise, Son set

After WeWork's fall, what next for SoftBank?

Son Masayoshi is ready to splurge again

"HIS EYES were very strong. Strong, shining eyes." So Son Masayoshi explained his decision back in 2000 to invest \$20m in a Chinese e-commerce startup founded by Jack Ma. By the time SoftBank, Mr Son's investment group, finished selling most of its stake in Alibaba earlier this year, it had made \$65bn from the gamble. Less successful was the Japanese billionaire's bet on Adam Neumann, the charismatic founder of WeWork, an office-rental firm that declared bankruptcy on November 6th. SoftBank is estimated to have torched around \$14bn backing it.

Mr Son's career has been a tale of soaring highs and crushing lows that have followed the hype cycles in tech. A strategy of doling out big cheques to buzzy firms has served SoftBank well in the upswings but poorly in the downswings. Now, after a bruising year, the indefatigable Mr Son is jumping on tech's latest craze for all things artificial intelligence (AI). It promises to be a wild ride.

SoftBank, which began life as a software distributor in Japan, reinvented itself amid the dotcom boom of the 1990s as an investment vehicle, buying stakes in hundreds of startups, including Yahoo, a once-popular search engine. At the height of dotcom mania, Mr Son was briefly the richest man in the world. After the bubble burst, he reoriented SoftBank around mobile internet, launching a telecoms business in Japan in 2005, buying a majority stake in Sprint, an American carrier, in 2013, and acquiring Arm, a British designer of smartphone chips, in 2016.

A year later Mr Son launched SoftBank's Vision Fund, a \$100bn war chest

bankrolled in part by Saudi Arabia's sovereign-wealth fund, and began pouring capital into loss-making startups. Despite some notable flops, including WeWork, by the summer of 2021 the investment binge looked like a resounding triumph, with the Vision Fund and its successors having made a cumulative gain of \$66bn. Since then, a collapse in tech valuations has flipped that into a \$6bn loss (see chart).

SoftBank is doubly exposed to higher interest rates, which decrease the value of startups whose profits lie mostly in the future and increase the cost of debt, of which the investment group has plenty. In May S&P Global, a rating agency, downgraded SoftBank's credit deeper into junk territory. To ease jittery investors, it has sold assets and expanded its cash pile from \$25bn two years ago to \$34bn, equal to a quarter of its interest-bearing debt. The initial public offering of Arm, in which SoftBank retains a 90% stake, has also made its portfolio more liquid.

Mr Son is now itching to start writing cheques again, having declared SoftBank ready to switch back into "offence mode". The firm has done only 23 deals so far this year, compared with 125 last year and 251 in 2021, according to PitchBook, a data provider. Mr Son has his eyes on AI, which he predicts will "surpass the total intelligence of humankind by ten times in ten years".

The danger is that the investment giant is entering the market at its frothiest. Valuations of AI companies have rocketed in recent months as investors have piled into competitive fundraising processes. As a result, SoftBank is also looking to carve out novel investment opportunities for itself, says Alex Clavel, co-head of the group's Vision Funds.

He gives the example of GreenBox, a new joint venture between SoftBank and Symbotic, a robotics company, that will develop and rent out automated warehouses. In September SoftBank was also reported to be in discussions

with OpenAI, the startup behind ChatGPT, and Jony Ive, a designer of the iPhone, to fund the development of an AI device powered by Arm's chips.

Yet other elements of SoftBank's approach to investment will remain. "We usually put our eggs in fewer baskets," says Mr Clavel, a pattern he expects to continue. Mr Son's willingness to trust his gut is also unlikely to change.

In a decade's time, when Mr Son's prognostications on AI have been tested, he will be 76, pointing to another question hanging over SoftBank: succession. Mr Son, who hopes the business will endure for at least 300 years, began talking publicly of handing over the reins in 2015. A string of potential successors have since left and SoftBank continues to revolve around its enigmatic founder. If it is to last, Mr Son must ready it for a future without him. ■



梧桐

一本新书把瑞·达利欧描绘成恶魔。这公允吗？

全球最大对冲基金的创始人受到严厉审视

这本书一开头就是瑞·达利欧（Ray Dalio）在大骂一名他显然知道已经怀孕的员工。他一遍又一遍地骂她“白痴”，直到她抽泣着跑出房间。这位全球最大对冲基金桥水基金（Bridgewater Associates）的创始人想来“很高兴”。他对这位女士的“盘问”证明了他坚守不惜一切代价“寻求真相”的原则。这位员工崩溃的场面被录了下来，上传到公司的会议资料库。他让人把它剪辑成一段视频，好展示给未来的员工看。

这只是《纽约时报》记者罗布·科普兰（Rob Copeland）所著关于达利欧的新书《桥水基金》（The Fund）中众多骇人轶事中的第一桩。该书的叙述可以归结为两点。一是达利欧的“原则”——他自述以“极端透明”为核心的一套理念——实际上不过是他用来欺压员工的一堆浪费时间的工具。这套体系要求对会议录像，让员工互评名次，把抱怨上传到一个平台上。其初衷是促进“想法择优”，但最好的结果也只是让员工能抱怨自助餐厅的豌豆太“皱巴巴”这样鸡毛蒜皮的小事，而最糟糕的是导致了一种恐惧文化。达利欧看来是操纵了这套体系来让自己的意见永远凌驾于一切之上。

第二点是桥水的成功“全无秘诀”。达利欧手下数百名研究人员撰写的报告他甚至看也不看。科普兰称，达利欧的所有投资决策都是他一个人拍板，或者是听了副手的一些意见后做出的。他并不像他对客户声称的那样有一套规范的行事法则，而是运用直觉和简单的“如果-就”思维，比如如果某个国家的利率下降，那么你就该卖出该国的货币。按作者所述，这些方法一度行之有效，但高频交易员和量化基金（往往追随市场“大势”）的崛起削弱了他的优势。桥水公司的旗舰基金“纯阿尔法”（Pure Alpha）在过去10年或15年的回报就低得可怜。

两方面的结论交织为一点：崇拜桥水基金是毫无意义的。桥水的员工能有

时间浪费在扯淡的事情上是因为投资过程实则很简单。达利欧可能是一位天才投资者——自1991年以来他为购入其基金的人赚到了580亿美元，但他将投资法则和文化集结成典的努力纯属浪费时间。他的传奇功业终将褪色。

科普兰的深入报道发掘出了一些非常负面的故事，但似乎写来只是为了极力丑化达利欧，例如有一个段落讲述了达利欧邀请著名历史学家尼尔·弗格森（Niall Ferguson）访问桥水基金的经过。达利欧送给弗格森一本他的书，其中提出了一套笼统的经济史理论和一个“经济机器”模型，但弗格森却对在场的桥水员工说，历史是无法建模的，因为模型无法解释“决策者的任性妄为”。达利欧开始冲弗格森大吼大叫，弗格森很快拂袖而去。科普兰写道，达利欧之后向员工发起了调查，问这场辩论谁胜谁负（达利欧大胜）。

这是用来揭露达利欧不讲原则的诸多轶事之一。他不但不听取直截了当的批评，还利用手中权力打压反对声。但看起来达利欧之后是征求了意见的，看自己是否举止失当了。他的员工恳求他不要邀请了别人到访桥水最后却把人骂走，据作者说他也听取了这个建议。达利欧的“极端透明”理念可能怪异、误入歧途，但他或许并不是个伪君子。

书中关于达利欧投资过程的论点更难令人信服。追随大势的宏观基金比比皆是，但很少有基金能企及桥水的战绩。至于达利欧的优势被削弱这一点，最早的趋势基金是在1980年代成立的，早于桥水创立的第一批基金。这些基金在1990年代和21世纪初发展壮大，而期间达利欧一直保持着明显优势。他究竟是如何取得这番成就的多少还是个谜。也许他确实能将其中一些魔法整理成册或捕捉下来，无论如何这值得一试。

达利欧对科普兰的书不屑一顾。他写道，此书“又是一本耸人听闻、内容失实的低俗读物，写出来就是为了赚八卦爱好者的钱”。达利欧的圣人传记已经有了：他在2017年自己写了一本。科普兰的新书仿佛是它的陪衬物——专挑他毛病的。此书值得读一读，但得记着这一点。■



Buttonwood

Ray Dalio is a monster, suggests a new book. Is it fair?

The founder of the world's largest hedge fund comes under scrutiny

THE TOME opens with Ray Dalio laying into an employee he apparently knew to be pregnant. He calls her an “idiot” over and over, until she runs from the room sobbing. The founder of Bridgewater Associates, the world’s largest hedge fund, was supposedly “delighted”. His “probing” of this woman was evidence of his commitment to “truth-seeking” at any cost. The meltdown, which had been recorded, was uploaded to a library of firm meetings. He had it edited into a clip to be shown to future employees.

This is just the first of many damaging titbits in “The Fund”, a new book about Mr Dalio by Rob Copeland, a reporter at the New York Times. The book’s narrative builds to two points. One is that Mr Dalio’s “principles”, a philosophy he described as being centred on “radical transparency”, are really little more than time-wasting tools which he uses to bully employees. The system requires meetings to be recorded, for employees to rank one another and for them to upload complaints onto a platform. This is supposed to foster an “ideas meritocracy” but instead leads, at best, to petty gripes about how the peas in the cafeteria are too “wrinkled” and, at worst, to a culture of fear. Mr Dalio is supposed to have manipulated this system so that his opinion always mattered most.

The second is that there is “no secret” to Bridgewater’s success. Mr Dalio’s hundreds of research staff write reports he does not even read. Mr Copeland claims Mr Dalio made all the investing decisions himself, or with some input from lieutenants. Far from having a codified set of rules, as he tells clients, he uses hunches and simple “if then” statements such as: if interest rates fall in a country then you should sell its currency. These worked,

the story goes, for a while, but the rise of high-frequency traders and quantitative funds, which often follow market “momentum”, eroded his edge. Returns for Bridgewater’s flagship “Pure Alpha” fund have been pretty paltry for the past 10 or 15 years.

The conclusions of the two intertwine: the cult of Bridgewater is pointless. Bridgewater’s employees have time to waste on nonsense because the investing process is simple, really. Mr Dalio might have been a gifted investor—since 1991 he has earned \$58bn for those who have bought into his funds—but his efforts to codify investment rules and culture were a waste of time. His legacy will fade.

Mr Copeland’s deep reporting unearthed damning tales, but they seem to have been told so as to place Mr Dalio in the worst possible light. Take, for example, a passage where Mr Dalio invites Niall Ferguson, a celebrated historian, to Bridgewater. Mr Dalio supplied Mr Ferguson with a copy of his book, which offers a sweeping theory of economic history and a model of “the economic machine”—only for Mr Ferguson to tell the assembled staff that there was no way of modelling history since models could not account for the “caprices of decision-makers”. Mr Dalio began shouting at Mr Ferguson, who soon left. Mr Copeland writes that Mr Dalio then sent round a poll asking who won the debate (Mr Dalio triumphed).

It is one of many anecdotes that are supposed to reveal that Mr Dalio is unprincipled. Far from listening to unfiltered criticism he uses his power to silence others. But apparently Mr Dalio later solicited advice asking whether he had behaved inappropriately. His employees implored him not to invite people to Bridgewater just to shout at them—advice to which he is said to have listened. Mr Dalio’s radical transparency might be strange and misguided, but perhaps he is not a hypocrite.

The book’s arguments about Mr Dalio’s investment process are harder still to

swallow. Macro funds that follow trends are a dime a dozen, and few come close to touching Bridgewater's record. As for the erosion of his edge, the earliest momentum funds were established in the 1980s, before Bridgewater set up its first funds. They grew in the 1990s and 2000s, when his edge was as sharp as ever. How Mr Dalio achieved what he did is something of a mystery. Perhaps some of the magic could have been codified or captured. It was worth trying, anyway.

Mr Dalio dismisses Mr Copeland's book out of hand. He has written that it is "another one of those sensational and inaccurate tabloid books written to sell books to people who like gossip". The hagiography of Mr Dalio already exists: he penned his own tale in 2017. Mr Copeland seems to have written its foil, which can find only the ill in Bridgewater's founder. The book is worth a read—but only with that in mind. ■



自由交流

夸一夸美国的汽车情结

对汽车的依赖让美国更公平、更高效

没有什么传统是神圣不可改变的，就连“不给糖就捣蛋”也不例外。在最近的万圣节活动中，许多美国人把它改成了“后备箱讨糖”。孩子们不再在街区里挨家挨户地敲门，而是在停车场的汽车之间穿梭，从装饰着巨型蜘蛛和可怕鬼怪的敞开的后备箱里收集糖果。这再次反映了长期以来的一个事实：汽车在美国人的生活中拥有惊人的支配力。美国对汽车的依赖远远超过任何其他大国，平均每个家庭大约拥有两辆车。而这又与许多弊病相关联：肥胖、污染、郊区无序扩张等。

尽管如此，仍有越来越多的美国人选择住在郊区，过着高度依赖汽车的生活。人口普查数据显示，经过几十年的稳步增长，现在有略多于一半的美国人居住在郊区。这似乎是精英观点（汽车和郊区糟透了）与大众偏好（人们很喜欢它们）背道而驰的经典案例。对许多人来说，郊区的主要吸引力是较低的住房成本和更高的安全性。然而，最近的研究揭示了汽车也是一个关键因素，它让美国的郊区实现了非凡的效率与公平。

首先是便利性。众所周知，美国的城市是围绕着汽车设计的，这一进程始于福特T型车风行的1920年代。以汽车为中心的城市设计在全美成为主流，包括宽阔的道路、充足的高速公路出入口以及大量停车场。其他国家在不同程度上效仿了这种模式。但美国几乎做到了极致。今年8月由世界银行资助的一篇论文中，一群经济学家研究了152个国家的道路车速。不出所料，富裕国家的车速高于贫穷国家。而在富裕国家当中，美国遥遥领先：其交通速度比成员大部分为发达国家的经合组织（OECD）的其他成员国快约27%。世界上车速最快的20个城市中有19个在美国。

这并不是因为美国的道路本身更好。速度佐证了美国人有多么热爱郊区和感觉很像郊区的小镇。与其他经合组织国家的城市相比，美国城市的人口

少24%，面积大72%，大型道路多67%。所有这些都让驾驶者可以快速穿梭往来。美国人口密度最高的城市纽约是个例外，领教过其交通拥堵的人都知道这一点。但大多数美国郊区更像堪萨斯州的威奇托（Wichita）和北卡罗来纳州的格林斯博罗（Greensboro），那里的司机很少遇到堵车。

行驶速度缩短了距离。如今在城市规划者中流行“15分钟城市”的概念，也就是建设让人们步行或骑车15分钟内可到达公司、学校和娱乐场所的社区。许多美国人可能根本看不出这种创新的必要性，因为他们已经生活在15分钟城市里了，只要有车一切都不成问题。对于郊区居民来说，大多数生活要素——杂货店、学校、餐馆、公园、医生等等——开车一小会儿就到了。

汽车无处不在，还有一个鲜为人知的好处。耶鲁大学的卢卡斯·康威尔（Lucas Conwell）及其同事最近研究了美国和欧洲的城市区域。他们计算了“可通达区”——可以很方便就到达市中心的区域。尽管欧洲城市拥有更好的公共交通系统，但总体而言，美国城市的通达性更高。如果计算距离市中心15到30分钟路程的可通达区的面积，使用公共交通的话，美国平均为34平方公里，而欧洲为63平方公里。如果使用私家车，差距就大得多：美国为1160平方公里，欧洲为430平方公里。

抵达美国城市中心更容易，同样，要从市中心离开也更容易。人们下班后纷纷逃离办公室，回到远处的家中。长此以往，市中心的活力也随之流失。不过，这种现象也有积极的一面：正是这种可通达性让美国广泛阶层的人们都能住上更大的房子和更安静的街区。智库布鲁金斯学会（Brookings Institution）的威廉·弗雷（William Frey）分析了2020年人口普查数据后发现，郊区在过去这些年里明显变得更加多元化。1990年，大约20%的郊区居民是非白人。2000年这一比例上升到30%，2020年升至45%。

汽车并非万能灵药。养车或租车要花很多钱，对于贫穷的工薪阶层来说更是沉重的负担。因此，在美国城市里经常可以听到人们抱怨糟糕的公共交通。然而，这种大众看法虽然普遍，却并不完全准确。即使道路主要是为

私家车而建，它也是一种共享资源，可以视为公交车的“轨道”。康威尔及其同事在研究中认为，美国基于大巴的公共交通出人意料地有效：在美国和欧洲，远郊区和市中心之间可选择的公交路线数量大致相当。虽然美国城市中心区的巴士服务还有改善的空间，但有一点很关键：为汽车设计的城市同样可以支持公共交通。

如今，一些变化正在发生。年轻的美国人开车变少了。更多的城市正在建设适合步行的社区。纽约可能很快就会开征拥堵费。简而言之，可以想象未来的美国可能不再那么沉迷于汽车。

但与此同时，新冠疫情改变了人们的生活方式，又可能有利于汽车的流行。人们去办公室的次数减少了。这减少了公共交通的需求和收入，同时也让道路不那么拥堵，使驾驶体验更加愉快。如果远程工作的兴起使家庭能够日益深入郊区，汽车将变得更加不可或缺。这一切将如何演变？鉴于汽车在美国人生活中根深蒂固的地位，“后备箱讨糖”可能会继续下去。■



Free exchange

In praise of America's car addiction

How vehicle-dependence makes the country fairer and more efficient

NO TRADITION IS sacred—not even trick-or-treating. In recent Halloween festivities, many Americans switched to trunk-or-treating. Instead of going door-to-door on neighbourhood streets, children shuffled between cars in parking lots and collected candy from their open boots, which were bedecked by giant spiders and terrible ghouls. It was the latest demonstration of something that has long been true: cars have a remarkably tight grip on American life. America is far more car-reliant than any other big country, averaging roughly two vehicles per household. This, in turn, is linked to many ills: obesity, pollution, suburban sprawl and so on.

Despite such horrors, more Americans than ever are consigning themselves to a car-defined existence by choosing to live in the suburbs. Census figures reveal that after decades of steady growth, a little more than half the American population is now based in the 'burbs. It seems a classic case of elite opinions (cars and suburbs are awful) diverging from mass preferences (people quite enjoy them). For many, the main attractions of suburbia are lower housing costs and greater safety. Yet recent research sheds light on how cars are a crucial part of the equation, making America's suburbs both impressively efficient and equitable.

Start with convenience. It is well-known that American cities are configured for vehicles, a process that began in the 1920s with the Model T. Car-centric urban designs became dominant throughout the country, involving wide roads, ample access to expressways and parking galore. To varying degrees, other countries have copied that model. Yet America has come closest to perfecting it. In a paper released in August, supported by the World Bank,

a group of economists examined road speeds in 152 countries. Unsurprisingly, wealthy countries outpace poor ones. And within the rich world, America is streets ahead: its traffic is about 27% faster than that of other members of the OECD club of mostly rich countries. Of the 20 fastest cities in the world, 19 are in America.

It is not that American roads are better in and of themselves. Rather, speed is a testament to America's love affair with both suburbia and smaller towns that feel suburban. Compared with those in other OECD countries, American cities are 24% less populous, cover 72% more area and have 67% more large roads. All this enables drivers to zip around. New York, the country's densest city, is an outlier, as anyone who has sat in its gridlock knows. But most of American suburbia more closely resembles Wichita, Kansas, and Greensboro, North Carolina, where drivers rarely face jams.

Driving speed shrinks distance. One fashionable concept among urban planners these days is the “15-minute city”, the goal of building neighbourhoods that let people get to work, school and recreation within 15 minutes by foot or bike. Many Americans may simply fail to see the need for this innovation, for they already live in 15-minute cities, so long, that is, as they get around by car. Most of the essentials—groceries, school, restaurants, parks, doctors and more—are a quick drive away for suburbanites.

The car's ubiquity has another rarely appreciated benefit. A recent study by Lucas Conwell of Yale University and colleagues examined urban regions in America and Europe. They calculated “accessibility zones”, defined as the area from which city centres can be readily reached. Although European cities have better public transport, American cities are on the whole more accessible. Consider the size of accessibility zones 15-30 minutes from city centres. If using public transport, the average is 34 square kilometres in America versus 63 square kilometres in Europe. If using private cars, the

difference is much starker: 1,160 square kilometres in America versus 430 square kilometres in Europe.

Just as it is easier to get into American city centres, so it is easier to get out of them. Over time that has sapped vibrancy from their downtown cores as people flee offices at the end of the day for far-flung homes. However, there is a more positive way of looking at this phenomenon: it is precisely such accessibility that has put larger homes and quieter streets within reach for a remarkably wide cross-section of the country. In his analysis of the census from 2020, William Frey of the Brookings Institution, a think-tank, showed that suburbia has become far more diverse over the years. In 1990 roughly 20% of suburbanites were non-white. That rose to 30% in 2000 and 45% in 2020.

Not that cars are a panacea. Owning or renting one costs plenty of money, and is an especially big burden for the working poor. It is therefore common to hear laments in American cities about the sorry state of mass transit. Yet this general perception, though widespread, is not entirely accurate. Even if primarily built for private cars, roads are a shared resource and can be viewed as the “tracks” for buses. In their study Mr Conwell and his colleagues conclude that bus-based transportation in America is surprisingly effective: public-transit options between distant suburbia and city centres are roughly comparable in America and Europe. Although America could do more to improve its bus services within its urban cores, the crucial point is that cities designed for cars can also support mass transit.

Today some things are in flux. Younger Americans are driving less. More cities are building walkable neighbourhoods. New York may soon introduce congestion charging. It is, in short, possible to imagine an America that is less addicted to cars.

At the same time, though, covid-19 has changed lifestyles in ways that may favour vehicles. People are venturing into offices less often. That has reduced demand and revenues for public transit while making roads less congested and thus more pleasant for drivers. If the rise of remote work enables families to drift ever deeper into suburbia, cars will become more indispensable. How will it all shake out? Given how ingrained cars are in American life, trunk-or-treating is probably here to stay. ■



巴托比

如何在招聘中消除谎言

来点“写实风”，会让这个奖赏夸大其词的流程受益

招聘过程可以被看作是坦率与欺瞒之间的一场战斗。你可能会认为这不过是寻求真相的公司和自我推销的候选人之间的简单斗争，在某种程度上确实如此。但企业自己也会扭曲现实，而且往往会被弄巧成拙。

先来看公认的始作俑者：求职者。简历或领英个人资料的要义就是把现实情况尽可能地美化成最亮眼的样子。只要超过了一定的经验水平，人人都是变革型领导者，负责创造了数百万美元的收入。如果这些自我标榜全都是真的，世界经济应该是实际规模的15倍左右才对。一般的英国人每天要花四个半小时看电视和刷视频。但一般的求职者却会把业余时间都花在有价值的事情上，比如在施粥处做志愿者，或者教孤儿编程。

求职信中的虚情假意是如此直白（“当我看到这份工作的招聘广告时，兴奋得都快晕过去了”），人们已渐渐不再把它当回事。在面试阶段，公司招聘人员面临的一个任务就是套出一个人对某个项目究竟贡献几何。问候候选人有什么弱点和失败经验这种老掉牙的问题是有原因的，因为没有人会主动提起这些。认知和行为测试之所以有用，部分原因是申请者更难钻空子。

沾染上这种夸大事实倾向的不单是应聘者，还有企业。公司通常都会一成不变地在职位描述中用“快节奏”和“创新”来描述自己的工作环境，再为“理想候选人”列出一连串难以企及的要求，而这样的人顾名思义基本上就不存在。有时，这些要求还包括穿越时空改变历史进程的能力——有的招聘广告要求应聘者具备的某个语言的编程经验年数比该语言本身存在的年头都长。

在工业化的招聘流程中，盲目的夸张往往会得到回报。当你申请某个职位时，如果你的简历与原本的招聘广告中出现的关键词不匹配，浏览你简历

的服务机构就会给你打低分。由此传达的信息很明确：要想进入下一阶段，就得扭曲自我以满足公司的期望。

在招聘人员那里，形式可能已经大于内容。一名软件工程师说，她恶搞了一份简历，上面显眼地列举了在微软和Instagram的工作经历，但同时也罗列了自己的其他许多功绩，包括组织了公司的袋鼠跳比赛，并“把生殖器疱疹传染给了60%的实习生”，从而增强了团队凝聚力。她收到回复的比率达到90%以上。推荐信很容易失真和不准确，因而许多公司都有不提供推荐信的政策，担心自觉受到诋毁的候选人或被蒙骗的雇主会采取法律行动。

准确描述某个职位实际上涉及什么工作内容的公司少之又少。特雷西·富兰克林（Tracey Franklin）是快速发展的制药公司莫德纳（Moderna）的首席人力资源官，也是我刊的新播客《老板课堂》（Boss Class）本周的受访者。她很推崇“实际工作预演”（RJP），它们意在让未来的新员工真切地感受所申请职位的优缺点，并对公司的企业文化有清晰的认识。一个有效的方法是用文字或视频的形式展示担任这个职位后一个典型的工作日是怎样的。

这种诚实本身就可能是一种回报。早有研究表明，RJP可以降低员工流失率，提高员工满意度。陶森大学（Towson University）的大卫·欧内斯特（David Earnest）及合著者在2011年的一篇论文中得出结论称，对此最好的解释是员工对公司的诚实作风的认同感。

招聘过程中的双方自然都有动机粉饰现实。如果求职者在回答问题时都实话实说（“我惯于犯灾难性的低级错误”），那许多人就会自砸饭碗。同样，如果公司对自己的描述毫无保留，那么许多公司会令优秀的求职者却步。但是，如果公司自己也能坦诚相告，那么这个旨在看见求职者真面目的流程就会顺畅许多。 ■



Bartleby

How to get the lying out of hiring

A process that rewards exaggeration would benefit from greater realism

HIRING PROCESSES can be thought of as a battle between candour and dishonesty. You might imagine this is a simple fight between truth-seeking firms and self-promoting candidates, and to a certain extent it is. But companies themselves are prone to bend reality out of shape in ways that are self-defeating.

Start with the obvious culprits: job applicants. The point of a CV or a LinkedIn profile is to massage reality into the most appealing shape possible. Everyone beyond a certain level of experience is a transformational leader personally responsible for generating millions in revenue; the world economy would be about 15 times bigger than it actually is if all such claims were true. The average Briton spends four and a half hours a day watching TV and online videos. But the average job candidate uses their spare time only for worthy purposes, like volunteering in soup kitchens or teaching orphans to code.

The cover letter is so open in its insincerity (“When I saw the advertisement for this job, I almost fainted with excitement”) that people are starting not to bother with it. At the interview stage one task facing the firm’s recruiters is to winkle out the truth of what a person actually contributed to a project. Those hoary questions about a candidate’s weaknesses and failures are there for a reason; no one will bring them up unprompted. Cognitive and behavioural tests are useful in part because they are harder for applicants to game.

But a tendency to stretch the truth infects companies as well as applicants.

The typical firm will write a job description that invariably describes the work environment as fast-paced and innovative, and then lays out a set of improbable requirements for the “ideal candidate”, someone who almost by definition does not exist. Sometimes—as when ads demand more years of experience in a programming language than that language has existed for—these requirements include an ability to go back and alter the course of history.

Industrialised hiring processes can often reward mindless exaggeration. Services that scan your résumé when you are making an application mark you down if your CV does not match the keywords that appear in the original job advertisement. The message is clear: to get through to the next stage, you have to contort yourself to meet corporate expectations.

Substance can matter less to recruiters than form. One software engineer says she got a 90%-plus response rate with a spoof CV showing apparent spells at Microsoft and Instagram but also boasting, among other things, that she had increased team-bonding by organising the company potato-sack race and “spread Herpes STD to 60% of intern team”. References are so prone to inaccuracy that many firms have a policy of not giving them, fearing legal action from defamed candidates or deceived employers.

Too few firms offer an accurate account of what a position actually involves. Tracey Franklin, the chief HR officer for Moderna, a fast-growing drugmaker—and an interviewee in this week’s episode of Boss Class, our new podcast—is a fan of “realistic job previews” (RJPs). These are meant to give prospective recruits a genuine sense of the negatives and positives of the job, as well as a clear idea of the company’s corporate culture. One effective tactic is to lay out, in text or video, what a typical day in the role would look like.

Such honesty can be its own reward. Research has long suggested that RJPs

lead to lower turnover and higher employee satisfaction. A paper in 2011 by David Earnest of Towson University and his co-authors concluded that favourable perceptions of the organisation's honesty are the best explanation for why.

The incentives on both sides of the hiring process lean naturally towards glossing reality. If candidates were to give genuinely truthful answers ("I have a habit of making basic but calamitous errors"), many would rule themselves out of jobs. And if firms were to give a warts-and-all description of themselves, many would end up deterring good applicants. But a process designed to uncover the truth about job applicants would run a lot more smoothly if firms were also honest about themselves. ■



终于展开

人工智能可以帮助大批失传的古希腊罗马文本重见天日

计算机让考古学家可以阅读一座古罗马图书馆中数百个被烧焦的卷轴【深度】

这个被称为P.Herc.Paris.3的物体看上去像一块深灰色的木炭。因其大小、形状都和香蕉差不多，而得到了“香蕉小子”（Banana Boy）的绰号。它实际上是一个莎草纸卷轴，出土于意大利坎帕尼亚大区（Campania）的古罗马城镇赫库兰尼姆（Herculaneum）的一座庄园遗址中。公元79年，维苏威火山（Mount Vesuvius）喷发，灼热的气体吞噬了整个城镇，“香蕉小子”和庄园图书馆里的其他千百个卷轴全部被烧成焦炭。也正是这一场火山喷发埋葬了附近的庞贝城。

虽然这些卷轴得以幸存，但因为被烧成了焦炭，所以几乎不可能打开了。如今，在近2000年之后的一场有奖挑战赛中，参赛者使用X射线和人工智能（AI）虚拟展开了“香蕉小子”，从而首次揭示了它内部的文字。

10月12日公布的首个被发现的单词是“porphyras”，在古希腊语中意为“紫色”（见下图）。它的发现者是内布拉斯加大学林肯分校（University of Nebraska-Lincoln）计算机科学专业的学生卢克·法里托（Luke Farritor），他也因此获得了四万美元的奖金。法里托的发现建立在前美国国家航空航天局（NASA）物理学家凯西·汉德默（Casey Handmer）的研究成果之上。汉德默查看“香蕉小子”炭化层的X射线图像后发现了一种特有的“裂纹”，表明有墨迹的存在。

柏林自由大学（Free University of Berlin）机器人技术专业的学生尤瑟夫·纳德（Youssef Nader）之后也发现了同样的单词。（汉德默和纳德各获得一万美元的奖金。）此后，纳德得出的卷轴的一页图像展示了并排的四列文字。对于研究古希腊罗马文明的学者来说，这是件激动人心的事情。上述庄园的主人被认为是凯撒大帝的岳父卢修斯·卡尔普尔尼乌斯·皮索（Lucius Calpurnius Piso）。能够读出庄园图书馆的丰富藏书大大扩展了

从古希腊罗马时期存留下来的文本数量。人们已经开始兴奋地猜测这其中是否会有一些被遗忘的戏剧和全新的哲学著作，甚至失传的荷马史诗。

从18世纪50年代这座庄园重见天日开始，人们为打开这些卷轴费尽心思。先是尝试用刀子割开，结果把它们弄碎了。意识到它们易碎之后，罗马教廷的文物修复员安东尼奥·皮亚焦（Antonio Piaggio）在1754年造了一台机器，利用绳子上的重物缓慢剥开它们。但展开的部分还是碎了。这些碎片几乎无法阅读：碳基的墨迹在烧焦的莎草纸的亮黑色中难以辨认。但从寥寥几个依稀可辨的文字中可以看出，一些卷轴是用古希腊文书写的哲学著作。

250年后的1999年，杨百翰大学（Brigham Young University）的科学家用红外线照亮其中一些碎片，在莎草纸和墨水之间形成强烈的明暗对比，使得字迹更易辨识。2008年使用的将多个波长的光结合在一起的多光谱成像技术效果更好，让从前无法辨认的文字显现出来。结果发现，许多碎片上书写的是希腊哲学家菲劳德乌斯（Philodemus of Gadara）的著作。而在之前，这些著作之所以为人们所知，只是因为在其他作品中被提及过。
(不过西塞罗[Cicero]很喜欢菲劳德乌斯的诗。)

还有约500个卷轴尚未打开。鉴于用物理方式展开会造成损毁，人们不再尝试这种方法，而是专注于想办法虚拟打开它们——对卷起来的卷轴进行3D扫描，生成一系列可辨识的2D图像。最先采用这种方法的是肯塔基大学（University of Kentucky）的计算机科学家布伦特·西尔斯（W. Brent Seales）。2009年，他使用一种常用于医学扫描的计算机断层成像（CT）X光机扫描“香蕉小子”和另一个被称为“胖家伙”（Fat Bastard）的卷轴。卷轴内部结构的详细图像首次被展现出来，但里面的墨迹无法分辨。

2015年，西尔斯分析了1970年在以色列死海附近的恩盖迪（En-Gedi）发现的另一个碳化卷轴。该卷轴在书写时用了一种富含金属的墨水，在X射线图像中非常显眼。（这段文本被发现是圣经旧约的《利未记》。）这表明，在适当的情况下，用数字化方式展开碳化卷轴并读取其内容确实是可行的。

下一步是把现有的方法整合成一种新方法。2019年，西尔斯用英国的“钻石光源”（Diamond Light Source）对“香蕉小子”、“胖家伙”和其他卷轴的四块碎片进行了高分辨率扫描。“钻石光源”是一种粒子加速器，可以产生比CT扫描机强得多的X射线。然后，他将这些碎片的红外图像（其中的墨迹很容易看到）与其X射线扫描图像（墨迹难以分辨）配对。

今年早些时候，与西尔斯共事的研究生斯蒂芬·帕森斯（Stephen Parsons）将这两组图像投喂给一个机器学习模型，该模型使用红外扫描图像来自学如何识别X射线图像中模糊的墨迹。将由此得到的模型应用于未展开卷轴的X射线图像，就有可能揭示卷轴上的内容。这时候，从理论上说，破译卷轴已经简化成了一个非常复杂的软件问题。但这种软件仍需要改进和扩展。

此时纳特·弗里德曼（Nat Friedman）登场了，这位科技公司高管兼投资者对古罗马历史文化很感兴趣。弗里德曼表示愿意资助西尔斯的研究。他们在一起喝威士忌时认定，加快进度的最好办法便是组织一场竞赛，参赛者完成不同的任务会得到相应的奖励。今年3月，弗里德曼和另一位企业家丹尼尔·格罗斯（Daniel Gross）发起了维苏威火山挑战赛（Vesuvius Challenge），总奖金为25万美元。科技业的其他捐款者很快把奖金加码到超过100万美元。活动伊始，第一轮初始挑战赛发布在举办数据科学竞赛的网站Kaggle上，目标是改进帕森斯开发的墨迹检测模型。

1200多支队伍参加了竞赛。许多队伍参加了随后的多轮挑战赛，以改进墨迹检测工具以及将卷轴表面的3D扫描图像转换为2D图像（此过程被称为“分段”）的工具。仔细查看“香蕉小子”的分段图像后，汉德默意识到裂纹模式表明了墨迹的存在。法里托利用这一发现微调了机器学习模型以发现更多裂纹，然后利用这些裂纹进一步优化自己的模型，直到模型最终揭示出可辨识的单词。

纳德则另辟蹊径，他从对分段图像的“无监督预训练”开始，要求一个机器学习系统在没有外部提示的情况下，尽可能多地从中找出任何可能存在的模式。然后他使用Kaggle上的墨迹检测挑战赛的获奖作品微调自己的模

型。在看到法里托早些时候的研究结果后，他在“香蕉小子”的同一分段上使用了这个模型，并发现了一些看似字母的东西。然后不断重复这一做法，用已发现的字母反复改进自己的模型。模型自行寻找更多字母的能力得到了缓慢但稳步的提高。所有研究结果在颁奖之前都要经过莎草纸古文稿专家的评估。

与技术同等重要的是这项工作的组织方式。可以这么说，这是把开源软件的开发方法（这是弗里德曼的专业领域）应用到了解决考古难题上。弗里德曼表示：“这是科技公司创始人和学界之间一次非同寻常的合作，使用未来的工具，把过去带到现在。”西尔斯认为，在竞争的激励下，人们过去三个月里完成了一般需要十年的研究工作。

一批踊跃的参赛者正在使用这些新工具来分析这两个扫描过的卷轴。维苏威火山挑战赛的大奖奖金为70万美元，要求参赛者能够辨认出独立的四段内容，每段至少包含140个字母。弗里德曼认为，今年年底前有75%的概率会有人斩获这一大奖。“这是一场竞速赛了，”他表示，“明年我们将能看上整本整本的书了。”

能够阅读“香蕉小子”着实只是个开始。古希腊罗马文学只有一小部分流传到了现代。不过，如果能用同样的工具扫描庄园中发现的其他几百个卷轴来阅读它们，将大大增加古希腊罗马时期的文本数量。西尔斯表示，他希望这些赫库兰尼姆卷轴中会包含“某个前所未知的全新文本”。弗里德曼尤其希望看到一首失传的荷马史诗。

更重要的是，所有这些可能继而重燃人们更完整地发掘这座庄园的兴趣，弗里德曼表示。现存的卷轴都是在图书馆的一个角落中被发现的，而学者们认为图书馆本身要大得多，有好几层楼。如果是这样的话，这个图书馆里可能藏有成千上万个古希腊文和拉丁文的卷轴。

现今古希腊罗马文本如此罕见的一个原因是，欧洲温和多雨的气候很难让它们书写其上的莎草纸完好保存下来。西尔斯指出，这便有了美妙的戏剧性结果：碳化一方面让这些卷轴变得极难阅读，一方面却也为后世保存了

它们；同时，当初用物理方式打开它们而得到的碎片，最终又为以虚拟方式打开其余的那些提供了钥匙。 ■



Unrolled at last

AI could help unearth a trove of lost classical texts

Computers could let archaeologists read hundreds of burnt scrolls from a Roman library

THE OBJECT known as P.Herc.Paris.3 resembles a dark grey lump of charcoal, about the size and shape of a banana. That explains its nickname: Banana Boy. It is in fact a papyrus scroll, found in the ruins of a villa in the Roman town of Herculaneum, in Campania. Along with hundreds of other scrolls in the villa's library, it was carbonised when scorching gases engulfed the town during the same eruption of Mount Vesuvius, in 79AD, that also buried the nearby town of Pompeii.

Although the scrolls survived, their charring means that unrolling them is almost impossible. Now, nearly 2,000 years later, words from inside Banana Boy have been revealed for the first time, after volunteers competing in a prize challenge used X-rays and artificial intelligence to do the unrolling virtually.

The first word to be found, announced on October 12th, was “porphyras”, which means “purple” in ancient Greek (see picture below). It was uncovered by Luke Farritor, a computer-science student at the University of Nebraska-Lincoln, earning him a \$40,000 prize. Mr Farritor built on work by Casey Handmer, a former NASA physicist, whose examination of X-ray images of Banana Boy's charred layers identified a characteristic “crackle pattern” indicating the presence of ink.

The same word was later found by Youssef Nader, a robotics student at the Free University of Berlin. (Dr Handmer and Mr Nader both received \$10,000 prizes.) Mr Nader has since produced an image from the scroll showing four columns of text, side by side. For classicists, this is heady stuff. The villa in

question is thought to have belonged to Lucius Calpurnius Piso, the father-in-law of Julius Caesar. The ability to read its well-stocked library could significantly expand the number of texts that have survived from antiquity. Already there is excited speculation about forgotten plays, new works of philosophy—or even lost Homeric poems.

Efforts to read the scrolls began in the 1750s, when the villa was rediscovered. Attempts to unpick them with knives caused them to disintegrate. Recognising their fragility, Antonio Piaggio, a conservator from the Vatican, built a machine in 1754 to unroll them slowly, using weights on strings. Even then, the unrolled scrolls fell to pieces. And the resulting fragments were almost impossible to read: charcoal-based ink is hard to see against the shiny black of charred papyrus. But the few characters that could be read revealed some scrolls to be philosophical works written in ancient Greek.

A quarter of a millennium later, in 1999, scientists from Brigham Young University illuminated some of those fragments with infrared light. That created a strong contrast between papyrus and ink, making the writing more legible. Multi-spectral imaging in 2008, combining many wavelengths of light, was even better, revealing previously unreadable words. Many fragments turned out to belong to texts written by a Greek philosopher called Philodemus of Gadara. Until then, they had been known only from mentions in other works. (Cicero, though, was a fan of his poetry.)

Around 500 scrolls remain unopened. Given the damage it does, physical unrolling is no longer attempted. Instead the focus has shifted towards finding ways to unwrap them virtually, by using 3D scans of the rolled-up scrolls to produce a series of legible 2D images. The pioneer of this approach is W. Brent Seales, a computer scientist at the University of Kentucky. In 2009 he arranged for Banana Boy, and another scroll known as Fat Bastard, to be scanned in a computerised tomography (CT) X-ray machine, of the

sort usually used for medical scans. This produced detailed images of their internal structures for the first time. But the ink within the scrolls could not be made out.

In 2015 Dr Seales analysed a different carbonised scroll found in 1970 at En-Gedi, near the Dead Sea in Israel. It had been written using a metal-rich ink, which stood out strongly in X-ray images. (The text turned out to be the Book of Leviticus.) This confirmed that, in the right circumstances, digitally unrolling a carbonised scroll and reading the contents could indeed be done.

The next step was to combine the existing approaches into a new one. In 2019 Dr Seales arranged for Banana Boy, Fat Bastard and four fragments of other scrolls to be scanned at high resolution using the Diamond Light Source in Britain, a particle accelerator that can produce much more powerful X-ray light than a CT scanner. He then paired infrared images of the fragments, in which the ink can be readily seen, with X-ray scans of the same fragments in which it cannot.

Earlier this year Stephen Parsons, a graduate student working with Dr Seales, fed the two sets of images into a machine-learning model, which used the infrared scans to teach itself how to recognise the faint signs of ink in the X-ray ones. By applying the resulting model to X-ray images from the rolled-up scrolls it would be possible to reveal their contents. At this point, deciphering the scrolls had, in theory, been reduced to a very complex software problem. But that software still needed to be improved and scaled up.

Enter Nat Friedman, a technology executive and investor with an interest in ancient Rome. Mr Friedman offered to help fund Dr Seales's work. Over a whisky, they decided that the best way to accelerate things was to organise a contest, with prizes handed out for completing various tasks. Mr Friedman

and Daniel Gross, another entrepreneur, launched the Vesuvius Challenge in March, with a prize fund of \$250,000. Other tech-industry donors soon increased that to over \$1m. To get the ball rolling, an initial challenge was posted on Kaggle, a website that hosts data-science contests, to improve the ink-detection model developed by Dr Parsons.

More than 1,200 teams entered. Many competed in subsequent challenges to improve the tools for ink detection and “segmentation”, as the process of transforming the 3D scans into 2D images of the scroll’s surface is known. Scrutinising segmented images from Banana Boy, Dr Handmer realised that the crackle pattern signified the presence of ink. Mr Farritor used this finding to fine-tune a machine-learning model to find more crackles, then used those crackles to further optimise his model, until eventually it revealed legible words.

Mr Nader used a different approach, starting with “unsupervised pretraining” on the segmented images, asking a machine-learning system to find whatever patterns it could, with no external hints. He tweaked the resulting model using the winning entries from the Kaggle ink-detection challenge. After seeing Mr Farritor’s early results, he applied this model to the same segment of Banana Boy, and found what appeared to be some letters. He then iterated, repeatedly refining his model using the found letters. Slowly but surely its ability to find more letters increased. All the results were assessed by papyrologists before the prizes were awarded.

No less important than the technology is the way the effort has been organised. It is, in effect, the application of the open-source software-development method, Mr Friedman’s area of expertise, to an archaeological puzzle. “It’s a unique collaboration between tech founders and academics to bring the past into the present using the tools of the future,” he says. Dr Seales reckons the spur of competition means the equivalent of ten years’ worth of research has been done in the past three months.

An active community of volunteers is now applying the new tools to the two scanned scrolls. Mr Friedman thinks there is a 75% chance that someone will claim the grand prize of \$700,000, for identifying four separate passages of at least 140 characters, by the end of the year. “It’s a race now,” he says. “We will be reading entire books next year.”

Being able to read *Banana Boy* would indeed just be the beginning. Only a small fraction of Greek and Roman literature has survived into modern times. But if the hundreds of other scrolls recovered from the villa could be scanned and read using the same tools, it would dramatically expand the number of texts from antiquity. Dr Seales says he hopes the Herculaneum scrolls will contain “a completely new, previously unknown text”. Mr Friedman is hoping for one of the lost Homeric epic poems in particular.

Even more important, all this might in turn revive interest in excavating the villa more fully, says Mr Friedman. The existing scrolls were recovered from a single corner of what scholars believe is a much larger library spread across several floors. If so, it might contain thousands of scrolls in Greek and Latin.

One reason that classical texts are so scarce is that the papyrus upon which they were written does not survive well in Europe’s temperate, rainy climate. So it is a delicious irony, notes Dr Seales, that the carbonisation of the scrolls, which makes them so difficult to read, is also what preserved them for posterity—and that fragments of scrolls that disintegrated when they were unrolled physically would eventually provide the key to unrolling the rest of them virtually. ■



当模型变成实体

实验室培养的胚胎模型越来越接近真胚胎

拟胚体有望带来诸多益处，但也带来了棘手的伦理问题【深度】

传统生成胚胎的方法是让精子细胞与卵子结合，通常发生在两个人吃完晚餐喝了点酒之后。但一种新的方式可能即将到来。近年来，科学家发现，他们可以诱使干细胞（那些能够转化为许多其他类型细胞的细胞）形成外观和机能都非常类似胚胎的结构。

这种被称为“拟胚体”的结构有助于胚胎学和妊娠研究，以及探究相关病症的原因。有些拟胚体看起来异常接近真胚胎。2022年，由在加州理工学院和剑桥大学任职的马格达莱纳·泽妮可-格兹（Magdalena Zernicka-Goetz）领导的研究团队和另一个由以色列的魏茨曼科学研究所（Weizmann Institute of Science）的雅各布·汉纳（Jacob Hanna）领导的团队分别发表了论文，介绍了具有肠道、大脑和跳动的心脏雏形的小鼠拟胚体。今年6月，泽妮可-格兹又发表了一篇论文，描述了一种人类拟胚体，旨在模仿真正的胚胎植入母体子宫后的最初发育阶段。

第二项研究引起了争议，一些科学家怀疑其成果并不像作者所声称的那样，算得上很大的进展。但这方面的最前沿迅速推进，一些人认为拟胚体和真胚胎之间可能很快就会难辨真假。从很多方面来说，这将是一件好事，因为模型越准确，用处就越大。人类拟胚体可以揭示发育性心脏缺陷或脊柱裂等疾病的病因，并提高试管婴儿（IVF）的成功率。

但胚胎研究是受到严格监管的，毕竟胚胎有可能发育成人。许多国家禁止在研究中使用体外培养超过14天的人类胚胎，而在没有此类立法的国家，研究人员通常会自愿遵守同样的标准。拟胚体与胚胎越相似，就越难以回避拟胚体研究是否应该遵守类似规则的问题。

一个自然胚胎始于单个受精卵。为了生成拟胚体，科学家会培养不同干细胞的混合物，这些干细胞取自胚胎，或者有时取自成体生物体。他们可能

会调整细胞之间的分子信号，并决定让哪些细胞的基因处于活跃状态。几天之内，胚胎样结构就出现了。

研究拟胚体之所以可取，部分原因是真正的胚胎非常稀缺——主要来源是IVF手术剩余的胚胎。这些真胚胎也很难培养发育，因此很难开展大规模实验。拟胚体提供了一种道德风险较低的替代选择。

体现拟胚体好处的一个例子是着床研究，即研究胚胎植入子宫的过程。大多数流产都是在这个过程中发生的。但在拟胚体出现之前，几乎不可能详细研究流产的原因。“我们无法通过母亲的身体来观察胚胎的发育过程。”泽尼可-格兹说。

拟胚体——确切来说是一种称为类囊胚的拟胚体——为研究人员提供了次优选择。它们最先由奥地利科学院的尼古拉斯·里夫龙（Nicolas Rivron）创造出来，类似于尚未着床、还处于囊胚期的胚胎。人类胚胎的着床发生在受精后的第七天左右，小鼠是在第四天左右。每个类囊胚都有一个空心细胞球，在真正的胚胎中，空心细胞球会成为胎盘的一部分。附着在细胞球内壁上的一个更小的细胞团在正常情况下会发育成胎儿。里夫龙的团队让类囊胚在培养皿中的子宫组织上滚动，由此发现只有在经过诱导，让其内细胞团最接近子宫组织时，类囊胚才能着床。

这意味着内细胞团会向外部细胞发送信号，指示它们粘附在子宫上。里夫龙认为他已经识别出了这些信号，并计划很快公布研究结果。他希望这将有助解释为何很多胚胎无法着床。这进而又可能会提高IVF的成功率，在美国，IVF的成功率仅为35%左右。里夫龙说，类囊胚大大方便了研究人员获得此类新发现。他创办了一家名为Dawn Bio的公司，利用类囊胚来筛选可能治疗不孕不育的候选药物。

研究人员尝试利用其他拟胚体来了解胚胎着床后的状态。最先进的拟胚体是用小鼠干细胞培养成的（例如前文提到的具有大脑和心脏的拟胚体），再现了小鼠胚胎发育到第八天的情况。汉纳博士持有人类拟胚体发育的最高记录。在9月发表的一篇论文中，他和同事描述了拟胚体模拟人类胚胎

在第8天至第14天之间的发育状况。他还在积极地向前推进，也许最终能来到第35天。那时，他的人类拟胚体将和老鼠的拟胚体一样，开始发育出器官。

汉纳相信这可能让拟胚体成为有医疗价值的细胞的来源。例如它们也许可以提供干细胞，干细胞又能转化为可以给白血病患者移植的骨髓。如果用于生成拟胚体的干细胞取自患者，那么最后得到的骨髓将与患者本人的骨髓有相同的基因。这将消除免疫排斥的风险，患者也就无需服用免疫抑制药物。

如果能让拟胚体进一步发育，可能会释放出真正令人震撼的可能性。从第50天左右开始，拟胚体就会长出性腺。这可能意味着，有朝一日，那些难以怀孕的女性可以得到新鲜培养出来的自己的全新卵子。（汉纳的公司Renewal Bio正在朝着这类目标努力。）

没有人知道这些目标何时能实现，甚至能否实现。伦敦的弗朗西斯·克里克研究所（Francis Crick Institute）的发育生物学家内奥米·莫里斯（Naomi Moris）也认为汉纳的第14天的拟胚体看起来还挺像回事。但她认为这些拟胚体不能完全替代人类胚胎。一方面，汉纳的拟胚体从未经历过像囊胚那样的阶段。缺失这一环节让它们无法附着在真正的子宫里，并可能限制它们可以在培养皿中继续发育的时间。

尽管如此，既然实验室已经在追求这些目标了，一些科学家认为现在就应该开始考虑监管问题。莫里斯提议赋予胚胎新的法律定义，其依据将是胚胎是否有可能发育成胎儿，胎儿阶段从受精后八周开始一直持续到出生。在许多国家，人类胚胎的法律定义并不明确。莫里斯希望她的提议能够明确，如果拟胚体也有可能发育成胎儿，就应该视为胚胎。

不过，要确定拟胚体是否能发育成胎儿可能会很棘手。唯一的方法就是试试看，不过一旦成功，这样的实验就可能违法。莫里斯和包括里夫龙在内的同事则建议进行一个两步走的试验，以求至少可以提出令人信服的论据，证明拟胚体已经接近于胚胎。

第一步是看看人类拟胚体的发育轨迹有多接近真实胚胎。第二步是尽可能长时间地培养动物拟胚体，最好能达到生成有生育能力的活体后代的阶段。这样的研究可能会从小鼠开始，然后再转到猪或猴子上。如果这种长期培养的拟胚体在生化方面看起来与人类最先进的胚胎相似，那么就应当谨慎对待。

莫里斯估计，在两到五年之内，就会有人创造出可以进入胎儿阶段的动物拟胚体。今年4月，中国的研究人员将猴子类囊胚移植到母猴体内，产生了20天之久的妊娠期。而且有人走上歪路的可能性总是存在的。2018年，中国的研究人员贺建奎宣布他已经创造出基因编辑的人类婴儿。他因此入狱，并受到广泛谴责。但并不难想象，有人可能会在拟胚体上做出类似的越界行为。

国际干细胞研究学会（International Society for Stem Cell Research）主席阿曼德·克拉克（Amander Clark）强调了另一个可能让监管变得困难的尴尬局面。由于在体外培养人类胚胎不能超过14天，科学家无法充分了解胚胎之后的发育过程。这就使得他们极难判断14天以上的拟胚体是否在按照“应有”的路线发育。唯一的参照物是动物胚胎和通过手术从孕妇身上取出的子宫的解剖结构。换句话说，这条旨在保护胚胎的规定导致研究人员可能很难判断其替代物是否足够好，或者好到需要给予法律保护。■



When the map becomes the territory

Lab-grown models of embryos increasingly resemble the real thing

Embryoids promise many benefits, but pose tricky ethical questions

THE TRADITIONAL way to make an embryo is to combine a sperm cell with an egg, often after dinner and a bottle of wine. But a new way may be around the corner. In recent years scientists have discovered that they can persuade stem cells—those with the ability to transform into many other sorts of cells—to form structures that look and behave very much like embryos.

“Embryoids”, as such creations are called, can help with the study of embryology and pregnancy, and how they can go wrong. Some of the facsimiles look strikingly real. In 2022 two teams, one led by Magdalena Zernicka-Goetz, who works at the California Institute of Technology and the University of Cambridge, and another by Jacob Hanna at the Weizmann Institute of Science, in Israel, published papers describing mouse embryoids with rudimentary guts, brains and beating hearts. In June Dr Zernicka-Goetz published a paper describing a human embryoid designed to mimic the earliest stages of development, shortly after a real embryo would have implanted into its mother’s womb.

That second study was controversial, with some other scientists dubious that it represented as much of an advance as its authors claimed. But the state of the art is moving fast enough that some think embryoids may soon become hard to distinguish from the embryos they are meant to model. In many ways, that would be a good thing: the more accurate a model, the more useful it is. Human embryoids could shed light on developmental heart defects or diseases like spina bifida, and boost the success rates of in-vitro fertilisation (IVF).

But research on embryos—which, after all, have the potential to develop into human beings—is strictly regulated. Many countries ban the use in research of human embryos that are more than 14 days old, and researchers in countries without such laws usually adhere to the same standard voluntarily. The more similar embryoids become to the real thing, the harder it becomes to avoid the question of whether they should be subject to similar rules.

A natural embryo begins with a single fertilised egg. To make an embryoid scientists grow a mix of different stem cells derived from embryos or, sometimes, from adult organisms. They may tweak the molecular signals between the cells and which of their genes are active. Within days, embryo-like structures appear.

Embryoids are desirable partly because real embryos are scarce: the main source is leftovers from IVF treatment. They are also hard to grow. That makes it tricky to run large-scale experiments. Embryoids offer a less ethically fraught alternative.

One example of their benefits is the study of implantation, the process by which an embryo implants into the womb. It is here that most pregnancy losses happen. But the reasons were almost impossible to study in detail before the advent of embryoids. “You cannot go through the body of the mother to see the development of this embryo,” says Dr Zernicka-Goetz.

Embryoids—specifically, a type called a blastoid—offer the next-best thing. First created by Nicolas Rivron at the Austrian Academy of Sciences, they resemble an embryo at the blastocyst stage, just before implantation. In humans implantation happens around day seven and in mice, around day four. Each blastoid consists of a hollow ball of cells that would, in a real embryo, go on to become part of the placenta. Attached to the inner wall is a smaller ball that would, in other circumstances, develop into the fetus. By

rolling blastoids across uterine tissue in a dish, Dr Rivron's team found that they only stick when they are oriented so that this inner mass is closest to the womb tissue.

That implies the inner mass sends signals to the outer cells, instructing them to stick to the womb. Dr Rivron thinks he has identified those signals, and plans to publish his results soon. He hopes to help explain why so many embryos fail to attach. That might, in turn, improve the success rates of IVF, which in America is only about 35%. Blastoids have made such discoveries much easier, says Dr Rivron. He has started a company, Dawn Bio, which uses blastoids to screen drug candidates that might be useful in fertility treatment.

Other embryoids try to capture what embryos look like after implantation. The most advanced are made with mouse stem cells, such as the brain-and-heart models described above, which represent day eight in mouse development. Dr Hanna holds the record for human embryoids. In a paper published in September he and his colleagues described embryoids that mimic the development of human embryos between days eight and 14. He is keen to try to push things further, perhaps to day 35. At that point, his embryoids, like the mouse ones, would be starting to develop organs.

Dr Hanna believes that could make them a source of medically useful cells. They might, for instance, provide stem cells that could in turn be turned into bone marrow for transplant in leukaemia patients. If the stem cells used to create the embryoid were taken from the patient, then the marrow would be genetically identical to the patient's own. That would remove the risk of immune rejection, and the need for immune-suppressing drugs.

Convincing the embryoids to develop still further might open up truly mind-bending possibilities. From day 50 or so, the embryoids would have gonads. That might mean, one day, that women struggling to get pregnant

could be given a brand new, freshly baked set of their own eggs. (Dr Hanna's company, Renewal Bio, is pursuing such goals.)

No one knows when—or even if—these goals might be achieved. Naomi Moris, a developmental biologist at the Francis Crick Institute in London, agrees that Dr Hanna's 14-day-old embryoids look the part. But she does not think they yet qualify as full replacements. For one thing, Dr Hanna's embryoids never go through a blastocyst-like stage. That missing link prevents them from attaching to a natural womb, and might impose limits on how long they can carry on developing in a dish.

Still, the fact that such goals are being pursued at all has convinced some scientists that the time to think about regulation is now. Dr Moris has proposed a new legal definition for embryos that would be based on their potential to develop into a fetus, a developmental stage that begins eight weeks after fertilisation and lasts until birth. In many countries human embryos are legally ill-defined. Dr Moris hopes her proposal would make clear that an embryoid could qualify as an embryo—if it had the same developmental potential.

Working out if they do, though, might be tricky. The only way to know for certain whether an embryoid could develop into a fetus would be to try it and see—though such an experiment might risk violating the law if it were successful. Instead Dr Moris and her colleagues, including Dr Rivron, have suggested a two-part test that would make at least a compelling argument that embryoids had closed the gap.

The first step would be to check just how closely human embryoids track the developmental trajectory of real embryos. The second would be to push animal embryoids as far as possible, ideally to the point of producing live, fertile offspring. Such a process might start with mice before moving on to pigs or monkeys. If such long-developing embryoids look biochemically

similar to the human state-of-the-art, caution would be warranted.

Dr Moris reckons that, within two to five years, someone will have produced animal embryoids that can reach the fetal stage. In April, Chinese researchers transplanted monkey blastoids into surrogate animals, producing pregnancies that lasted for up to 20 days. And there is always the chance that someone goes rogue. In 2018 He Jiankui, a Chinese researcher, announced that he had created gene-edited human babies. He was jailed, and widely condemned. But it is not inconceivable that someone might try to push the boundaries in a similar way with embryoids.

Amander Clark, the president of the International Society for Stem Cell Research, highlights another irony that could make regulation difficult. Since human embryos cannot be cultured for longer than 14 days, scientists do not have a detailed picture of how they develop afterwards. That would make it very difficult to tell if embryoids older than 14 days were behaving as they are supposed to. The only comparators are animal embryos and dissections of wombs surgically removed from pregnant women. In other words, the very rule meant to protect embryos means researchers could struggle to tell whether their alternatives were good enough—or so good they should be given legal protection in turn. ■



熊彼特

对美国科技巨头来说，中国应用是把双刃剑

Shein和Temu的广告闪电战会持续多久？

在过去的一年里，两家以五美元连衣裙和淡化自己的中国出身闻名的“超快时尚”新贵Shein和Temu在美国掀起了一场法律“内讧”。总部设在新加坡的Shein在这两家公司中更为出名，它率先发难，指责抢夺它美国地盘的Temu盗用它的商标以及利用网红来抹黑它。总部位于波士顿、但隶属于中国电商巨头拼多多的Temu发起反击，指斥Shein垄断，比如利用市场支配力迫使中国8000多家供应商拒与Temu做生意。随后，10月27日，路透社报道称两家公司已经暂停敌对行动。

要放在以前，这难看的场面在西方观察家的眼里可能不过是一些娱乐花絮。但它们表明，中国的电商恶战现在已经打到了美国。Shein和Temu的命运与美国一些最大的科技公司的命运紧密交织，比如拥有社交媒体帝国的Meta、拥有谷歌的Alphabet，以及美国电商巨头亚马逊，更不用说像沃尔玛这样的实体零售商和遍布美国商业街的一元店了。没有人愿意大声说出这一点，然而尽管大家都在谈论中美脱钩，事实上有中国背景的电子商务平台正在强势挤入美国商界，它们所用的“震慑战术”与视频应用TikTok用来围攻社交媒体的打法如出一辙。对于数字广告主来说，这喜忧参半。对于折扣零售商来说，这是一大祸根。对所有人而言，这可能会改变跨境贸易的方方面面。

先来看广告。Meta在10月下旬公布的第三季度业绩中透露，来自中国的广告主（包括电子商务和游戏公司）对其收入增长产生了“特别大”的影响。Meta没有列出这些公司的名字，也没有量化它们的影响，但超级侦探们也没闲着。其中一位是布赖恩·维泽（Brian Wieser），他曾是一名广告人，后来转行做了分析师。五年前，他从公司数据中发现，在Facebook平台上卖广告的人和看广告的人的地理位置存在差异，这促使人们第一次注意到中国广告主在Facebook上的重大份额。直到今年，Meta才开始承认中国

的重要性，证实了他的发现。研究公司MoffettNathanson利用类似的位置数据估计，在截至9月的九个月里，Shein和Temu贡献了Meta近三分之一的收入增长，也就是将近30亿美元（这一数字远低于维泽的估计）。Alphabet也在发类似的横财。市场营销公司Tinuiti表示，第三季度在Google Shopping的广告拍卖中，Temu和沃尔玛是旗鼓相当的竞争者。一年前这家羽翼未丰的公司还榜上无名。

再来看电子商务。亚马逊的平台上一直都有来自中国的廉价商品卖家。他们很少宣传自己的来路。不过，电子商务研究公司Marketplace Pulse的创始人尤扎斯·卡兹尤科纳斯（Juozas Kaziukenas）梳理了实际地址，推测出在亚马逊上销售商品的许多商家都在中国。随着Shein和Temu的迅速流行，其中一些商家可能会转向这两个平台。目前，卡兹尤科纳斯并不认为这两家主打折扣营销的公司会对亚马逊的业务构成实质性挑战，因为亚马逊的业务规模要大得多，销售的商品类别更多，交货速度也快得多。话虽如此，如果中国的电子商务发展有什么借鉴意义的话，那就是这些新贵们不会被对手的实力吓倒，它们会不懈努力，直到从美国竞争对手那里夺取市场份额。TikTok也正在成为网络购物领域不可忽视的力量，它通过直播卖货吸引购物者，这在中国是一种常见的做法。MoffettNathanson称这三管火炮齐发是近年来对电子商务的“最大的颠覆性威胁”。

如果这亚洲三强的影响力如此之大，为什么美国的科技巨头面对它们不动声色？对于那些乐享广告横财的公司来说，原因之一可能是Shein和Temu的营销狂欢能否持续是个问题。在大众零售这个利润微薄的行业里，如果往数字广告狂砸数十亿美元的战略持续过久，就是走上一条自我毁灭之路。Meta和Alphabet可能不想让人们注意到这一收入流存在潜在不稳定性。

美国的政治阻力也可能越来越大。国会中的中国怀疑论者像担忧TikTok那样担心起Shein和Temu来，指责这对快时尚双雄利用了美国法律中的一个例外，即允许价值低于800美元的包裹免税进入美国，而且很少受到检查。据估计，在这一规定下进入美国的包裹中有30%是这两家公司的。堵上这一漏洞可能会大大降低这两家平台在美国能提供的折扣。此外，它们

的算法利用了大量关于购物者的数据，这让它们面临与TikTok相同的攻击。

这些零售公司貌似躲过的一个风险是中国国内的整顿运动。由于总部设在国外，它们不太可能像一些成功的中国科技公司那样，在近年得罪了国家主席习近平而遭打压。数据收集机构Insider Intelligence的斯凯·卡纳维斯（Sky Canaves）认为，它们的成功其实可能是在帮助其中国供应商抵消国内经济放缓的影响。她认为这会提升它们在政府心中的地位。

目前尚不清楚Shein和Temu为什么会握手言和，结束法律纠纷，但这肯定会让北京当局松一口气。毕竟，共同战线比在数字T台上互撕更有利于国家的海外形象。休战是否意味着它们会少费些火力跟对方打营销战，还有待观察。但美国科技巨头正处于一个新的世界秩序中。它们在很大程度上仍被中国拒之门外。而中国则通过代理全面进入它们的主场。新的竞争无疑让科技巨头沮丧，对它们的客户来说却是一份包装精美的礼物。■



Schumpeter

Chinese apps are a mixed blessing for American big tech

How long will the advertising blitzes of Shein and Temu last?

DURING THE past year Shein and Temu, two ultra-fast-fashion upstarts famous both for \$5 frocks and for playing down their Chinese heritage, have waged an internecine legal battle in America. Singapore-based Shein, the better-known of the two, threw down the frilly gauntlet, accusing Temu, which has invaded its territory in America, of stealing its trademarks and using social-media influencers to disparage it. Temu, which is based in Boston but owned by PDD, a Chinese e-commerce giant, struck back. It accused Shein of monopolistic practices like using its market power to force a network of 8,000-plus suppliers in China to refuse to do business with Temu. Then, on October 27th, Reuters reported that the firms had suspended hostilities.

To observers in the West these goings-on might once have seemed like an entertaining sideshow. But they illustrate that the cut-throat drama of Chinese e-commerce has now arrived in America. The fortunes of Shein and Temu are intricately bound up with those of some of America's biggest technology firms, such as Meta, with its social-media empire, Alphabet, owner of Google, and Amazon, America's e-commerce behemoth—not to mention physical retailers like Walmart and the dollar stores ubiquitous across American strip malls. No one likes to say this out loud, but for all the talk of Sino-American decoupling, China-linked e-commerce platforms are muscling into American business with the same shock-and-awe tactics that TikTok, a video app, used to besiege social media. For digital advertisers it is a mixed blessing. For discount retailers it is a curse. For everyone it may change the warp and weft of cross-border commerce.

Take advertising for starters. In its third-quarter results announced in late October, Meta revealed that advertisers from China, including e-commerce and gaming firms, had an “outsized” impact on revenue growth. Meta did not name the firms or quantify their impact, but supersleuths went to work. One was Brian Wieser, a former adman turned analyst, who five years ago first drew attention to the importance of Chinese advertisers on Facebook after spotting differences in company data between the geographic location of those who sell ads on its platforms and those who see them. Only this year did Meta start acknowledging China’s importance, vindicating his work. Using similar location data, MoffettNathanson, a research firm, estimates that Shein and Temu provided nearly a third of Meta’s revenue growth in the nine months to September, or almost \$3bn (a figure well short of Mr Wieser’s estimates). Alphabet, too, is reaping the bonanza. Tinuiti, a marketing firm, says that in the third quarter Temu was as big a competitor in auctions for ads on Google Shopping as Walmart. A year ago the fledgling firm was nowhere.

Then there is e-commerce. Amazon’s platform has long hosted sellers of cheap goods from China. They seldom advertise their provenance. Nonetheless, Juozas Kaziukenas, founder of Marketplace Pulse, an e-commerce research firm, has combed through physical addresses to estimate that many merchants selling on Amazon are based in China. As Shein and Temu surge in popularity, some of those vendors may switch to their platforms. For now, Mr Kaziukenas does not expect the cut-price duo to materially challenge Amazon’s business, which is much bigger, has a broader range of goods for sale and vastly outpaces them on speed of delivery. That said, if e-commerce in China is any guide, the upstarts will not rest until they have taken market share from American competitors, undaunted by their rivals’ heft. TikTok, too, is becoming a force to be reckoned with in online shopping, using live jamborees to attract shoppers, a common practice in China. MoffettNathanson calls the triple-barrelled

onslaught the “biggest disruptive threat” to e-commerce in years.

If the Asian trio loom so large, why are America’s tech giants so hush-hush about them? For those enjoying the ad windfall, one reason may be questions about the longevity of Shein’s and Temu’s marketing sprees. In mass-market retail, with wafer-thin margins, pouring billions of dollars into digital ads is a road to ruin if it goes on too long. Meta and Alphabet may not want to draw attention to the potential volatility of the revenue streams.

Political headwinds in America may be mounting, too. Sinosceptics in Congress, in a similar tizzy about Shein and Temu as they are about TikTok, accuse the fast-fashion duo of exploiting an exception in American law that allows packages under \$800 in value to enter the country duty-free and with scant inspection. It reckons the two firms are responsible for 30% of packages entering America under this rule. Closing the loophole could significantly cut the discounts the two platforms offer in America. Moreover, their algorithms draw on oceans of data about shoppers. That opens them up to the same attacks as TikTok.

One risk that the retail firms are apparently spared is a crackdown in China. With headquarters outside the country, they are less likely to suffer the fates of successful Chinese tech firms that have fallen foul of President Xi Jinping in recent years. Sky Canaves of Insider Intelligence, a data-gatherer, says their success may in fact be helping their Chinese suppliers offset the economic slowdown at home. She thinks that will boost their standing with the government.

It is not clear why Shein and Temu settled their legal grievances, but it will surely be a relief to the powers that be in Beijing. After all, a common front is better for the country’s image abroad than a catfight on the digital catwalk. Whether the truce means they will spend less to out-market each other remains to be seen. But American tech giants are in a new world order. They

are still largely shut out of China. China, by proxy, is all over their home turf. The new competition no doubt frustrates big tech. To its customers, it is a neatly wrapped gift. ■



【首文】“全能明星”诞生

人工智能将如何改变名利场

对这项新技术怨声最大的群体很可能获益最大

几十年来，计算机一直在颠覆枯燥乏味的工作。现在，人工智能（AI）正向最光彩夺目的工作发起冲击。好莱坞已停摆了大半年，直到11月8日各大影视公司与罢工演员们达成协议，同意保护他们不被机器人对手抢走饭碗。在上周的各大音乐排行榜上，在世的音乐人被一位通过AI复活的已故披头士成员挤到了后头。斯嘉丽·约翰逊（Scarlett Johansson）等演员和约翰·格里森姆（John Grisham）等作家正在起诉科技公司未经授权使用他们的形象和文字。

明星们可能担心AI在窃取他们的作品，还让资质平平的演员有了跟他们抢观众的能耐。但事实上，最高声抱怨AI的明星恰恰是最能从这种新技术中受益的人群。AI非但不会削弱明星的影响力，还会让最大牌的明星可以随时随地以各种形式出现在所有市场上，收获空前的名气。来为“全能明星”的崛起鼓掌吧（或者你更想戴上耳塞的话也可以）。

技术改变了名利场的规则，这也并非头一回。18世纪，阅读的普及让人有可能在有生之年真正成名，开始有了“明星”一说。电影和广播电台最初看似是对明星的一种威胁，他们担心自己的现场表演会贬值，而事实上，这些技术引领人们走入了“超级明星”（在上世纪20年代流行起来的说法）的时代。类似的恐慌也出现在电视发明之际，并在1960年导致好莱坞上一次大罢工。但是，当时的这项新技术又一次让名人变得更出名，让他们走进了每家每户的客厅。到上世纪60年代，更是出现了“巨星”一说。

随着AI生成的内容涌入娱乐业，住在洛杉矶富人区马里布（Malibu）的敬业明星们再一次担心自己的名气会遭稀释。然而，结果很可能再一次是相反的。互联网时代有一个悖论，在上传到YouTube、TikTok等平台上的内容创造了海量用户自制内容的“长尾”的同时，大牌艺人的热门作品也越发

声名远播。在过去六年里，Spotify上每年版税收入超过1000美元的音乐人数量翻了一番不止，但每年收入超过1000万美元的音乐人数量已是原来的五倍之多。即使小众内容（船夫号子、口哨以及各种古怪音乐）蓬勃发展，也无碍泰勒·斯威夫特（Taylor Swift）成功举办了史上最赚钱的巡回演唱会。受冲击的是中游艺人。

整个娱乐业都呈现类似的模式。过去二十年里，每年上映的剧情长片的数量翻了一番，但最卖座的大片占总票房的份额也翻了一番。自费出书的浪潮并没有侵蚀明星作家的销量。在海量选择面前，观众和读者愈加依赖算法及他人推荐，把自己引向最受欢迎的内容。AI势必将带来更多选择，受众的搜索成本也就会进一步增加，他们将继续被少数头部明星所吸引。

AI将使得这些巨星能真正做到对粉丝来说无处不在。AI配音已经可以让演员和播客主用自己的声音与外国观众即时对话。很快，能让口型和新语言相匹配的视频剪辑技术也将成为标配。当红演员可能会得到更多工作，因为AI可以让明星们在根本不同场的情况下共同演出，解决艺人档期太满这个好莱坞的老问题。“数字肉毒素”将延长演员的演艺生命，甚至让他们能在死后继续“表演”。迪士尼已获得92岁的詹姆斯·厄尔·琼斯（James Earl Jones，《星球大战》电影中黑武士的配音演员）的声音使用权，这样黑武士就可以吓唬一代又一代的孩子了。

明星还可以通过最近才出现的新形式为粉丝表演。伦敦一座场馆内一周七场的ABBA乐队虚拟演唱会门票火热售罄，还有Meta最近推出的明星语音聊天机器人，这些都只是顶级明星满足粉丝需求并借此盈利的开胃小菜而已。

这些机会是有附加条件的。艺人的确有理由担忧版权问题；若不想AI成为一种合法化的盗版，就必须使版权受到保护。过往的新技术也不例外：18世纪，印刷机的出现促使第一部版权法诞生；上世纪60年代，版权费被重新调整以补偿那些作品在电视上播出的电影演员；本世纪初，Napster等公司掀起的盗版音乐免费下载狂欢最终让位给流媒体与唱片公司之间的协议。内容创作者对内容使用权限和报酬有疑问是合理的（在此我们应声

明，此处关涉我们自己的利益）。而在这些问题得到解答之前，AI将是法律的“狂野西部”。

更大的问题是，“全能明星”时代如何让观众满意。风险在于厌倦。AI在把旧素材拿来混剪和重制方面才华过人，但不那么擅长制作令人心跳加速、脊背发麻的内容，目前为止这还是人类的专长。但AI作品还是可能会吸引到电影制片厂、唱片公司和其他创意中间商，它们倾向沿袭旧有的成功套路，把风险降到最低。好莱坞就已经更愿意把系列电影“炒冷饭”而非开拍新作品，看看票房榜上那一长串续集和翻拍电影就知道了。AI将使制片厂把同样的原则应用到演员身上。迪士尼最新推出的《星球大战》衍生片仍由卢克·天行者的原扮演者出演，但经过AI处理而令其长相年轻化。目前，观众会被这样的花招惊艳。但是可能远等不到《速度与激情94》上映，他们就已经生厌了。

但娱乐市场具有很强的自我修正能力。观众能瞬间让炙手可热的节目过气，这一点明星们再清楚不过了。而且，就在AI支持的娱乐发展之时，消费者看起来仍然钟爱真人戏剧。体育竞技也许是血有肉、最能抵御AI的观赏盛事了，近年来它对于媒体公司的价值不断飙升（与此同时，没有人观看由电脑驱动的国际象棋比赛，即使其中最强的电脑可以击败任何人类棋手）。此外，AI将进一步拉长娱乐业的长尾，形成更深厚的利基市场，更个性化的内容。在AI时代，观众将面对从泰勒·斯威夫特到黑武士等少数“全能明星”的轰炸，但他们想要换台的话也将比以往任何时候都容易。 ■



The omnistar is born

How artificial intelligence will transform fame

Those complaining the loudest about the new technology stand to benefit the most

COMPUTERS HAVE spent decades disrupting humdrum jobs. Now artificial intelligence (AI) is coming for the most glamorous ones. Hollywood has been at a standstill for half the year, until studios agreed on November 8th to offer striking stars protection from robotic rivals. Living artists were nudged down last week's music charts by a dead Beatle, resurrected by AI. Actors like Scarlett Johansson and authors like John Grisham are suing tech firms over the unauthorised use of their image and words.

Stars may worry that AI is stealing their work and giving less talented performers the skills to snatch their audience. In fact, the famous folk complaining the loudest about the new technology are the ones who stand to benefit the most. Far from diluting star power, AI will make the biggest celebrities bigger than ever, by allowing them to be in all markets, in all formats, at all times. Put your hands together—or insert your earplugs if you prefer—for the rise of the omnistar.

This is not the first time that technology has changed the rules of the fame game. People began to talk of stars in the 18th century, after the spread of reading made it possible to be truly famous within your lifetime. Film and radio initially seemed like a threat to stars, who worried that their live performances would be devalued. In fact, those technologies ushered in the era of the superstar, a term that caught on in the 1920s. A similar panic greeted the invention of television (and led to the last big Hollywood strike, in 1960). But again, the new tech made the famous even more so, bringing them into every living room. By the 1960s people were talking of megastars.

As AI-generated content floods into the entertainment business, the hardworking folk of Malibu are worrying once more that their fame will be diluted—and again, the outcome is likely to be the opposite. One of the paradoxes of the internet age is that, even as uploads to YouTube, TikTok and the like have created a vast “long tail” of user-made content, the biggest hits by the biggest artists have become even bigger. The number of musicians earning over \$1,000 a year in royalties on Spotify has more than doubled in the past six years, but the number earning over \$10m a year has quintupled. Even as niche content thrives—sea shanties, whistling and all kinds of eccentricities—Taylor Swift is marching through the most lucrative concert tour in history. It is the mid-ranking artists who have suffered.

Similar patterns hold across entertainment. The number of feature films released each year has doubled in the past two decades, but the biggest blockbusters have simultaneously doubled their share of the total box office. A tide of self-published books has not eroded the sales of star writers. In a sea of choice audiences rely more on recommendations, both algorithmic and human, which funnel them towards the most popular content. AI promises even more choice, and thus even higher search costs for audiences, who will continue to gravitate to the handful of stars at the top.

AI will give these megastars the ability to be truly omnipresent for their fans. AI-powered dubbing is already allowing actors and podcasters to speak to foreign audiences instantly and in their own voice. It will soon be standard for video to be edited so that their lips match the new language, too. In-demand actors may get more work because AI removes the perennial Hollywood problem of crowded schedules, allowing stars to perform alongside each other while not being together at all. Digital Botox will increase actors’ shelf-life and even enable them to perform posthumously. Disney has acquired the rights to the voice of James Earl Jones, 92, so that Darth Vader can scare children for generations to come.

Stars will also be able to perform for fans in formats that are only beginning to emerge. The ABBA avatars that sell out a London arena seven times a week, and the celebrity-voiced chatbots recently launched by Meta, are just a taste of the ways in which the biggest stars will be able to satisfy—and monetise—their fans.

These opportunities come with strings attached. Artists are right to worry about copyright, which must be protected if AI is not to become a legalised form of piracy. Past technologies were no different: the printing press led to the first copyright laws in the 18th century; royalty payments were rejigged in the 1960s to compensate big-screen actors whose work was shown on TV; the musical free-for-all unleashed by companies like Napster at the turn of the century eventually gave way to deals between streamers and record companies. Content creators have legitimate questions about permission and payment (we declare an interest here). Until those are answered, AI will be a legal Wild West.

The bigger question is how the age of the omnistar will suit audiences. The risk is boredom. AI is brilliant at remixing and regurgitating old material, but less good at generating the pulse-racing, spine-tingling stuff that is, for now, a human speciality. AI output may nonetheless appeal to film studios, record labels and other creative middlemen, who prefer to minimise risk by sticking to tried-and-tested ideas. Hollywood already favours franchises over new work: witness the rash of sequels and reboots at the box office. AI will let studios apply the same principle to actors. A de-aged Luke Skywalker stars in Disney's latest "Star Wars" spin-off. At present, audiences are wowed by such trickery. They may grow tired of it long before "Fast and Furious 94".

Yet the entertainment market is strongly self-correcting. Audiences have the power to turn a hot property into a has-been in an instant, as stars are all too aware. And even as AI-powered entertainment grows, consumers still seem to relish human drama. Sport, perhaps the most AI-proof, flesh-and-bones

spectacle there is, has seen its value to media companies soar in recent years (meanwhile, no one watches computer-powered chess, though its best players could beat any human). Moreover, AI will make entertainment's long tail even longer, with deeper niches and more personalised content. In the AI age, audiences will face heavy bombardment from a handful of omnistars, from Taylor Swift to Darth Vader. But it will be easier than ever for them to change the channel. ■



【首文】好到难以置信

违背重力法则的世界经济不可持续

威胁重重，包括“长期高息”

战争肆虐、地缘局势恶化之际，世界经济却捷报频传。仅仅一年前，所有人都还认为高利率将很快引发经济衰退。现在，就连乐观派也感到困惑。美国经济在第三季度强劲增长，年化增速达到惊人的4.9%。在世界各地，通胀正在下降，失业率大多保持在低位，各大央行可能已经停止了货币紧缩。饱受房地产危机困扰的中国似乎很可能在适度刺激政策下有所起色。不幸的是，这种欢欣鼓舞无法长久。当前增长的根基看起来并不稳固。眺望前路，威胁重重。

无法压制的经济亢奋已经促使人们押注利率虽不再快速上升，也不会大幅下降。过去一周里，欧洲央行和美联储都维持了利率稳定；预计本文发表后不久，英国央行也会在11月2日的议息会议上效仿。长期债券收益率也相应大幅攀升。美国政府现在必须为30年期国债支付5%的利息，而在疫情造成的萧条最为严重时利息仅为1.2%。即使是以低利率著称的经济体也出现大幅上涨。不久前，德国的借贷成本还是负数；现在其十年期债券收益率接近3%。日本央行几乎已经放弃了将十年期借贷成本维持在1%的承诺。

包括美国财长耶伦在内的一些人士表示，利率上升是件好事——反映世界经济正处于最健康的状态。而事实上，它是一个危险的源头。因为利率很可能持续高企，今天的经济政策将会失效，它们促成的经济增长也就无法持续。

要想知道为什么今天的良好状况无法持续下去，不妨考虑一下美国经济尤其好于预期的一个原因。美国消费者在疫情期间因政府补贴和闭门不出而积累了许多现金，他们一直在花这些钱。本来预计这些超额储蓄到现在已经见底了，但近期数据显示居民仍有1万亿美元的剩余资金。这就解释了

为什么尽管他们现在存下的收入比2010年代任何时候都要少，却仍然问题不大。

当这些超额储蓄的缓冲耗尽时，高利率的不利影响就会开始显现，迫使消费者不再那么自在地花费。而如果利率继续走高，世界各地的经济将开始出现问题。在欧洲和美国，企业破产已经在增加；即使是通过发行长期债务锁定低利率的公司，也终究不得不面对更高的融资成本。随着房贷成本上升，房价将会下跌，至少按通胀调整后的房价会下跌。而持有长期证券的银行原本依靠短期贷款（包括美联储的贷款）来维持，现在将不得不筹集资本或进行合并，以填补因利率上升而在资产负债表上出现的窟窿。

财政刺激政策加剧了世界经济的亢奋。在“长期高息”的世界里，这同样看起来不可持续。根据国际货币基金组织（IMF）的数据，2023年英国、法国、意大利和日本的赤字都可能达到GDP的5%左右。在截至9月的12个月里，美国的赤字达到了惊人的2万亿美元，在经会计信息失真调整后占GDP的7.5%，约为2022年中所做预期的两倍。在低失业率时期，这种不计后果的举债令人惊掉下巴。综合看来，目前发达国家的政府债务占GDP的比重处于拿破仑战争以来的最高水平。

在低利率时代，即使债务高企也是可控的。而今利率上升，利息支出正逐步掏空预算。因此，“长期高息”有可能使政府与以控制通胀为目标的央行形成对立。耶伦已经不得不喊话，称美债并没有风险溢价，而美联储主席鲍威尔则坚称，美联储绝不会降息、放任通胀飞涨来缓解政府的预算压力。

无论鲍威尔怎么说，“长期高息”的时代将导致投资者质疑政府保持低通胀和偿还债务的承诺。欧洲央行持有的债券已经开始向其默默支持的意大利政府债务倾斜——在高利率的世界里，这么做的难度大增。即使去年日本国债收益率只有区区0.8%，利息支出仍然占了预算的8%。试想一下，如果收益率达到哪怕德国这种相对适中的水平，压力会有多大。一些政府会因此勒紧裤腰带。但这又可能给经济带来痛苦。

在这些压力之下，很难想象世界经济何以实现市场当前的诸多期望：躲过衰退、低通胀，同时又能承受巨额债务和高利率。更有可能出现的情形是，“长期高息”的时代将会自行终结：它引发了经济疲软，促使央行降息而不致通胀飙升。

一种更让人心存希望的可能性是生产率飞速增长，或许要归功于生成式人工智能。由此带来的收入和税收增长应该会让高利率变得可以承受。事实上，预计11月2日公布的数据将显示美国测得生产率在第三季度飙升。人工智能有潜力进一步提高生产率，这或许可以解释为什么“长期高息”到目前为止还没有击穿股市。若不是微软和英伟达等七家科技公司估值上升，美股标普500指数今年早已下跌。

然而与这一希望背道而驰的是，世界也被各种拖累生产率增长的威胁困扰。特朗普誓言，如果他重返白宫，将大幅开征新关税。各国政府纷纷出台产业政策，日益扭曲市场。随着人口老龄化、绿色能源转型推进，以及世界各地的冲突要求增加国防开支，政府支出在经济中所占的比重正在不断增加。面对这一切，如果还寄望于世界经济能够继续高歌猛进，那就是一场豪赌。 ■



Too good to be true

The world economy is defying gravity. That cannot last

Threats abound, including higher-for-longer interest rates

EVEN AS WARS rage and the geopolitical climate darkens, the world economy has been an irrepressible source of cheer. Only a year ago everyone agreed that high interest rates would soon bring about a recession. Now even the optimists have been confounded. America's economy roared in the third quarter, growing at a stunning annualised pace of 4.9%. Around the world, inflation is falling, unemployment has mostly stayed low and the big central banks may have stopped their monetary tightening. China, stricken by a property crisis, looks likely to benefit from a modest stimulus. Unfortunately, however, this good cheer cannot last. The foundations for today's growth look unstable. Peer ahead, and threats abound.

The irrepressible economy has encouraged bets that interest rates, though no longer rising rapidly, will not fall by much. Over the past week the European Central Bank and Federal Reserve have held rates steady; the Bank of England was expected to follow suit shortly after we published this on November 2nd. Long-term bond yields have accordingly risen sharply. America's government must now pay 5% to borrow for 30 years, up from just 1.2% in the depths of the pandemic recession. Even economies known for low rates have seen sharp increases. Not long ago Germany's borrowing costs were negative; now its ten-year bond yield is nearly 3%. The Bank of Japan has all but given up on its promise to peg ten-year borrowing costs at 1%.

Some people, including Janet Yellen, America's treasury secretary, say these higher interest rates are a good thing—a reflection of a world economy in the rudest of health. In fact, they are a source of danger. Because higher

rates are likely to persist, today's economic policies will fail and so will the growth they have fostered.

To see why today's benign conditions cannot continue, consider one reason why America's economy in particular has fared better than expected. Its consumers have been spending the cash they accumulated during the pandemic from handouts and staying at home. Those excess savings were expected to have been depleted by now. But recent data suggest households still have \$1trn left, which explains why they can get away with saving less out of their incomes than at any point in the 2010s.

When those excess savings buffers have been run down, high interest rates will start to bite, forcing consumers to spend less freely. And trouble will start to emerge across the world economy if rates stay higher for longer. In Europe and America business bankruptcies are already rising; even companies that locked in low rates by issuing long-term debt will in time have to face higher financing costs. House prices will fall, at least in inflation-adjusted terms, as they respond to dearer mortgages. And banks holding long-term securities—which have been supported by short-term loans, including from the Fed—will have to raise capital or merge to plug the holes blown in their balance-sheets by higher rates.

Fiscal largesse has added to the world economy's sugar rush. In a higher-for-longer world, it too looks unsustainable. According to the IMF, Britain, France, Italy and Japan are all likely to run deficits in the region of 5% of GDP in 2023. In the 12 months to September America's deficit was a staggering \$2trn, or 7.5% of GDP after adjusting for accounting distortions—about double what was expected in mid-2022. At a time of low unemployment, such borrowing is jaw-droppingly reckless. All told, government debt in the rich world is now higher, as a share of GDP, than at any time since after the Napoleonic wars.

When interest rates were low, even towering debts were manageable. Now that rates have risen, interest bills are draining budgets. Higher-for-longer therefore threatens to pit governments against inflation-targeting central bankers. Already, Ms Yellen has felt obliged to argue that Treasuries carry no risk premium, and Jerome Powell, the Fed's chairman, has insisted that his bank would never cut rates and let inflation rip to ease pressure on the government's budget.

Whatever Mr Powell says, a higher-for-longer era would lead investors to question governments' promises both to keep inflation low and also to pay their debts. The ECB's bondholdings are already becoming skewed towards the Italian government debt that it tacitly backstops—a task that has become far harder in a high-rate world. Even when Japanese government-bond yields were a paltry 0.8% last year, 8% of Japan's budget went on interest payments. Imagine the strain if yields reached even Germany's relatively modest levels. Some governments would go on to tighten their belts as a result. But doing so may bring economic pain.

These strains make it hard to see how the world economy could possibly accomplish the many things that markets currently expect of it: a dodged recession, low inflation, mighty debts and high interest rates all at the same time. It is more likely that the higher-for-longer era kills itself off, by bringing about economic weakness that lets central bankers cut rates without inflation soaring.

A more hopeful possibility is that productivity growth soars, perhaps thanks to generative artificial intelligence (AI). The resulting boost to incomes and revenues would make higher rates bearable. Indeed, figures published on November 2nd are expected to show that America's measured productivity surged in the third quarter. The potential of AI to unleash further productivity gains may explain why higher-for-longer has so far not punctured stockmarkets. Were it not for the rising valuations of seven tech

firms, including Microsoft and Nvidia, the S&P 500 index of American stocks would have fallen this year.

Set against that hope, though, is a world stalked by threats to productivity growth. Donald Trump vows swinging new tariffs should he return to the White House. Governments are increasingly distorting markets with industrial policy. State spending is growing as a share of the economy as populations age, the green-energy transition beckons and conflicts around the world require more spending on defence. In the face of all this, anyone betting that the world economy can just keep carrying on is taking a huge gamble. ■



嗜睡的消费者

欢迎来到隐士消费者的时代

全球经济见证价值每年6000亿美元的行为转变

从某些方面来看，新冠疫情只是一个小插曲。富裕世界的失业率经历了2020年的飙升后，迅速降至疫情前的低点。各国在短时间内恢复到了疫情前的GDP水平。然而，在解除封锁两年多后，至少有一个变化留存了下来：富裕国家的消费者习惯已经发生了决定性的、也许是永久性的转变。欢迎来到隐士时代。

在疫情前，服务业占消费支出的份额稳步上升。随着社会变得更加富裕，人们更多地寻求奢侈体验、医疗照护和财务规划。然后到了2020年，从酒店住宿到理发，服务支出暴跌。人们待在家里的时间越来越长，他们对商品的需求激增，蜂拥购买电脑设备和健身自行车。

三年过去了，用于服务的支出份额仍低于疫情前的水平（见图1）。相比疫情前的趋势预测，下降幅度还要更大。与在2019年时会做出的预期相比，富裕国家消费者现在每年在服务上的支出要少6000亿美元左右。人们尤其对餐饮住宿和休闲娱乐等需要走出家门的休闲活动兴致减退。消费被重新导向了各种各样的商品，从椅子和冰箱等耐用品，到服装、食品和葡萄酒等消耗品。

在封锁时间较短的国家，隐士式习惯还没到根深蒂固的程度。然而在其他地方，行为的改变似乎已深入骨髓。在遭受新冠重击的捷克，服务业的份额比趋势水平低了三个百分点。美国也差不多。在日本，用于招待客户和其他商业目的的餐厅预订量下降了50%。对在东京的声色犬马之地仍能见到的脚步踉跄、醉醺醺的上班族多些怜惜吧，他们可是濒临灭绝的物种。

乍一看，这些数字很难与坊间传闻对上号。现在要在餐馆找个位子难道不是前所未有的难吗？然而，人满为患的真正原因并不是需求高涨，而是供应受限。如今，想从事餐饮接待业的人变少了一—在美国，该行业的就业

率仍低于2019年。受疫情影响，许多本应在2020年和2021年开业的新酒店和餐馆始终没有开张。自2019年以来，英国的酒店数量一直没有增长，仍在1万家左右。

企业界注意到了这个价值6000亿美元的转变。在最近的财报电话会议上，美国优质连锁餐厅之一橄榄园（Olive Garden）的经营者达登餐饮（Darden Restaurants）的一名高管指出，相较于疫情前的水平，“我们的客流量大概恢复到了80%”。销售家装工具的家得宝（Home Depot）的实际收入比2019年增长了约15%。高盛跟踪了两类公司的股价，一类是从人们足不出户中受益的公司，如电子商务公司，另一类是靠人们迈出家门而生意兴隆的公司，如航空公司。即使在今天，市场仍然看好那些为宅家族提供服务的公司（见图2）。

为什么隐士行为会持续？第一个可能的原因是一些紧张不安的人们依然害怕感染，无论是新冠还是其他疾病。在英国，汽车使用量与疫情前的常态一致，而公共交通的使用量显著下降。人们似乎也不再那么热衷于近距离的私人服务。在美国，美发和个人护理方面的支出比疫情前的趋势低20%，而化妆品、香水和美甲护甲产品方面的支出增长了四分之一。

第二个原因与工作模式有关。根据伦敦国王学院的切瓦特·吉雷·阿克索伊（Cevat Giray Aksoy）及其同事的研究，在整个富裕世界，人们现在差不多每周在家工作一天。这导致他们减少了在办公室内购买包括午餐在内的服务的需求，提高了对DIY类商品的需求。去年，意大利人在玻璃器皿、餐具和家用器具上的支出比2019年增加了34%。

第三个与价值观有关。新冠可能真的让人们变得更像隐士了。根据美国官方数据，去年人们每天的睡眠时间比2019年增加了11分钟。他们在需要会员资格的俱乐部以及其他社交活动上的开销也减少了，在园艺和宠物等自得其乐的活动上花费得更多。与此同时，全球对接龙这种单人纸牌游戏的在线搜索量相比疫情前差不多翻了个倍。看起来，新冠最大的“后遗症”是人与人之间的距离越来越远了。 ■



Consumerzzzzzzzz

Welcome to the age of the hermit consumer

The world economy is witnessing a \$600bn-a-year shift in behaviour

IN SOME WAYS covid-19 was a blip. After soaring in 2020, unemployment across the rich world quickly dropped to pre-pandemic lows. Countries re-attained their pre-covid GDP in short order. And yet, more than two years after lockdowns were lifted, at least one change is enduring: consumer habits across the rich world have shifted decisively, and perhaps permanently. Welcome to the age of the hermit.

Before covid, the share of consumer spending devoted to services was rising steadily. As societies became richer, they sought more luxury experiences, health care and financial planning. Then in 2020 spending on services, from hotel stays to hair cuts, collapsed. With people spending more time at home, demand for goods jumped, with a rush for computer equipment and exercise bikes.

Three years on, the share of spending devoted to services remains below its pre-covid level (see chart 1). Relative to its pre-covid trend, the decline is sharper still. Rich-world consumers are spending around \$600bn a year less on services than you might have expected in 2019. In particular, people are less interested in leisure activities that take place outside the home, including hospitality and recreation. Money is being redirected to goods, ranging from durables like chairs and fridges, to things such as clothes, food and wine.

In countries that spent less time in lockdown, hermit habits have not become ingrained. Elsewhere, though, the behaviour looks pathological. In the Czech Republic, which was whacked by covid, the services share is three

percentage points below trend. America is not far off. Japan has witnessed a 50% decline in restaurant bookings for client entertainment and other business purposes. Pity the drunken salaryman staggering round Tokyo's pleasure districts: he is an endangered species.

At first glance, the figures are difficult to reconcile with the anecdotes. Isn't it harder than ever to get a table at a restaurant? Yet the true source of the crowding is not sky-high demand, but constrained supply. These days fewer people want to work in hospitality—in America employment in the industry remains lower than in 2019. And pandemic disruption means many new hotels and restaurants that would have opened in 2020 and 2021 never did. The number of hotels in Britain, at around 10,000, has not grown since 2019.

Firms are noticing the \$600bn shift. In a recent earnings call an executive at Darden Restaurants, which runs one of America's finest restaurant chains, Olive Garden, noted that, relative to pre-covid times, "we're probably in that 80% range in terms of traffic". At Home Depot, which sells tools to improve homes, revenue is up by about 15% on 2019 in real terms. Goldman Sachs, a bank, tracks the share prices of companies that benefit when people stay at home (such as e-commerce firms) and those that thrive when people are out (such as airlines). Even today, the market looks favourably upon firms that serve stay-at-homers (see chart 2).

Why has hermit behaviour endured? The first possible reason is that some tremulous folk remain afraid of infection, whether by covid or something else. In Britain, car use is in line with the pre-covid norm, whereas public-transport use is well down. People also seem less keen on up-close-and-personal services. In America spending on hairdressing and personal grooming is 20% below its pre-covid trend, while spending on cosmetics, perfumes and nail preparations is up by a quarter.

The second reason relates to work patterns. Across the rich world people

now work about one day a week at home, according to Cevat Giray Aksoy of King's College London and colleagues. This cuts demand for services bought at the office, including lunches, and raises demand for do-it-yourself goods. Last year Italians spent 34% more on glassware, tableware and household utensils than in 2019.

The third relates to values. Covid may have made people genuinely more hermit-like. According to official data from America, last year people slept 11 minutes more a day than in 2019. They also spent less on clubs that require membership and other social activities, and more on solitary pursuits, such as gardening and pets. Meanwhile, global online searches for "Patience", a card game otherwise known as Solitaire, are running at about twice their pre-pandemic level. Covid's biggest legacy, it seems, has been to pull people apart. ■



钠电池新生

一些公司正在探索用钠电池替代锂电池

与锂不同，钠便宜又丰富【深度】

它们驱动小巧的手机和两吨重的电动汽车。它们成为越来越多的电网蓄电系统的核心，平抑风能和太阳能发电站的输出波动。没有它们，很难想象能够实现电气化，从而避免全球变暖带来的最坏影响。2019年，三位研发它们的先驱获得了诺贝尔奖。

但是锂离子电池也有缺点。首先是锂的稀缺性。性能最好的锂离子电池使用层状氧化物阴极，还需要钴和镍。这两种金属也很稀缺——并且钴具有争议性，因为很多钴矿都在刚果（金），那里的工作条件亟待改善。第二种锂离子电池即所谓的聚阴离子型使用磷酸铁锂（LFP），不需要镍或钴。但是这种电池的能量密度比不上层状氧化物的电池。

不过，一些公司认为自己还有另一种选择——用钠来制造电池。与锂不同，钠资源非常丰富：海水中的盐大部分成分就是钠。化学家们发现，相比锂，使用钠的层状氧化物阴极在没有钴或镍助力的情况下依然堪用。因此，大规模生产钠离子电池的想法正得到越来越多的支持。工程师们正在改进设计。生产钠离子电池的工厂如雨后春笋般涌现，尤其是在中国。自锂离子革命开始以来，锂在电化学上的骄人地位首次受到挑战。

锂和钠都属于碱金属，位于元素周期表的第一列中，紧跟在氢的下面。众所周知碱金属具有很高的反应活性。（在水中投入一些碱金属，水便会嘶嘶地冒很多泡。有的还会引起爆炸。）这是因为碱金属原子的最外层只有一个电子。这些“价电子”很容易脱离出去，产生正离子（阳离子），正离子可以与负离子（阴离子，比如源自水的羟基离子）结合。这样便产生了氢氧化锂和氯化钠等化合物——后者也就是我们熟知的食盐。

但是，如果脱离的电子是通过导线传递到指定目的地，而不是直接跑到附近的原子或原子团上，而与此同时阳离子单独通过一种叫作电解液的介质

移动，这就构成了电化学电池。当电子经过导线时，可以从中提取能量（见示意图）。反之，如果通过施加电流逆转整个过程，就可以给电池充电。

这个过程对锂和钠都成立。既然钠更具成本优势，非化学专业人士可能就会疑惑了，为什么不一开始就考虑钠而考虑锂呢？答案是：钠原子比锂原子更大、更重。锂原子有三个质子和三个中子，而钠原子有11个质子、12个中子，此外还多了一个电子壳层。相同容量的钠电池会比锂电池更大更重。

小而轻的电池对手机来说至关重要，在汽车上至少也是加分项。但小而轻并非在所有情形下都要紧。钠电池可以用于电网级储能、家庭储能，以及货车和船舶等重型运输工具。

中国对钠电池的兴趣部分源于政府现行的五年经济规划（始于2021年）。除了其他目标，该规划提出要探索各种电池化学。伦敦的基准矿业情报机构（Benchmark Mineral Intelligence，以下简称Benchmark）列出了36家正在生产或研究钠电池的中国公司。这些公司大多对外保密——Benchmark的研究人员甚至无法确定其中四家涉及哪种电池化学材料。不过人们普遍认为领头羊是总部位于福建的宁德时代。

宁德时代已经是全球最大的锂离子汽车电池制造商。2021年，它发布了世界上首款用于电动汽车的钠电池。中国汽车制造商奇瑞即将推出的iCAR品牌会使用宁德时代的钠电池和锂电池。

宁德时代的主要竞争对手、本身也是汽车制造商的比亚迪同样活跃。今年4月比亚迪在上海车展发布的掀背式汽车海鸥很快也会采用钠离子电池。另一家老牌电池制造商孚能科技已与江铃汽车联手；专注于钠离子电池研发的中科海钠正与另一家汽车制造商江汽集团合作；蜂巢能源则有一个现成的汽车合作伙伴，同属于它的母公司长城汽车。

Benchmark称，这五家公司和其他22家公司都在使用层状氧化物阴极（而除了那四家情况不明的公司，其余几家要么在研究聚阴离子，要么在研究

第三种方式，其中涉及一种叫做普鲁士蓝的含铁物质）。而层状氧化物阴极正是钴和镍的用武之地。经验表明，含有钴离子和镍离子（还有价格便宜、开采起来也没有争议的锰的离子）的氧化物层是最好的锂电池阴极材料。

钴和镍（还有锰和铁）是所谓的过渡金属，有不止一个价电子。锂离子和钠离子总是带单一的一个正电荷，而像钴这样的原子可以形成带2到3个正电荷的离子。当一个电子到达层状氧化物电池的阴极时，它与一个过渡金属离子发生反应，使其失去一个正电荷，同时产生一个净负电荷。带正电荷的碱金属离子进入晶体结构，让电荷保持平衡。

在钠电池中，可以只用锰和铁（不过为提高性能，也可加入铜和钛等金属）来制造层状氧化物阴极。原因尚不完全清楚。德国卡尔斯鲁厄理工学院（Karlsruhe Institute of Technology）的多米尼克·布雷塞尔（Dominic Bresser）认为，这是因为钠原子体积更大且电子性质有所不同，因此能够适应更多类型的晶体。无论是什么原因，实际结果是大幅降低了原料成本。这种灵活度也让钠离子电池可以得到性能上的改进，比如更高的功率输出，而这些是锂离子电池难以做到的。

Benchmark的研究分析师罗里·麦克纳尔蒂（Rory McNulty）表示，中国企业在本土已建、在建或宣布待建的钠离子电池工厂共有34家，并计划在马来西亚新建一家。相比之下，其他地方的老牌电池制造商还没有表现出太大的兴趣。不过，中国以外有一些创业公司（即便并没有什么五年规划在指引它们）正在研发层状氧化物的替代品以求抢占先机，它们希望能改进技术、降低成本，或者两者兼得。

在这些新进者中，最令人瞩目的当属加州圣克拉拉（Santa Clara）的Natron Energy。它所采用的方法用到了普鲁士蓝。普鲁士蓝是一种价格低廉的常见染料，但Natron希望能用它来延长电池的使用寿命。至少在目前，钠离子的层状氧化物阴极不如锂离子的耐用。Natron声称，它生产的电池可以经受五万次充放电循环，是商用锂离子电池的10到100倍。Natron已经在密歇根州建立了一家工厂，表示将于今年底投产。

其他非中国公司没有那么先进，但也信心满满。瑞典的Altris也在建厂，它使用了一种叫做普鲁士白的材料，用钠代替普鲁士蓝中的一些铁。法国的Tiamat采用了含钒的聚阴离子材料。英国的Faradion（现在归印度的信实公司[Reliance]所有）打算坚持使用层状金属氧化物体系。

事情会如何发展还需拭目以待。麦克纳尔蒂呼吁人们谨慎行事，至少在短期内如此。电池技术的成熟需要时间，比如人们对锂电池的研究最早可以追溯到上世纪60年代。Benchmark预测，到2030年，钠电池的产能将达到每年约140吉瓦时。不过，该公司认为，届时这些产能中将只有一半略多会有实际产出。这相当于Benchmark预测的2030年锂电池产量的2%。

尽管如此，钠电池看起来确实很有吸引力。就电网储能而言，它们似乎是磷酸铁锂电池的有力竞争对手——尽管它们还必须与全钒液流电池等其他新技术竞争。它们在货车和航运市场上的主要竞争对手可能是氢燃料电池，但这种技术还未经检验，因为它所依赖的氢能供应基础设施尚未建成。

而在那些对重量敏感的高价值应用领域，比如电动汽车，甚至飞机，它们的未来就不那么确定了。关键还是原料价格。如果对锂、钴和镍的勘探能带来足够多的新矿，继而把它们的价格打下来，那么可能就没有必要花钱让科学家和工程师去提高钠电池的能量密度了。但是，如果那些金属的成本维持高位，钠可能就会迎来光明的前景。■



A battery ReNaissance

Firms are exploring sodium batteries as an alternative to lithium

Unlike lithium, sodium is cheap and abundant

THEY POWER tiny phones and two-tonne electric cars. They form the guts of a growing number of grid-storage systems that smooth the flow of electricity from wind and solar power stations. Without them, the electrification needed to avoid the worst effects of global warming would be unimaginable. And in 2019 they earned three of their pioneers a Nobel prize.

But lithium-ion (Li-ion) batteries have downsides. Lithium is scarce, for one. And the best Li-ion batteries, those with layered-oxide cathodes, also require cobalt and nickel. These metals are scarce, too—and cobalt is also problematic because a lot of it is mined in the Democratic Republic of Congo, where working conditions leave much to be desired. A second sort of Li-ion battery, a so-called polyanionic design that uses lithium iron phosphate (LFP), does not need nickel or cobalt. But such batteries cannot store as much energy per kilogram as layered-oxide ones.

A clutch of companies, though, think they have an alternative: making batteries with sodium instead. Unlike lithium, sodium is abundant: it makes up most of the salt in the oceans. And chemists have found that layered-oxide cathodes which use sodium rather than lithium can get by without cobalt or nickel to jazz them up. The idea of making sodium-ion (or Na-ion) batteries at scale is therefore gaining traction. Engineers are tweaking designs. Factories, particularly in China, are springing up. For the first time since the Li-ion revolution began, lithium's place on the electrochemical pedestal is being challenged.

Lithium and sodium, members of a group called the alkali metals, sit just

below hydrogen in the first column of the Periodic Table. Alkali metals are famously reactive. (Dropping some in water will give you a lot of fizzing. Others will produce explosions.) This is because the outermost shell of electrons surrounding the nucleus of an alkali-metal atom has but a single occupant. These “valence” electrons are easily shed, creating positive ions (cations) that can link up with negative counterparts (anions), such as hydroxyl ions derived from water. The results are compounds like lithium hydroxide and sodium chloride, better known as table salt.

If, however, the lost electrons are routed to their destinations via a wire, rather than hopping directly to a neighbouring atom or group of atoms, while the cations make the journey separately, through a medium called an electrolyte, the result is an electrochemical cell. Energy can be drawn from this as the electrons journey through the wire (see diagram). Conversely, if the whole process is put into reverse by applying a current, the cell can be recharged.

All this applies as much to sodium as to lithium. Given sodium’s cost advantages, non-chemists may wonder why it was not preferred to lithium in the first place. The answer is that sodium atoms, which have 11 protons, 12 neutrons and an extra electron shell, are bigger and heavier than lithium ones (three protons and three neutrons). A sodium battery will be bigger and heavier than a lithium one of the same capacity.

Small size and a low weight are crucial for phones, and at least desirable in cars. But they do not matter everywhere. Sodium batteries could work for grid-scale storage, home storage and heavy forms of transport, such as lorries and ships.

China’s interest stems partly from the government’s current five-year economic plan, which began in 2021, and which aims, among other things, to explore a variety of battery chemistries. Benchmark Mineral Intelligence,

a firm in London, lists 36 Chinese companies that are either making or investigating sodium batteries. These firms mostly play their cards close to their chests—in four cases Benchmark's researchers cannot even determine exactly which battery chemistry is involved. The leader of the pack is, nevertheless, generally agreed to be CATL, based in Fujian.

CATL is already the world's largest maker of Li-ion vehicle batteries. In 2021 it announced the world's first sodium battery for electric vehicles. Chery, a Chinese carmaker, will use CATL's sodium batteries, alongside some lithium ones, in its iCAR brand, to be launched shortly.

BYD, CATL's chief rival and a carmaker in its own right, is similarly active. Its Seagull hatchback, which was unveiled at the Shanghai Auto Show in April, will also soon sport Na-ion batteries. Farasis Energy, another established battery-maker, has teamed up with Jiangling Motors; HiNa Battery Technology, a firm created specifically to develop Na-ion batteries, is collaborating with JAC group, yet another carmaker; and Svolt, a subsidiary of Great Wall Motor, has a ready-made automotive partner in its parent company.

According to Benchmark, these five firms, together with 22 of the others, are using layered-oxide cathodes (besides the four unknowns, the remainder are working either on polyanionic designs or a third approach involving an iron-containing substance called Prussian blue). And this is where the cobalt and nickel come in. Experience has shown that oxide layers involving cobalt and nickel ions (together with those of manganese, which is cheap and uncontroversial to mine) result in the best lithium battery cathodes.

Cobalt and nickel (and also manganese and iron) are so-called transition metals, with more than one valence electron. Whereas lithium and sodium ions always have a single positive charge, cobalt, for example, can form ions with charges of +2 or +3. When an electron arrives at a layered-oxide

battery's cathode, it reacts with a transition-metal ion, reducing its positive charge by one and creating a net negative charge. An alkali-metal ion (which is positively charged) moves into the crystal structure to balance out the charges.

In sodium batteries, layered-oxide cathodes can be made with just manganese and iron (though they may be spiced with metals such as copper and titanium to improve performance). Why is not entirely clear. Dominic Bresser of the Karlsruhe Institute of Technology, in Germany, reckons it is because sodium atoms' larger sizes and somewhat different electronic properties allow them to fit into a wider range of crystals. Whatever the answer, the practical upshot is a big reduction in cost of materials. This flexibility also allows the engineering into Na-ion batteries of properties, such as higher power output, that are harder to achieve with Li-ions.

Between them, according to Rory McNulty, a research analyst at Benchmark, Chinese firms have 34 Na-ion-battery factories built, being built or announced inside the country, and one planned in Malaysia. Established battery-makers in other places, by contrast, are not yet showing much interest. Even without a five-year plan to guide them, though, some non-Chinese startups are seeking to steal a march by developing alternatives to layered oxides, in the hope of improving the technology, reducing its cost, or both.

One of the most intriguing of these neophytes is Natron Energy, of Santa Clara, California. It is taking the Prussian blue approach. Prussian blue, which is a common dyestuff, is cheap. But Natron hopes it can prolong a battery's service life. At least at the moment, Na-ion layered-oxide cathodes are less durable than their Li-ion counterparts. Natron claims that its cells can endure 50,000 cycles of charging and discharging—between ten and 100 times more than commercial Li-ion batteries can manage. The firm has built a factory in Michigan, which it says will begin production later this

year.

Other non-Chinese firms are less far advanced, but full of hope. Altris, in Sweden, which is also building a factory, employs a material called Prussian white that substitutes some of the iron in Prussian blue with sodium. Tiamat, in France, uses a polyanionic design involving vanadium. And Faradion, in Britain (now owned by Reliance, an Indian firm), intends to stick with a layered-metal-oxide system.

How things will all play out remains to be seen. Dr McNulty urges caution, at least in the short term. Battery technologies take time to mature (the first research into lithium batteries dates back to the 1960s). Benchmark predicts that sodium battery manufacturing capacity in 2030 will be about 140 gigawatt-hours of storage a year. However, the firm thinks that only just over half of this capacity will actually be churning out cells. This amounts to 2% of its projection for lithium-cell production in that year.

Sodium batteries do, nevertheless, look attractive. For grid storage, they seem like serious competitors with LFPs—though they will also have to compete with other novel approaches, such as vanadium flow-batteries. Their chief rivals in the lorry and shipping markets are probably hydrogen fuel cells, but these are an untested technology that rely on an as-yet-unbuilt infrastructure to supply the hydrogen.

For weight-sensitive, high-value applications such as electric cars or even aircraft, their future is less certain. The crucial factor will be materials prices. If prospecting for lithium, cobalt and nickel creates enough new mines to keep these down, the incentive to pay scientists and engineers to drive up the amount of energy per kilogram which sodium batteries can store may evaporate. But if the costs of those metals remain high, then for sodium the sunny uplands could beckon. ■



巴托比

领导者比管理者更拉风吗?

区分两者有理据，但无裨益

如果让你想象一个管理者，你很可能会想到一个无聊透顶、终日伏案、单调乏味的人。要是让你想象一个领导者，你很可能会想到一个人正在发表一场激动人心的演讲。可能还会有匹马。你脑子里肯定还有各种各样的领导者。管理者和领导者之间确实有区别，但不应过度区分。

人们做了各种各样的尝试来确定两者之间的差异，但最后都归结为同一点。亚伯拉罕·扎列兹尼克（Abraham Zaleznik）1977年在《哈佛商业评论》上发表的一篇影响颇广的文章指出，管理者重视秩序，领导者能容忍混乱。约翰·科特（John Kotter）后来在同一刊物上发表的一篇文章将管理描述成一门解决问题的学科，通过做计划和做预算创造出可预测性。相比之下，领导力则是拥抱变化，激励人们勇敢面对未知。让领导力研究登堂入室的美国学者沃伦·本尼斯（Warren Bennis）认为，管理者做管理，领导者做创新。

这些定义有的可能有点武断，但仍可能有用。太多的公司把员工提升到管理岗位，是因为这是他们获得职业发展的唯一途径。但有些人的管理者气质远在其他人之上。他们更注重过程；他们喜欢电子表格、井然有序，以及支持他人做好工作。电子商务公司Shopify考虑到这些内驱力上的差异，给管理人员和开发人员提供了不同的职业发展道路。

管理和领导不仅仅是在语义方面有差别。伦敦政治经济学院的奥莉安娜·班迪埃拉（Oriana Bandiera）和她的合著者研究了六个国家的1114位CEO的日志，并将他们的行为分为两类。

根据他们的定义，“领导者”同其他高管有更多的会议，与公司内外的许多人有更多的互动。“管理者”则花更多的时间与参与业务活动的员工在一起，并有更多的一对一会议。领导者做沟通和协调；管理者向下深入，关

注个体。这一研究表明，由领导者经营的公司比由管理者经营的公司表现得更好。

但指出管理者和领导者之间的差异可能并无裨益，原因有二。首先，做领导者似乎比做管理者风光太多。这在一定程度上是因为领导素质与资历有关。随着人们在职场上升迁，他们会参加领导力课程，加入领导团队，并以“作为领导者”这样的话开头。还有一个原因是这两种类型生来就不平等。你愿意做个喜欢做预算的人，还是能深刻影响别人的人？是安于现状的人，还是想要改变世界的人？“成为管理者既不需要天才，也不需要英雄主义。”扎列兹尼克写道。难怪有那些个著名的全球年轻领导者课程，而不是全球年轻管理者课程。

职位升得越高，激励他人和探入未知领域的能力确实愈显重要。但管理技能的重要性并没有降低。班迪埃拉及其同事的结论是，尽管总体而言，CEO展现出领导者风范与公司业绩更好存在关联，但不同的公司可能需要不同类型的老板。有些公司拥有“管理者”CEO会更好。而且公司业绩也和其他因素独立相关，包括管理实践的质量。

管理者和领导者之争的第二个无益的副产品是，它往往会让人们分成非此即彼的两个阵营。而实际上当老板必须把两方面的品质结合起来。即便你非常高效，但鼓舞人心的本事就像菲达奶酪一样臭，那也很难激励别人；同样，如果你给未来定下雄心勃勃的愿景，对于如何实现它们却毫无头绪，那也没什么用处。你得要来回转换——从战略到执行，从变革到秩序，从激情到过程，从领导者到管理者。 ■



Bartleby

Are leaders sexier than managers?

The distinction is both valid and unhelpful

IF YOU WERE asked to imagine a manager, you might well conjure up someone comically boring, desk-bound and monotonous. Now do the same for a leader. You may well be picturing someone delivering a rousing speech. A horse may be involved. You almost certainly have different types in mind. There is indeed a distinction between managers and leaders, but it should not be overdone.

Various attempts have been made to pin down the differences between the two, but they boil down to the same thing. Managers, according to an influential article by Abraham Zaleznik in the Harvard Business Review in 1977, value order; leaders are tolerant of chaos. A later article in the same publication, by John Kotter, described management as a problem-solving discipline, in which planning and budgeting creates predictability. Leadership, in contrast, is about the embrace of change and inspiring people to brave the unknown. Warren Bennis, an American academic who made leadership studies respectable, reckoned that a manager administers and a leader innovates.

Some of these definitions might be a tad arbitrary but they can be useful nonetheless. Too many firms promote employees into management roles because that is the only way for them to get on in their careers. But some people are much more suited to the ethos of management. They are more focused on process; they like the idea of spreadsheets, orderliness and supporting others to do good work. Shopify, an e-commerce firm, has created separate career paths for managers and developers with these differences in motivation in mind.

The difference between managing and leading is not just a matter of semantics. Research by Oriana Bandiera of the London School of Economics and her co-authors looked at the diaries of 1,114 CEOs in six countries, and categorised their behaviours into two types.

On their definitions, “leaders” have more meetings with other C-suite executives, and more interactions with multiple people inside and outside the company. “Managers” spend more time with employees involved in operational activities and have more one-to-one meetings. Leaders communicate and co-ordinate; managers drill downwards and focus on individuals. The research suggested that firms that are run by leaders perform better than those run by managers.

But pointing to the differences between managers and leaders can also be unhelpful, for two reasons. The first is that being a leader seems so much sexier than being a manager. That is partly because leadership qualities are associated with seniority. As people scale the corporate ladder, they go on leadership courses, join leadership teams and start sentences with phrases like “as a leader”. It is also because the two archetypes are not created equal. Would you rather be the person who likes to do budgeting or the one who holds others in thrall? The type that likes the status quo or the one that wants to change the world? “It takes neither genius nor heroism to be a manager,” wrote Zaleznik. No wonder there are feted programmes for young global leaders but not for young global managers.

The capacity to inspire others and to head into uncharted waters does become more salient the higher you rise. But management skill does not become less important. Dr Bandiera and colleagues concluded that although CEOs who displayed the behaviour of leaders were associated with better company performance overall, different firms may require different types of boss. Some would be better off with “manager” CEOs. And performance is independently correlated with other things, including the quality of

management practices.

The second unhelpful by-product of the debate about managers and leaders is that it tends to separate people into one camp or the other. In fact, bosses must combine the qualities of both. Just as it is hard to motivate people if you are highly efficient but have the inspirational qualities of feta cheese, so it is not much use laying out ambitious visions for the future if you don't have a clue how to make them reality. You need to turn the dial back and forth—from strategy to execution, change to order, passion to process, leader to manager. ■



不可能的任务

可怜的现代管理者——他们精疲力尽、心烦意乱、不堪重负

企业的领导岗位比以往任何时候都更具挑战，但也更加重要

管理者不是显而易见值得同情的对象。要为颐指气使的办公室头头们感到难过就很难了，更别提那些年入百万的高管大佬了。然而他们的处境值得仔细研究，甚至也值得一些同情。从高管办公室到中层领导的工位，他们繁忙的工作有增无减。

招聘和外包公司德科集团（Adecco Group）最近对23个国家的员工进行的一项调查发现，在1.6万名受访管理者中，在过去12个月内感到筋疲力尽的人数比例从去年的43%增加到68%，高于非管理人员的60%。“我感觉自己就像跳上了一台跑步机，坡度和速度都由别人控制着。”一位科技大厂高管叹了一口气说道。他的许多同行也有同样的感受。管理者越来越需要精力耐力——招聘公司称，公司经常询问高管职位的候选人是否经常锻炼身体。

这不仅对疲惫的个人来说是一个问题，对他们的雇主来说同样是一个问题，而且鉴于近几十年来管理岗位不断增加，对整个经济体来说都是个问题。如今美国有1900万名管理者，比2000年增加了60%。美国公司有五分之一的员工管理他人。

由于知识产业里的公司逐渐把日常任务自动化，而且都依赖同样的数字工具（Amazon Web Services、Gmail、微软办公软件），因此能给它们带来竞争优势的是更好的管理，而不是对技术的投资。管理不善可能会降低生产率并提高员工流失率，导致竞争力削弱。盖洛普（Gallup）2015年的一项调查显示，一半的美国人离职是因为上司差劲。去年，麦肯锡咨询公司发现，同样比例的离职者表示，他们感觉自己没有受到上司的重视。

因此，良好管理的价值越来越大。与此同时，管理者的工作环境正在发生转变。与过去相比，某些技能在新环境中的回报会增加，另一些技能的回

报会变少。其结果是，你未来的上司将会和你父母那一代的上司不一样。

波士顿咨询公司的老板施伟策（Christoph Schweizer）回忆道，直到2000年代时，“CEO还都是超级英雄”，他们非同凡响，很少犯错，从不犹疑。对于各式高管来说，“最高的赞美就是‘才华横溢’”，休伯特·乔利（Hubert Joly）说。他曾是电子产品零售商百思买（Best Buy）的CEO，如今在哈佛商学院执教。

智力仍然很重要。一项针对瑞典企业老板的研究发现，大公司领导的智商水平一般位列总人口的前17%。但在各个管理层级上，更软性的社交技能都逐渐变得更为重要，例如清晰沟通、建立信任，以及愿意展现出脆弱的一面。哈佛商学院前院长尼廷·诺里亚（Nitin Nohria）表示，包括CEO在内的高管需要能从容面对不确定性，并愿意把那些放在过去他们绝不会放手的战略责任也委托给他人。（诺里亚出任董事长的Exor持有《经济学人》母公司的股份。）

哈佛大学的大卫·戴明（David Deming）发现，需要社交互动的管理岗位的数量增速快于平均水平，此类职位的工资增速也是如此。哈佛商学院的拉法埃拉·萨顿（Raffaella Sadun）及其同事对高管招聘广告的一项研究发现，2000年至2017年间，提及社交技能的职位描述增加了近30%。那些列明对财务和物质资源的管理能力的减少了40%（见图表1）。公司到德科的培训平台EZRA上为自家主管聘用管理教练时，最常提出的目标包括沟通、情商、建立信任和协同合作。斯坦福大学商学院最热门的课程之一是《人际互动》（Touchy Feely），教学员如何评估自己给他人的印象。

社交技能可以更好地协调人员、目标和资源，因而越来越受欢迎。而21世纪的商业又比以往任何时候都更需要这样的协调。以前，管理者管理的是执行重复性任务的个人。如今，他们管理的往往是组成团队做复杂项目的专业人员，而项目的结果难以精确衡量。公司的外部环境也变得更加复杂。正如戴明所说，所有这些都意味着“综合所有因素做出一项决定需要更多的时间”。管理者归根结底主要扮演协调者的角色，好的管理者可以减少决策所需的时间。因此，这种让不同的人和目标顺利融合起来的能力

非常宝贵，特别是相对于纯粹的智力和技术技能而言。

让协调变得更加困难的一个因素是一个原本受欢迎的变化——员工更加多元化。在美国20世纪的大部分时间里，管理者和被管理者都是白人男性。“过去你管理的差不多是些小号的你。”斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）说。萨顿指出，这意味着可以假定管理者拥有不言自明的对下属的“心理推测能力”，即对下属的世界观和感受有直觉式的了解。

值得庆幸的是，这已经不再是一个可靠的假定。如今在美国，女性管理者占42%，高于2010年的38.5%。2013年至2022年间，管理职位上非白人的比例从14%上升至18%以上（见图表2）。相对于女性和非白人在美国人口中所占的比例，他们在管理岗位上的代表性仍然不足，而且相较于白人员工，非白人更有可能离职，因为他们觉得自己在公司没有归属感。但进步是不可否认的。诺里亚表示，多元化“已开始显现其影响”。

对于管理者来说，无论其性别和肤色，问题在于不再能自然而然地站在员工的角度换位思考。诺里亚指出，因为不能认为自己知道别人在想什么，所以就需要具有敏锐的社交“触角”。用布鲁姆的话来说，在混合工作模式下，管理者通过对居家工作做出决定，“判决着员工的私人生活”，这让管理的工作变得更加微妙。

与多元化一样，疫情后远程工作的普及在带来好处的同时也增加了协调的成本。在线管理员工队伍带来了组织学学者所说的“管理开销”。即使网络连接没问题，没有人忘记取消静音，虚拟会议也会让交流失去大量眼神交流和手势等非语言信号。虚拟会议也让人更加疲惫。一项研究发现，人们在Zoom上说话的声音比面对面交流时更大。

而且虚拟会议正越来越多地占用管理者的时间。微软对31个国家使用365办公软件的3.1万家企业用户的一项研究发现，2023年3月，人均参加Teams视频和音频会议的次数是2020年2月的三倍。在大概同一段时间内，人均发送的聊天消息增加了32%。

2020年至2022年间，临时线上会议的次数增加了8%，占所有Teams会议的64%。现在大约60%的此类会议在15分钟内结束。萨顿说，较短的会议可能意味着更多干扰。在微软的研究中，有三分之二的员工抱怨他们在工作日缺乏足够的时间去不间断地专注于工作。“工作变得越来越断断续续。”负责微软这项研究的贾里德·斯帕塔罗（Jared Spataro）总结道。萨顿补充说，这会带来沉重的认知成本——或许也给前述令人不安的疲惫数据提供了一些解释。

高管们也比以前更难专注了，包括CEO在内。萨顿和合著者研究了六个国家1100名老板的时间分配，他们发现这些高管的工作日只有四分之一的时间无人打扰，其中一些时间用来写电子邮件。诺里亚和迈克尔·波特（Michael Porter）对27位大公司CEO的时间利用情况进行了长期跟踪研究，发现他们经常利用长途旅行的时间思考问题。疫情后商务旅行的减少意味着这一部分时间更少了。如果高管工作时间的构成反映了这些时间所处理的工作的相对价值，那么比起战略思考，协调的价值更高。

最后一个可能推高社交技能的价值的因素是技术。自从一年前创业公司OpenAI开发的聊天机器人ChatGPT席卷全球以来，AI大大向前迈进了一步。支持者认为，机器可以承担一些过去需要“才华”才能完成的任务，这与乔利的观点相呼应。执行这些任务所需的非人工智能的相对价值可能会下降。OpenAI的老板山姆·阿特曼（Sam Altman）甚至宣称智力成本“将逐渐趋近于零”。

目前尚不清楚AI何时能够实现这种大胆预测——如果它能够实现的话。但它应该至少会对管理的实践及其所需的能力产生一定影响。足有70%的受访者在德科的调查中表示，他们在工作中已经在使用“生成式”AI。微软（持有OpenAI大量股份）的斯帕塔罗表示，此类工具对管理者最为有效。“他们将这些工具视为团队的最新成员，并向其委派任务。”而且委派的不仅仅是日常行政事务。在微软的研究中，近80%的人表示他们愿意利用AI处理分析工作，四分之三的人对创意类工作也持同样的态度。

管理者不会成为只有共情能力但缺乏专业能力的人。许多主管仍然追求擅

长管理的传统特征。与其雇主相比，德科EZRA平台上的用户寻求战略、个人发展和清晰表达抱负方面的指导的可能性要高得多，选择提高情商、建立信任和协同合作方面的培训的可能性要小得多（见图表3）。也许比斯坦福大学的《人际互动》课程更受欢迎的是《通往权力之路》（Paths to Power），这门课本质上是为那些野心勃勃的马基雅维利主义者提供的成功指南。

这些相互竞争的侧重点可能是许多管理者感到不堪重负的原因。偏重社交能力和协调能力的新管理模式正开始占据主导，而奖励专业知识和才智的旧模式尚未放松其掌控。在所有这些对他们的要求和期待之中，用德科集团负责人丹尼斯·马丘埃尔（Denis Machuel）的话说，管理者“迷失了方向”。他们越快明确自己的角色越好——对于他们自己和他们的雇主来说都是如此。 ■



The impossible job

Pity the modern manager—burnt-out, distracted and overloaded

Corporate leadership is more daunting, but also more important, than ever

MANAGERS DO NOT make for obvious objects of compassion. It is hard to feel sorry for the bossy office lead, let alone the big-shot chief executive who pockets millions of dollars a year in compensation. Yet their lot deserves scrutiny and even some sympathy. From the corner office to the middle manager's cubicle, the many demands on their time are intensifying.

A recent survey of workers in 23 countries by Adecco Group, a recruitment and outsourcing firm, found that 68% of the 16,000 managers in the sample suffered burnout in the past 12 months, compared with 60% for non-managers, and up from 43% the year before. "I feel like I jumped on a treadmill where someone controls both the incline and the speed," says a big-tech executive with a sigh. Plenty of his peers share the sentiment. Managers increasingly require literal stamina: recruiters report that firms often ask candidates for executive positions how much they exercise.

That is a problem not just for the haggard individuals, but also for their employers and, given the boom in management jobs in recent decades, whole economies. Today America has 19m managers, 60% more than in 2000. One in five employees at American companies manages others.

As firms in knowledge industries automate routine tasks and rely on the same digital tools—Amazon Web Services, Gmail, Microsoft office software—it is better management, not investments in technology, that can give them a competitive edge. Poor management can blunt it, by killing productivity and raising staff turnover. According to a Gallup survey from 2015, half of Americans who left a previous job did so because of a bad

manager. Last year McKinsey, a consultancy, found that a similar share of job-leavers said they did not feel valued by their managers.

The value of good management, then, is rising. At the same time, the environment in which managers do their job is being transformed. This new landscape rewards some skills more and some less than in the past. As a result, your manager tomorrow will not look the same as your parents' did.

Until the 2000s, remembers Christoph Schweizer, boss of BCG, a consultancy, "CEOs were superheroes": larger than life, seldom wrong, never in doubt. For all manner of executive, "the highest compliment was 'brilliant,'" says Hubert Joly, who ran Best Buy, an electronics retailer, and now teaches at Harvard Business School (HBS).

Intellect still matters. A study of Swedish bosses found that the typical head of a large firm was in the top 17% of the population by IQ. But across all layers of management, the emphasis has gradually shifted towards softer social skills, such as clear communication, ability to build trust and willingness to show vulnerability. Executives, including CEOs, need to be comfortable with uncertainty, and happy to delegate even the strategic responsibilities that they would once have hogged, observes Nitin Nohria, a former dean of HBS. (Mr Nohria is also chairman of Exor, which part-owns The Economist's parent company.)

David Deming of Harvard University has found that the number of jobs that require social interaction is rising faster than average, as are wages for such roles. A study of executive job listings, by Raffaella Sadun of HBS and colleagues, found that between 2000 and 2017 descriptions mentioning social skills rose by nearly 30%. Those singling out an ability to manage financial and material resources declined by 40% (see chart 1). The most common goals requested by firms that employ management coaches for their managers on EZRA, Adecco's coaching platform, include

communication, emotional intelligence, building trust and collaboration. One of the hottest courses at Stanford University's Graduate School of Business is "Touchy Feely", which teaches students to assess how they come across to others.

Social skills are increasingly sought-after because they enable better co-ordination of people, goals and resources. And 21st-century business requires more such co-ordination than ever. Managers once used to supervise individuals performing repetitive tasks. Today they often oversee professionals working in teams on complicated projects with outcomes that are hard to measure with precision. The world outside the firm is becoming more complex, too. All this means that, as Mr Deming remarks, "it takes more time to converge on a decision." A good manager, whose main role boils down to that of co-ordinator, can cut this time. This ability to get disparate people and goals to coalesce smoothly is thus at a premium, especially relative to purely intellectual and technical skills.

One thing making co-ordination harder is an otherwise welcome development—greater workforce diversity. For much of the 20th century in America the manager and the managed were the same white men. "You used to run mini-mes," says Nicholas Bloom of Stanford University. That, Ms Sadun notes, meant managers could be assumed to possess an implicit "theory of mind" of their underlings—an intuitive understanding of how they thought and felt about the world.

This is, thankfully, no longer a safe assumption. In America, women make up 42% of managers, up from 38.5% in 2010. Between 2013 and 2022 the share of non-whites in managerial posts has risen from 14% to over 18% (see chart 2). Women and non-whites are still underrepresented in such roles, relative to their share of America's population; non-white employees in particular are likelier than white colleagues to leave a job because they didn't feel they belonged at their companies. But progress is undeniable.

Diversity has, says Mr Nohria, “caught up with us”.

The problem for managers, be they women or men, white or not, is that putting yourself in subordinates’ shoes is no longer automatic. Because you cannot assume you know what others are thinking, you need keen social “antennae”, Mr Nohria observes. Hybrid work, where managers, in Mr Bloom’s words, “adjudicate private lives” via decisions about home-working, makes the task even more delicate.

Like diversity, the post-pandemic spread of remote work brings benefits while raising co-ordination costs. Running a workforce virtually imposes what organisational scholars call “management overhead”. Even when the network connection is not patchy and people don’t forget to unmute themselves, virtual meetings strip out lots of signals, such as eye-contact and gestures. They are more tiring; one study found that people speak more loudly on Zoom than face-to-face.

And they are taking up more and more of managers’ time. A study by Microsoft of 31,000 corporate users of its 365 office software in 31 countries found that in March 2023 the average person participated in three times as many Teams video-conferencing meetings and calls as in February 2020. In roughly the same period the typical user sent 32% more chat messages.

The number of unscheduled calls rose by 8% between 2020 and 2022, to 64% of all Teams meetings. Some 60% of such encounters are now under 15 minutes. Shorter activities probably mean more interruptions, says Ms Sadun. Two in three workers in the Microsoft study complained they did not have enough uninterrupted focus time during the workday. “Work has become more staccato,” sums up Jared Spataro, who oversaw the research at Microsoft. That, Ms Sadun adds, imposes a heavy cognitive cost—and may explain some of the troubling burnout numbers.

Focus is scarcer for executives, too, including CEOs. When Ms Sadun and co-authors looked at how 1,100 bosses in six countries spent their time, they discovered that only a quarter of their working days involved being alone, and some of that was taken up by writing emails. A long-running study of 27 leading chief executives' time use by Mr Nohria and Michael Porter found that bosses often used long-haul travel to think. The post-pandemic decline in business trips means there is less of this time to recoup. If the composition of executives' working hours reflects the relative value of the things those hours consume, then co-ordination outweighs pondering strategy.

A final thing that may lift the premium for social skills is technology. Ever since ChatGPT, an artificially intelligent chatbot developed by a startup called OpenAI, took the world by storm a year ago, progress in AI has kicked up a notch. Boosters argue that machines can take on some of the tasks that would in the past have required "brilliance", to echo Mr Joly. The comparative value of the non-artificial intelligence required to perform them may decline. OpenAI's boss, Sam Altman, went so far as to declare that the cost of intelligence is "going to be on a path towards near-zero".

It is unclear when—if ever—AI will live up to such bold forecasts. But it is likely to have at least some effect on the practice of management and the competences required for it. Fully 70% of respondents told the Adecco survey that they were already using "generative" AI at work. Mr Spataro of Microsoft (which has a big stake in OpenAI) says that managers are such tools' most effective users. "They treat it as the newest member of the team, and delegate tasks to it." And not just routine administrative chores: nearly 80% of people in Microsoft's study said they would be comfortable using AI for analytical work; three-quarters said the same of creative work.

Managers are not about to become clueless empaths. Many still seek old-school markers of good management. Those on Adecco's EZRA platform

are much likelier than their employers to ask for coaching on strategy, individual development and articulating ambition, and much less likely to pick emotional intelligence, trust-building and collaboration (see chart 3). Maybe more popular still than Stanford's "Touchy Feely" course is "Paths to Power", in essence a how-to guide for aspiring Machiavellian princes.

These competing priorities may be why so many managers feel overwhelmed. The new model of management, which favours social aptitude and co-ordination skills, is taking hold before the old one, which rewarded expertise and intellect, has loosened its grip. Amid all this managers are, in the words of Denis Machuel, head of Adecco Group, "lost in translation". The quicker they find themselves, the better: for them and their employers alike. ■



Meta这一年

扎克伯格逃出元宇宙级大坑

但他的长期赌注并未动摇

对扎克伯格来说，过去的一年可谓跌宕起伏。这位社交媒体巨头Facebook（现已改名Meta）的联合创始人对公众的指责全不陌生。但到了一年前此时，就连投资者似乎也心灰意冷，指斥他丢弃了公司的核心业务，将大把金钱撒在了春秋大梦般的元宇宙中，在这个虚拟世界里，似乎只有他独自漂浮在妄想的幻境中。去年Meta发布疲软的第三季度财报的当天，股价急挫超过五分之一。扎克伯格深陷泥潭。

在那之后的一年来，Meta恢复了元气。其核心业务——在Facebook、Instagram和WhatsApp上每天吸引31亿人并向广告主出售获取这些人注意力的机会——重新焕发出强健活力。10月25日，该公司公布第三季度收入341亿美元，同比增长23%。这是自新冠疫情催生的数字经济繁荣以来的最大涨幅。净利润翻了一番不止，达到116亿美元。与去年的谷底相比，Meta的股价已上涨了250%。

在媒体报道中，鲜有人称道扎克伯格的商业头脑。人们更关注别的东西：他近来对武术的热衷；迟迟没有举行的与马斯克的笼中格斗；公众的谴责，例如10月24日美国数十个州提起诉讼，指控Meta故意要让用户对Facebook和Instagram上瘾。然而，在去年最后几个月的时间里，他做出了两项变革性的商业决策，其中展现出的谦逊和灵活令人刮目相看——考虑到他控制着公司58%的总投票权，几乎不需要工作，更不用说听取股东的意见，这就更能可贵了。

面对投资者施压，扎克伯格完成了科技史上最快的转向动作之一。在去年第三季度业绩大跌后的两周内，他大幅裁减了Meta的支出计划，削减成本并解雇员工。面对OpenAI的ChatGPT以及围绕生成式人工智能的热潮，他发起了一场内部革命，目标是利用这项技术来激活Meta的核心业务。这些

动作在很大程度上揭示了扎克伯格的领导风格，甚至最终可能证明他对元宇宙的信仰是正确的。

扎克伯格身边的人说，当他意识到自己激怒了投资者时，他并没有惊慌失措。他变得很有章法。扎克伯格的亲密顾问尼克·克莱格（Nick Clegg）解释道，他的老板不喜欢身边的人“大喊大叫”。他更喜欢像工程师一样，把难题分拆成各个组成元素，然后确定一系列行动方案。在这种情况下，他明白自己的长期聚焦与投资者的短期关注不一致。因此，他决定“相应地量入为出”。但他完好无损地保留了自己的许多长期投资计划，强调它们主要涉及AI，而不是元宇宙。几周后，当ChatGPT横空出世时，这番强调看起来十分精明。

Meta此前已经花了很多年建立自己的AI基础设施。重点不是打造聊天机器人，而是设法利用AI提高用户沉浸度、提升广告业务的效率，以及为元宇宙开发混合现实头显。公司高层很快就意识到他们具备了充分利用生成式AI的所有要素——足够的数据中心、图形处理器（GPU）和研发人员。到2月，他们已经确定了重点方向。7月，他们向开发者免费提供了Llama 2大语言模型。9月，他们发布了第一批生成式AI相关的小设备，例如智能眼镜。扎克伯格自己则潜心钻研技术要点。他的竞争本能被唤醒了。看起来，研究一项新技术——而不是令人厌烦的成本削减工作——让他重新充满了活力。

开源的Llama让扎克伯格从硅谷的反派变成了英雄。风险投资公司凯鹏华盈（Kleiner Perkins）的利·玛丽·布拉斯韦尔（Leigh Marie Braswell）说，创业公司“非常赞赏”这一举动，它帮助许多公司发展了AI方面的业务。生成式AI对Meta本身的变革作用可能不亚于对微软和谷歌母公司Alphabet的影响，后两家公司由于先人一步押注自营的大模型而吸引了最多关注。

先来看对用户参与度的影响。Meta正在其社交媒体平台上添加聊天机器人的虚拟化身，希望它们会带动人们花更多时间刷信息流，并帮助企业通过即时通讯应用与客户互动。一些用户说这些化身有点乏味，这可能是因为该公司担心AI的“幻觉”效应。无论如何，在这方面还有潜力可挖。比如简·

奥斯汀（Jane Austen）这个化身，它模仿了同名作者高傲的幽默感。请她描述扎克伯格时，她说他“聪明、有干劲，但可能有点太陶醉于自己的想法了”。她将元宇宙描述为“一个人们可以逃避现实、活出最美好人生的虚拟世界。天啊，太.....不浪漫了”。

短期内，更令人瞩目的是AI在广告方面的潜力。独立分析师埃里克·塞弗特（Eric Seufert）说，自从苹果限制Meta在iPhone上通过第三方应用追踪用户数据以来，扎克伯格的公司不得不“彻底改造”其广告业务。他认为，Meta取得了不俗的成效，它不再追踪用户行为本身，而是利用AI为用户行为建模。去年，该公司推出了名为Advantage+的广告技术，用AI自动创建广告推广活动。投资银行杰富瑞（Jefferies）的布伦特·蒂尔（Brent Thill）表示，广告主为之折服。服装零售商J. Crew Factory告诉Meta，这些功能将其广告支出的回报提高了近七倍。

生成式AI有可能进一步提升广告自动化。Meta在10月推出了几款工具，可以让广告主即时生成不同的背景图像和文案。到目前为止，这些还只是初步尝试，但哈佛商学院的安迪·吴（Andy Wu）将其比作一场淘金热的开端。他说，通过创建生成式AI加持的广告活动，Meta从这项技术中的获益或许能与GPU龙头商英伟达相当。

广告主也有自己的顾虑。在行业盛会AdWeek NYC上，一位广告人将Meta的AI辅助营销形容为“黑盒子”，它控制着所有数据。这让Meta对品牌形象拥有了巨大的影响力，如果AI失控，品牌形象就可能受损。还有人担心AI会为了提高Meta社交网络上的用户参与度而做一些不光彩的事情，导致品牌遭到连带损害。社交媒体上关于加沙冲突的虚假图片引发的争议就说明了这个问题仍然令人担忧。克莱格坚称，凭借多年来在安全和平台操守上的投入，Meta已经对此做好了准备。但并非人人都信服。

一些投资者也仍然持怀疑态度。另一家投资银行Evercore ISI的马克·马哈尼（Mark Mahaney）认为，95%的投资者会希望扎克伯格在元宇宙上少花些钱。许多人对虚拟现实头显等硬件投资态度谨慎，因为这些产品的利润率往往低于数字产品。

尽管如此，扎克伯格“完全没有撤回”他的长期赌注，克莱格表示。一些虚拟现实迷将AI视为元宇宙的救星，认为它能帮助开发关键的手部追踪技术，并降低创作者构建三维世界的成本。由雷朋（Ray-Ban）制造的Meta的智能眼镜集成了其聊天机器人MetaAI，透露出未来的发展方向。它能捕捉佩戴者的所见所闻，在社交媒体上直播，还能回答问题。当被问及在哪里可以找到商业中的批判性思维时，这个AI的回答是“《经济学人》”。是机智、谄媚，还是可怕？你自己看吧。 ■



A year in the life of Meta

How Mark Zuckerberg escaped a metaverse-sized hole

His long-term bet still stands, though

IT HAS BEEN quite a year for Mark Zuckerberg. The co-founder of Facebook, a social-media Goliath now called Meta, is no stranger to public rebuke. But exactly a year ago even investors appeared to throw in the towel, accusing him of trashing the core business while lavishing money on his pharaonic dreams for the metaverse, a virtual world where he alone appeared to float in a deluded fantasy realm. On the day Meta issued weak third-quarter earnings last year, its share price fell by more than a fifth. Zuck's name was mud.

In the year since it has been rehabilitated. Meta's core business—engaging 3.1bn people a day on Facebook, Instagram and WhatsApp, and selling advertisers access to their attention—is back to rude health. On October 25th the company reported revenues of \$34.1bn in the third quarter, up by 23% year on year. That was the sharpest rise since the digital boom of the covid-19 pandemic. Net profits more than doubled to \$11.6bn. Meta's share price has risen by 250% since last year's nadir.

In the media, Mr Zuckerberg gets little credit for his business nous. There is more focus on other stuff: his recent passion for martial arts; the cage fight with Elon Musk that never happened; public haranguings, such as lawsuits filed by dozens of American states on October 24th, alleging that Meta intentionally sought to make users addicted to Facebook and Instagram. And yet, in the space of a few months late last year, he made two transformative business decisions that were remarkable for their humility and agility—all the more so, given that he controls 58% of the firm's overall voting rights and barely needs to work, let alone listen to shareholders.

In response to investor pressure, Mr Zuckerberg performed one of the fastest pivots in tech history. Within a fortnight of the third-quarter rout he slashed Meta's spending plans, cut costs and fired staff. And in response to OpenAI's ChatGPT and the blaze of excitement around generative artificial intelligence (gen AI for short) he launched an internal revolution aimed at using the technology to galvanise Meta's core business. Those manoeuvres reveal a lot about Mr Zuckerberg's leadership style. They may even end up vindicating his faith in the metaverse.

When Mr Zuckerberg realised he had incensed investors, those around him say, he did not panic. He became methodical. As Nick Clegg, a close adviser to Mr Zuckerberg, explains, his boss doesn't like people around him "shouting and yelling". He prefers, like an engineer, to break down a problem to its component parts and decide on a course of action. In this case, he understood that his long-term focus was at odds with investors' short-term horizons. So he decided to "cut his cloth accordingly". But he kept many of his long-term investment plans intact, emphasising that they mainly concerned AI, not the metaverse. That emphasis looked shrewd weeks later, when ChatGPT burst onto the scene.

Meta had spent years building up its AI infrastructure. Rather than creating chatbots, it was looking for ways to use AI to improve engagement and make its ad business more efficient, as well as working on mixed-reality headsets for the metaverse. Its top brass soon realised they had all the ingredients—enough data centres, graphics processing units (GPUs) and boffins—to make the most of gen AI. By February they had worked out what to focus on. By July they had made their Llama 2 large language model available free of charge to developers. In September they announced the first gen-AI-related gadgets, such as smart spectacles. Mr Zuckerberg, for his part, threw himself into the technical nitty-gritty. His competitive instinct awakened. He appears to have been rejuvenated by working on a new technology rather than on the irksome task of cost-cutting.

Making Llama open-source helped turn Mr Zuckerberg from Silicon Valley's villain to its hero. Leigh Marie Braswell of Kleiner Perkins, a venture-capital firm, says startups "really applauded" the move, which helped many develop AI-related businesses. And gen AI may be no less transformative for Meta itself than for Microsoft and Alphabet, owner of Google, whose early bets on proprietary large language models have attracted most of the attention.

Start with engagement. Meta is populating its social-media platforms with chatbot avatars which, it hopes, will increase the amount of time people spend on their feeds, and help businesses interact with customers on messaging apps. Some users call them a bit humdrum, probably because the firm is worried about AI's "hallucinations". Nonetheless, there is potential. Take Jane Austen, an avatar that emulates the author's haughty humour. When asked to describe Mr Zuckerberg, she says he is "bright, driven but perhaps a bit too fond of his own ideas". She describes the metaverse as a "virtual world where people can escape reality and live their best lives. Dear me, how...unromantic."

More compelling in the near term is AI's potential for advertising. Since Apple restricted Meta's ability to track user data across third-party apps on iPhones, Mr Zuckerberg's firm has had to overhaul its advertising business "down to the studs", says Eric Seufert, an independent analyst. It has done that fairly effectively, he thinks, by using AI to model user behaviour, rather than tracking the behaviour itself. Last year the company rolled out ad technology called Advantage+, which used AI to automate the creation of ad campaigns. Brent Thill of Jefferies, an investment bank, says that advertisers are impressed. J. Crew Factory, a clothing retailer, has told Meta that the features boosted its return on ad spending almost seven-fold.

Gen AI could take automation further. This month Meta launched tools that let advertisers instantly doodle with different backgrounds and wording.

These are baby steps so far, but Andy Wu of Harvard Business School likens them to the start of a gold rush. He says that by creating gen-AI-infused ad campaigns Meta could benefit from the technology as much as Nvidia, the leading maker of GPUs.

Advertisers have their concerns. An ad man at AdWeek NYC, an industry jamboree, described Meta's AI-assisted campaigns as "black boxes" where it controls all the data. That gives it huge influence over a brand's identity, which could be tarnished if the AI goes rogue. Others worry about AIs doing untoward things to boost engagements on Meta's social networks, which could hurt brands by association. Controversies over fake images of the conflict in Gaza on social media illustrate how fraught the terrain remains. Not everyone is convinced by Mr Clegg's insistence that Meta is prepared for this thanks to years of investment in safety and platform integrity.

Some investors, too, remain sceptical. Mark Mahaney of Evercore ISI, another investment bank, reckons that 95% of them would prefer Mr Zuckerberg to spend less on the metaverse. Many are wary of investments in hardware, such as virtual-reality headsets, which tend to generate lower margins than digital products.

Still, Mr Zuckerberg has "not resiled at all" from his long-term bet, Mr Clegg says. Some VR enthusiasts see AI as the metaverse's saviour, helping with the development of crucial hand-tracking technologies and making it cheaper for creators to build three-dimensional worlds. Meta's Smart spectacles, integrated with its chatbot, MetaAI, and built by Ray-Ban, offer a hint of things to come. They capture what the wearer sees, can live-stream it on social media, and answer questions. Asked for sources on critical thinking in business, the AI replied "The Economist". Smart, smarmy or scary? Take your pick. ■



电视

电视的黄金时代正在褪色

足球教练如何干掉黑道家族【《潘多拉的盒子》、《人如其观》书评】

《潘多拉的盒子》，彼得·比斯金德著。William Morrow出版社，400页，32.50美元；Allen Lane出版社，25英镑。

《人如其观》，沃尔特·希基著。Workman出版社，240页；30美元/25英镑。

“嘘，没事儿。”弗兰克·安德伍德（凯文·史派西饰）轻抚着一只刚被车撞伤的狗，低声说道。狗在呜咽，他安抚着它——然后，他抬头直视着观众的眼睛，拧断了狗的脖子。

这是奈飞（Netflix）2013年开播的《纸牌屋》开头的一幕，而就在那之前不久，这样的画面还没法在美国的电视上播出。广播电视台公司一方面受到联邦法令的限制，不得随意播出粗俗或淫秽的内容，一方面又受到广告主的胁迫，被要求刻画正义英雄并安排圆满结局。但是到了21世纪，反派人物却大行其道。比如缺德的国会议员（后来成为总统的）安德伍德、《黑道家族》中的暴徒托尼·索普拉诺、《毒枭》中走私可卡因的巴勃罗·埃斯科瓦尔，以及《继承之战》中不可一世的媒体大亨洛根·罗伊等，他们在电视荧屏上大放异彩。剧评人则誉之为电视的黄金时代。随着观众从传统广播电视转移到有线电视，再到流媒体，剧集变得越发暗黑和大胆。

然而今天，电视业再次处于变化之中——而它产出的内容亦是如此。此前异军突起的流媒体已经站稳脚跟，变成了春风得意的在位者。大型科技公司正使用流媒体来推广自己的其他产品。其结果是，21世纪初那些以大胆冒险、打破常规为特色的剧集正在让位于原创度不高的大众化节目——彼得·比斯金德（Peter Biskind）在他让人欲罢不能的关于电视业的《潘多拉的盒子》（Pandora's Box）一书中指出。

文化评论家比斯金德认为，电视的黄金时代可以追溯到1972年有线电视网 Home Box Office (HBO) 的开播。凭借《丁字裤天后》(G-String Divas)、《出租车实录》(Taxicab Confessions) 等剧集，HBO 最初以“黄暴”闻名。但后来它开始委托制作原创剧集，并涉足广播电视台从未进入的领域。HBO和其他有线电视网可以无视对那些限制传统广播电视台的条条框框。它们收取订阅费，也就没有了插播广告，因此也就不会有神经过敏的广告主要求它们制作平淡乏味而不会伤及品牌的内容。

编剧们很享受这种自由。《监狱风云》的一位编剧说：“我搞的那些事情都够他们把我逮进去啦。”HBO 的这部以监狱为题材的剧集不断挑战人们的底线，其中有一段，一名囚犯被人用香烟在屁股上烫了个纳粹标志。喜欢发号施令的广告主受到了冷遇。当另一家有线电视网AMC的高管们试图在《广告狂人》中植入杰克丹尼威士忌的广告时，一位编剧回应：“如果你想让我把这玩意儿加到剧里头，我就让人拿它在堕胎诊所后头的巷子里给器械消毒。”

新派电视不只是能让观众目瞪口呆。有线电视也让编剧们得以创作出复杂精良的剧集。正如《黑道家族》的编剧大卫·蔡斯 (David Chase) 所说：“在网络上，人人都心直口快，直抒胸臆。我希望我笔下的人物是会说谎的。”由于剧集在有线电视上反复播放，编剧可以认为观众始终都跟得上剧情进展，这也就使得故事线可以贯穿整个播出季，而不是塞进单独一集中。这吸引了明星导演和演员来试水小荧幕，斯皮尔伯格和汤姆·汉克斯就在2001年为HBO制作了《兄弟连》。在戏剧中，“开头不能省，结尾不能省，中间部分却没那么紧要，而电视剧是关于中间部分的。”在HBO的《继承之战》中扮演洛根·罗伊的布莱恩·考克斯 (Brian Cox) 说。

流媒体继承并发展了有线电视开创的模式。观众可以随时点播整季剧集，痛快刷剧，这让剧情重新变得重要起来，一改过去在《黑道家族》等剧集中塑造人物优先于构造情节的取向。由于观众对前几集的内容还记忆犹新，所以不需要过多冗长的剧情回顾。流媒体同时提供成千上万个节目，这也让小众内容得以蓬勃发展。过去那些即使对有线电视来说都过于大胆、怪异或晦涩难懂的故事创意——不管是韩国恐怖片还是瑞典爱情片，

都在流媒体中找到了一席之地。奈飞的联合创始人里德·黑斯廷斯（Reed Hastings）说：“我们之于有线电视网，就如有线电视网之于传统广播电视台。”

如今好莱坞的产出正在变化。今年编剧和演员持续了六个月的罢工导致影视剧制作停摆。（目前编剧们已经返回岗位，但演员们还没有。）甚至在罢工之前，由于投资者开始要求看到利润、而不仅仅是订户增长，影视公司就在准备减产了。去年，美国发行了2000多部原创剧集（见图表）。这或许是产出的最高点，有线电视网FX的董事长约翰·兰德格拉夫（John Landgraf）认为。

随着新剧数量的下降，一些人认为质量也在降。好几家影视公司遭遇了让它们焦头烂额的现实戏剧：HBO自从2018年被电视业门外汉、电信公司AT&T收购以来，经历了不愉快的四年。（AT&T的老板建议把《权力的游戏》制作成20分钟一集的剧集，以便在手机上播放。）放眼整个行业，一种转变正在发生。比斯金德引述了一些编剧和演员的抱怨，他们称流媒体正在回归传统广播电视台过去一贯秉持的安全的中间立场。“我就想写些让你难受的玩意。”《喜新不厌旧》（Black-ish）等原创剧的编剧肯亚·巴里斯（Kenya Barris）说。但“奈飞要的是中间路线，四平八稳……奈飞变成了CBS”。

随着流媒体试图从订户身上榨取更多利润，广告又卷土重来。刷剧也不如过去那么痛快了。如今大多数流媒体会每周发布一次新剧，以期更长久地留住订户。就连刷剧模式的先驱奈飞也在转向这条路，挤牙膏似地一集一集播放某些新剧。

奈飞和亚马逊Prime Video这类平台拥有数亿订户，超过了任何一家传统广播电视台的观众数。随着它们羽翼渐丰，流媒体似乎正在从小众走向主流。体育赛事就是一个例证。亚马逊已经花大钱买下了美国橄榄球赛事的转播权，奈飞将在11月直播其第一场体育赛事（一场名人高尔夫锦标赛）。流媒体和有线电视公司也开始像电影公司一样，对系列作品和续集产生了依赖。HBO长期以来拒拍衍生剧和前传，但现在已经欣然接受了

《欲望都市》的重启版和《权力的游戏》的多部衍生剧，后者包括几部动画片和一部舞台剧。

电影公司在困难时期依赖系列作品并不奇怪：这是保险的选择，沃尔特·希基（Walt Hickey）在《人如其观》（You Are What You Watch）中指出。该书使用了大量图表来展现影视娱乐业。希基是新闻网站Insider的数据记者，据他计算，自1980年以来，电影续集的平均票房收入是其预算的4.2倍，而原创作品是2.8倍。

或许让流媒体走向主流的最大推手是科技巨头的挤入。亚马逊和Apple TV+都将在这场烧钱的流媒体大战中活下来。（电影导演史蒂文·索德伯格告诉比斯金德，它们会“把每个人的头摁在水里，直到他们淹死”。）但亚马逊和苹果把流媒体视为提高观众对它们其他业务的兴趣的一个途径。亚马逊的创始人贝索斯曾在好莱坞对那些满腹牢骚的人说，“赢得金球奖能帮我们卖出更多鞋子。”

这导致节目制作要保证绝对的品牌安全。苹果公司老板蒂姆·库克说过，苹果希望制作具有“广泛吸引力”的节目，而不是其他流媒体上充斥的“裸露、粗言秽语和暴力”。如此就诞生了像《足球教练》（Ted Lasso）和《早间新闻》（The Morning Show）这样的剧：前者用其中一位制片人的话来说，是一瓶包治百病的“阳光疏通剂”；后者最初是一部针砭广播电视新闻网络有害文化的正剧，后来却退化成一部无脑肥皂剧。亚马逊早期委托制作的剧集还很大胆，现在也开始主打中间立场，比如缺乏想象力的大制作谍战片《堡垒》（Citadel），其中充斥着大量爆炸场面，剧情却毫无悬念。

在一些话题上，这些业务遍布全球的科技巨头甚至比传统广播电视网络更敏感。苹果不久前取消了讽刺类时事节目《囧斯图的问题》（The Problem with Jon Stewart）的播出，据说是因担心斯图尔特在中国和AI问题上所持的批评立场。

一些帮助创造了电视黄金时代的人们如今对它的未来感到悲观。HBO“卒

于50岁”，在1980年代执掌这个电视网的迈克尔·富克斯（Michael Fuchs）告诉比斯金德，“HBO已经不复存在了。”HBO最写实、最有名的电视剧之一《火线》的一名制片人表示，如果放在今天，HBO根本拍不出这部剧。对于创作者来说，电视的黄金时代正在变成一个镀金的笼子。■



Television

A golden age of TV is losing its shine

How Ted Lasso killed Tony Soprano

Pandora's Box. By Peter Biskind. William Morrow; 400 pages; \$32.50. Allen Lane; £25

You Are What You Watch. By Walt Hickey. Workman; 240 pages; \$30 and £25

"SHH, IT'S OK," whispers Frank Underwood (played by Kevin Spacey), as he strokes an injured dog just hit by a car. As the dog whimpers, he soothes it—then, after looking the viewer directly in the eye, wrings its neck.

Not so long ago this scene, which launched Netflix's "House of Cards" in 2013, would have been unshowable on American television. Broadcasters were bound by federal rules against rude or racy content and cowed by advertisers who demanded wholesome heroes and happy endings. But in the 21st century bad guys have had a good run. The amoral Congressman (later President) Underwood, the violent mobster Tony Soprano, the cocaine-smuggling Pablo Escobar of "Narcos" and the megalomaniacal media baron Logan Roy have lit up the small screen in what critics have hailed as a golden era for TV. As viewers migrated from broadcast channels to cable, and then to streaming, shows became darker and more daring.

Yet today, the TV business is in flux once more—and so is the nature of its output. Insurgent streamers have settled in as cosy incumbents. Big tech firms are using streaming to promote their other products. The upshot, argues Peter Biskind in "Pandora's Box", a binge-worthy book about TV, is that the risky, rule-breaking shows that defined television in the early 21st century are giving way to less original fare.

Mr Biskind, a cultural critic, traces TV's recent golden era to the launch in 1972 of Home Box Office (HBO), a cable network. With its "G-String Divas", "Taxicab Confessions" and so on, HBO was initially known for "fighting and fondling". But then it began to commission original drama series and ventured where broadcast television did not. HBO and other cable networks could ignore the nannying rules that constrained broadcasters. And their subscription fees meant no ads, and therefore no jittery advertisers demanding bland, brand-safe content.

Writers relished this freedom. "The things I'm getting away with, I should be arrested for," said a writer on "Oz", a boundary-pushing HBO prison drama whose plotlines include an inmate having a swastika burnt onto his bottom with a cigarette. Bossy advertisers got short shrift. When executives at AMC, another cable network, tried to arrange a product placement for Jack Daniel's whisky in "Mad Men", a writer responded: "If you want me to work this thing into the show, I'm going to have it sterilising equipment in the back alley of an abortionist clinic."

New television was not just about shock. Cable allowed writers to make shows more sophisticated. As David Chase, the creator of "The Sopranos", put it: "On network, everybody says exactly what they're thinking at all times. I wanted my characters to be telling lies." Since cable aired episodes repeatedly, writers could assume that viewers were up to date, meaning that story arcs could last whole seasons rather than being crammed into self-contained episodes. This attracted star directors and actors to try out the small screen, including Steven Spielberg and Tom Hanks, who made "Band of Brothers" for HBO in 2001. In drama, "The beginning is inevitable, the end is inevitable, but the middle is not so inevitable, and television is about the middle," says Brian Cox, who played Logan Roy in HBO's "Succession".

Streaming took what cable started and pushed it further. Making whole seasons available on demand has allowed viewers to binge, reviving the

importance of plot, which had been subordinated to character in shows like “The Sopranos”. With past episodes fresh in the viewer’s mind, less plodding exposition is needed. Streamers’ offering of thousands of shows at once has also enabled niches to thrive. Streaming has found a home for ideas that were too daring, weird or obscure even for cable, from Korean horror to Swedish romance. As Reed Hastings, Netflix’s co-founder, put it, “We are to cable networks as cable networks were to broadcast networks.”

Today Hollywood’s output is changing. Six months of strikes by writers and actors have halted production this year. (Writers have gone back to work, but actors have not.) Even before that, studios were preparing to cut back, as investors began to demand evidence of profits rather than just subscriber growth. In America more than 2,000 original series were released last year (see chart). This will probably be the high-water mark, believes John Landgraf, chairman of FX, a cable network.

As the quantity of new shows falls, some believe the quality is diminishing, too. Several studios have been plagued by real-life drama: from 2018, HBO endured four unhappy years of ownership by AT&T, a phone company that knew little about TV. (Its boss suggested producing “Game of Thrones” in 20-minute episodes to be mobile-friendly.) Across the industry, a shift is under way. Mr Biskind quotes writers and actors who complain that streamers are returning to the safe centre ground that broadcast networks used to occupy. “I want to do in-your-face shit,” says Kenya Barris, the creator of inventive shows such as “Black-ish”. But “Netflix wants down-the-middle...Netflix became CBS.”

Advertising has made a comeback, as streamers try to squeeze more dollars out of subscribers. And bingeing is being reined in. Most streamers now release new shows weekly to keep subscribers on board for longer. Even Netflix, the pioneer of bingeing, is moving this way, dripping out episodes of some new shows one by one.

With hundreds of millions of subscribers, the likes of Netflix and Amazon Prime Video have bigger audiences than any broadcaster. As they grow, streamers seem to be edging away from niches and towards the mainstream. One example is sport. Amazon has shelled out for the rights to American football, and Netflix will air its first live sporting event (a celebrity golf tournament) in November. Streamers and cable firms are also becoming like film studios by developing a dependence on franchises and sequels. HBO, which long resisted spin-offs and prequels, has embraced a “Sex and the City” reboot and multiple “Game of Thrones” spin-offs, including animations and a stage play.

It is hardly surprising that studios are leaning on franchises during hard times: they are safe bets, argues Walt Hickey in “You Are What You Watch”, a chart-filled tour through the entertainment business. Mr Hickey, a data journalist at Insider, a news site, calculates that since 1980 the average movie sequel has made 4.2 times its budget at the box office, while the equivalent figure for original works is 2.8 times.

Perhaps the biggest driver of the move to the mainstream is the tech titans’ push into streaming. Both Amazon and Apple TV+ will survive the financially ruinous streaming wars. (They will “hold everybody’s head under water until they drown,” Steven Soderbergh, a film director, tells Mr Biskind.) But Amazon and Apple see streaming as a way to bolster audiences’ interest in their other businesses. As Jeff Bezos, Amazon’s founder, once said to groans in Hollywood: “When we win a Golden Globe, it helps us sell more shoes.”

The result is resolutely brand-safe output. Rather than the “nudity, raw language and violence” on other streamers, Apple wants to make shows with “broad appeal”, Tim Cook, the company’s boss, has said. This leads to shows like “Ted Lasso”—a “sunshine enema”, in the words of one of its producers—and “The Morning Show”, which debuted as a hard-hitting

drama about a broadcast-news network's toxic culture but has degenerated into a mindless soap opera. Amazon, whose early TV commissioning was more daring, now also focuses on the middle ground, with series such as "Citadel", a big-budget, low-imagination thriller with plenty of explosions and no surprises.

There are some subjects where the globe-spanning tech titans are even touchier than the old broadcast networks. Apple recently cancelled "The Problem with Jon Stewart", a satirical current-affairs show, reportedly because of concerns about Mr Stewart's critical stances on China and AI.

Some of the people who helped to create TV's golden age are downbeat about its future. HBO "died at 50", Michael Fuchs, who ran the network in the 1980s, tells Mr Biskind. "There's no longer an HBO." A producer of "The Wire", one of HBO's grittiest and most celebrated shows, says the company would never make it today. For creatives, television's golden age is turning into a gilded cage. ■



自由交流

中东经济卷入战火

加沙开战之前，这里曾势头兴旺

一个月前，也就是在哈马斯袭击以色列之前，人们有理由对中东充满希望。海湾国家把数以十亿计美元的石油利润投资到各种光鲜夺目的项目中，打造运动队、沙漠城市乃至整个制造业。乐观者认为，这些财富也许还能惠及该地区较贫穷的国家。

人们之所以抱持这样的希望，是因为中东在此前经历了自2011年“阿拉伯之春”以来最长的安定时期。在此期间，利比亚和也门的内战等激烈冲突以及巴勒斯坦人对以色列的有组织抵抗运动似乎冷却了下来。暴力冲突少有发生，有人认为这是暴力冲突完全消失的前兆。中东地区的死敌之间关系渐趋缓和。国际投资者纷纷涌入海湾地区抢占先机。

哈马斯的袭击和以色列的反应显示，在未来数月甚至更长的时间内，该地区将深陷一场血腥的、摧毁性的冲突之中。碍于来自本国民众的压力，阿拉伯国家的领导人把当前局势归咎于以色列，尽管措辞谨慎。一夜之间，他们的关注焦点从经济增长转到遏制并缩短战事。包括埃及和卡塔尔在内的中东各国正采取一切外交措施来阻止战火蔓延。

即使冲突只限于哈马斯和以色列之间，整个地区还是会付出代价。分析师曾对该地区经济一体化的前景满怀希望。2020年，阿联酋和巴林实现与以色列关系正常化，为深化商业联系打开了大门。尽管不少其他阿拉伯国家仍拒绝承认以色列，但它们中有许多越来越愿意私下和以色列做生意。连沙特阿拉伯的公司也在偷偷和以色列的同行做贸易以及向它们投资，毕竟以色列劳动者的生产率是该地区数一数二的，两国之前还在谈判一项关系正常化协议。

这种谈判会停顿多久还有待观察，但是鉴于本国民众亲巴勒斯坦加之来自邻国的压力，加沙遭受的破坏越大，阿拉伯国家领导人今后就越发难以与

以色列交好。尽管阿联酋对外贸易国务部长塔尼·阿尔-泽尤迪（Thani al-Zeyoudi）承诺商业归商业，政治归政治，但其他人怀疑这是否可能。一名为海湾地区企业起草合同的土耳其投资银行家表示，他那些考虑投资以色列的客户大多在观望局势走向。

对于较贫穷的中东国家而言，后果将更严重，日子最难过的将是埃及。该国本就举步维艰，年通胀率高达38%，政府依靠从海湾国家央行贷款来偿还堆积如山的美元债务。现在，它又遭遇了以色列停供天然气。11月1日，开罗官员允许少数加沙伤员和拥有双重国籍的人入境埃及。一些外交官希望，如果埃及得到适当的经济激励，它或许能接收更多难民，甚至可能达到约旦在上世纪40年代接收巴勒斯坦人和在2010年代接收叙利亚人的规模。2016年，约旦政府为照顾65万叙利亚难民耗资26亿美元，远高于它收到的13亿美元的外国援助。而当前加沙境内流离失所的难民数量是上述数字的两倍。

如果冲突升级会怎样？最坏的情况是整个地区陷入战争（或许包括伊朗和以色列之间的直接对抗），各经济体被搅得天翻地覆。这样的战争规模很可能导致石油价格急剧上涨。阿拉伯产油国甚至可能收紧对西方的供应，正如它们在1973年赎罪日战争期间的做法。世界银行估计这可能会导致油价上涨70%，达到每桶157美元。尽管当今世界经济的能源密集度下降了，但海湾产油国仍将从中获益。然而，全面战争爆发将阻碍海湾国家追求经济多元化。外籍劳工会离开。没有安全的运输条件，制造业将难以起步。未来主义风格的购物中心和酒店将游客寥寥。而对于该地区的能源进口国（包括埃及和约旦）而言，油价飙升将是一场灾难。

冲突升级还有另一种更可能的情形。到目前为止，伊朗虽然屡有口头威胁和误射导弹，但并未转为直接攻击。以色列的地面进攻规模和速度都低于预期，有助局势不致失控。然而，冲突仍有可能外溢出加沙边境。试想一下，如果约旦河西岸爆发战事，或者真主党进一步介入，这种情况下，投资中东的风险似乎将大大提高。假如邻国战火四起，海湾国家的领导人将更难以说服投资者相信短期内可实现地区稳定以及加深与以色列的关系。

在那种情况下，埃及不会是唯一岌岌可危的国家。黎巴嫩经济的自由落体式下滑已进入第三个年头，通胀飙升至超过100%，随着以色列和以黎巴嫩为基地的真主党之间爆发冲突，这种自由落体还会加速。约旦河西岸局势高度紧张，在这里开战将给毗邻的约旦带来麻烦。跟埃及一样，约旦也几近破产。去年，约旦从国际货币基金组织获得了12亿美元的贷款，但最近被该组织告知，其2.6%的年增长率不足以解决问题。难民问题可能导致约旦无力偿还债务。其边境地区的动乱也可能令债权人不敢施救。

一旦埃及或约旦破产，就会加剧该地区的不稳定。这两个国家都与巴勒斯坦领土接壤，为其提供补给，向盟友提供情报。两国都在巴勒斯坦权力机构那里说得上话。它们也都拥有年轻而不满的人口。“阿拉伯之春”表明，一个阿拉伯国家发生动荡，很容易就会蔓延到另一个阿拉伯国家。就连可能相对不易受影响的海湾国家官员也宁愿避免这种不稳定。 ■



Free exchange

The Middle East's economy is caught in the crossfire

Before the war in Gaza, it had been poised to boom

A MONTH AGO, on the eve of Hamas's attack on Israel, there were reasons to be hopeful about the Middle East. Gulf states were ploughing billions of dollars of oil profits into flashy investments, building everything from sports teams and desert cities to entire manufacturing sectors. Perhaps, optimists thought, the wealth would even trickle down to the region's poorer countries.

What prompted such hope was the longest period of calm since the Arab spring in 2011. Gnarly conflicts, such as civil wars in Libya and Yemen, as well as organised Palestinian resistance to Israel, appeared to have frozen. Violent clashes were rare, which some believed a precursor to them disappearing altogether. The region's great rivals were inching towards warmer relations. International investors flocked to the Gulf to get in on the action.

Hamas's attack and Israel's response suggest that the region will now be laden with a bloody, destructive conflict for months to come, if not longer. Under pressure from their populations, Arab leaders have blamed Israel for the situation, even if they have been careful in their language. Overnight, their focus has shifted from economic growth to containing and shortening the war. Countries across the region, including Egypt and Qatar, are pulling out all the diplomatic stops to stop the spread of fighting.

Even if the conflict remains between just Hamas and Israel, there will be costs. Analysts had been upbeat about the prospects for economic integration. In 2020 the United Arab Emirates (UAE) and Bahrain

normalised relations with Israel, opening the door to deeper commercial ties. Although many other Arab countries refused to recognise Israel, many were increasingly willing to do business with it on the quiet. Even Saudi Arabian firms surreptitiously traded with and invested in their Israeli counterparts, whose workers are among the region's most productive; the two countries were working on a deal to formalise relations.

How long the pause in such negotiations lasts remains to be seen, but the greater the destruction in Gaza, the harder it will be for Arab leaders to cosy up to Israel in future, given their pro-Palestinian populations and pressure from neighbours. Although Thani al-Zeyoudi, the UAE's trade minister, has promised to keep business and politics separate, others are unsure that will be possible. A Turkish investment banker, who draws up contracts for firms in the Gulf, reports that most of his clients considering Israel as an investment destination are waiting to see what happens next.

For the Middle East's poorer countries, the consequences will be worse—and nowhere more so than in Egypt. The country was already struggling, with annual inflation at 38% and the government living between payments on its mountain of dollar debts by borrowing deposits from Gulf central banks. Now it has lost out on the gas that flowed from Israel. On November 1st officials in Cairo allowed across the border a handful of injured Gazans, as well as those with dual nationalities. Some diplomats hope that a larger influx might follow, perhaps even on the scale seen by Jordan when it welcomed Palestinians in the 1940s and Syrians in the 2010s, if Egypt were given the right financial incentives. In 2016 looking after 650,000 Syrian refugees cost Jordan's state \$2.6bn, much more than the \$1.3bn it received in foreign aid. There are twice as many internally displaced people in Gaza.

What if the conflict escalates? In the worst case, the region descends into war—perhaps including direct confrontation between Iran and Israel—and

economies are turned upside down. Any such war is likely to see a sharp rise in oil prices. Arab oil producers might even restrict supplies to the West, as they did during the Yom Kippur war in 1973, which the World Bank reckons could push up prices by 70%, to \$157 per barrel. Even though the world economy is less energy-intensive today, the Gulf's oil producers would benefit. All-out war, however, would hinder efforts to diversify their economies. Migrant workers would leave. Manufacturing industries would be hard to get off the ground without secure transport. Futuristic malls and hotels would lack the tourists to fill them. And for the region's energy importers, which include Egypt and Jordan, a spike in oil prices would be a disaster.

There is another, more plausible escalation scenario. So far Iran has declined to turn threats and errant missiles into a direct attack. Israel's ground invasion—smaller and slower than expected—is helping keep a lid on things. Nevertheless, conflict could still spill across Gaza's borders. Imagine, say, fighting in the West Bank or greater involvement from Hizbulah. In this scenario, investing in the Middle East would look much riskier. If fighting flashed in neighbouring countries, leaders in the Gulf would find themselves working harder to convince investors that a return to calm and closer ties with Israel might happen soon.

In such a world, Egypt would not be the only country exposed. Lebanon's economic free fall—now in its third year, as inflation rages above 100%—would accelerate with clashes between Israel and Hizbulah, which is based in the country. Fighting in the West Bank, where tensions are high, would spell trouble for Jordan, which sits next door. Like Egypt, the country is almost broke. It took out a \$1.2bn loan from the IMF last year, and was recently told by the fund that its annual growth of 2.6% was insufficient to fix its problems. Refugees could leave the state unable to repay debts. Unrest along its borders could deter creditors.

If either Egypt or Jordan were to run out of cash the results would be destabilising for the region. Both countries border a Palestinian territory, feeding it with supplies and providing allies with information. Both have the ear of the Palestinian Authority. And both have a young, unhappy population. The Arab spring showed how easily unrest in one Arab country can spread to another. Even Gulf officials, relatively insulated though they may be, would rather avoid such instability. ■



价差赌注

为什么石油巨头正在加强其贸易部门

世界动荡导致市场波动，市场波动带来丰厚利润

上世纪50年代，石油市场掌控在“七姐妹”手中。这七家西方石油巨头控制着全球85%的原油储量，以及从油井到油泵的整个生产过程。它们联手固定价格，瓜分了石油市场。撇开七姐妹做石油贸易几乎不可能。到了70年代，这种统治地位被彻底打破。阿拉伯石油禁运、波斯湾石油生产国有化，以及嘉能可（Glencore）、维多（Vitol）和托克（Trafigura）等贸易商的大胆闯入，让七姐妹失去了影响力。到1979年，独立贸易商交易了世界五分之二的石油。

如今世界再次陷入动荡，不单单是因为以色列和哈马斯之间的冲突很可能有升级失控的风险。俄乌战争、西方与中国之间的地缘紧张，以及全球在遏制气候变化方面断断续续的努力都在给石油市场注入波动性（见图表1）。在充满不确定性的时期，大宗商品贸易商的毛利润会大幅提升；奥纬咨询（Oliver Wyman）的数据显示，它们在2022年增长了60%，达到1150亿美元。但是，这一次挤进市场的可不是什么新贵，而是七姐妹的后代及其他石油巨头，它们视贸易为自己的未来中日益扩大的部分。

这些公司不喜欢谈论它们的这部分业务。其贸易队伍的利润被隐藏在组织架构的其他部分中。面对打听刺探，高管会回避问题。他们说一旦公开数据，可能会向竞争对手泄露过多信息。但与分析师和业内人士聊聊，即可窥见一幅大而复杂的业务图景，而且它们还在不断增长——不论是规模还是复杂度。

今年2月，美国最强大的超级石油巨头埃克森美孚（ExxonMobil）宣布将重拾它在二十年前放弃的大规模石油贸易。海湾国家的国有石油巨头也愿意一试：沙特阿美（Saudi Aramco）、阿布扎比国家石油公司（Abu Dhabi National Oil Company）和卡塔尔能源公司（QatarEnergy）正在扩

大贸易业务，以跟上超级石油巨头的步伐。但贸易野心最大的还是欧洲的石油巨头。

自本世纪初以来，BP、壳牌和道达尔能源（TotalEnergies）一直在悄悄扩大自己的贸易业务，咨询公司睿咨得能源（Rystad Energy）的豪尔赫·莱昂（Jorge Léon）表示。据研究公司盛博（Bernstein）估计，2023年上半年，这三家公司的贸易部门总计创造了200亿美元的毛利润。这比2019年同期增加了三分之二（见图表2），占总毛利的五分之一，而四年前只占七分之一。奥纬咨询估计，2016年至2022年间，全球最大私营石油公司的交易员人数增加了46%。其中大部分增长都来自欧洲三巨头。这些交易员的人均利润产出也比七年前增加了一倍半。

目前，BP在全球雇有3000名交易员。据信壳牌的交易员也有数千人，道达尔能源可能有800名。这几乎可以肯定要比托克和维多这类独立贸易商（同样对外含糊其辞）的交易员队伍更大——这两家的交易员人数估计分别在1200人和450人左右（根据已披露的作为公司股东的员工人数推断）。BP的CEO伯纳德·鲁尼（Bernard Looney）最近刚刚离职，最热门的继任人选是其贸易主管卡罗尔·豪尔（Carol Howle），这可能并非巧合。

这些超级巨头的贸易部门在未来一段时间内很可能会很忙碌，因为世界能源市场看起来不太可能平静下来。正如托克的萨阿德·拉希姆（Saad Rahim）所说：“我们正从一个大宗商品周期性波动的世界转向一个大宗商品价格飙升的世界。”这样的世界是贸易商梦寐以求的。

波动加剧的原因之一是地缘冲突加剧。以巴冲突只是最新一例。另一个是俄乌战争。去年，欧盟因俄侵略行为对其实施制裁后，俄罗斯停止向西输送天然气，触发对液化天然气（LNG）的需求猛增。欧洲那些石油巨头的贸易部门等立即采取行动弥补需求缺口，在此过程中大赚了一笔。盛博的数据显示，去年这些公司从LNG贸易中共赚取了150亿美元，约占其交易利润的五分之二。

这可能只是一个开始。咨询公司麦肯锡近期的一份报告模拟了出现区域油

气贸易联盟的场景。俄罗斯燃料将向东流向中国、印度和土耳其，而不会向西流向欧洲。与此同时，中国正试图将海湾地区的产油大户从美国及其盟友手中撬走。所有这些都为石油贸易公司创造了巨大的套利机会。

预计波动将持续的另一个原因是气候变化。气温升高、海平面上升，再加上极端天气，将更频繁地扰乱化石燃料的供应。2021年，德克萨斯州的一场寒流让美国近40%的石油生产关停了约两周。风险咨询公司Verisk Maplecroft表示，全球约30%的油气储量有“高风险”遭遇类似的气候干扰。

还有一个原因是为了避免更严重的极端气候而推进的能源转型。从长远来看，更绿色的能源系统很可能比当今基于化石燃料的能源系统的波动性更小。它将更加分散，因而不会像化石燃料那样集中在世界不稳定地区的少数生产国。但从现在通往气候友好型未来的道路上充满了不确定性。

一些政府和维权股东正在敦促石油公司（尤其是欧洲的石油公司）减少在化石燃料方面的押注。睿咨得能源估计，一定程度上因为这类施压，今年全球对石油和天然气生产的投资将达5400亿美元，比2014年的峰值下降35%。与此同时，对石油的需求继续上升。“这会给能源系统带来压力。”麦肯锡的罗兰·雷希斯坦纳（Roland Rechtsteiner）说。

这为贸易商提供了机会，而且不仅仅是在石油上。雷希斯坦纳指出，大量投资可再生能源却没有同时增加输电容量也会造成瓶颈。研究公司彭博新能源财经（BloombergNEF）表示，在英国、意大利和西班牙，由于电网无法消纳，超过150吉瓦的风能和太阳能发电（相当于这三个国家现有可再生能源发电总量的83%）无法并网。贸易商建不了电网，但可以协助将可再生电力引导到最有利可图的用途，帮助缓解电网拥堵。

欧洲石油三巨头已经在交易电力和碳信用，天然气交易也大幅增长——这种污染程度最低的化石燃料被认为对能源转型至关重要。去年它们处理这些交易的交易员人数是2016年的两倍。奥纬咨询的恩斯特·弗兰克尔（Ernst Frankl）估计，他们在此期间创造的毛利润从60亿美元增至300亿

美元。接下来这些公司可能还会交易其他绿色大宗商品。现就职于咨询公司贝恩的BP前贸易主管戴维·奈普（David Knipe）预计，一些巨头会开始交易用于电池制造的金属锂。如果氢经济能如许多石油巨头希望的那样起飞，它们既能生产也能买卖的东西就又多了一样。■



Spread bets

Why big oil is beefing up its trading arms

A volatile world makes for choppy markets, and choppy markets make for rich profits

IN THE 1950S the oil market was in the gift of the “Seven Sisters”. These giant Western firms controlled 85% of global crude reserves, as well as the entire production process, from the well to the pump. They fixed prices and divvied up markets between themselves. Trading oil outside of the clan was virtually impossible. By the 1970s that dominance was cracked wide open. Arab oil embargoes, nationalisation of oil production in the Persian Gulf and the arrival of buccaneering trading houses such as Glencore, Vitol and Trafigura saw the Sisters lose their sway. By 1979, the independent traders were responsible for trading two-fifths of the world’s oil.

The world is in turmoil again—and not only because the conflict between Israel and Hamas is at risk of escalating dangerously. Russia’s war in Ukraine, geopolitical tensions between the West and China, and fitful global efforts to arrest climate change are all injecting volatility into oil markets (see chart 1). Gross profits of commodity traders, which thrive in uncertain times, increased 60% in 2022, to \$115bn, according to Oliver Wyman, a consultancy. Yet this time it is not the upstarts that have been muscling in. It is the descendants of the Seven Sisters and their fellow oil giants, which see trading as an ever-bigger part of their future.

The companies do not like to talk about this part of their business. Their traders’ profits are hidden away in other parts of the organisation. Chief executives bat away prying questions. Opening the books, they say, risks giving away too much information to competitors. But conversations with analysts and industry insiders paint a picture of large and sophisticated operations—and ones that are growing, both in size and in sophistication.

In February ExxonMobil, America's mightiest supermajor, which abandoned large-scale trading two decades ago, announced it was giving it another go. The Gulf countries' state-run oil giants are game, too: Saudi Aramco, Abu Dhabi National Oil Company and QatarEnergy are expanding their trading desks in a bid to keep up with the supermajors. But it is Europe's oil giants whose trading ambitions are the most vaulting.

BP, Shell and TotalEnergies have been silently expanding their trading desks since the early 2000s, says Jorge Léon of Rystad Energy, a consultancy. In the first half of 2023 trading generated a combined \$20bn of gross profit for the three companies, estimates Bernstein, a research firm. That was two-thirds more than in the same period in 2019 (see chart 2), and one-fifth of their total gross earnings, up from one-seventh four years ago. Oliver Wyman estimates that the headcount of traders at the world's largest private-sector oil firms swelled by 46% between 2016 and 2022. Most of that is attributable to Europe's big three. Each of these traders also generates one and a half times more profit than seven years ago.

Today BP employs 3,000 traders worldwide. Shell's traders are also thought to number thousands and TotalEnergies' perhaps 800. That is almost certainly more than the (equally coy) independent traders such as Trafigura and Vitol, whose head counts are, respectively, estimated at around 1,200 and 450 (judging by the disclosed number of employees who are shareholders in the firms). It is probably no coincidence that BP's head of trading, Carol Howle, is a frontrunner for the British company's top job, recently vacated by Bernard Looney.

The supermajors' trading desks are likely to stay busy for a while, because the world's energy markets look unlikely to calm down. As Saad Rahim of Trafigura puts it, "We are moving away from a world of commodity cycles to a world of commodity spikes." And such a world is the trader's dream.

One reason for the heightened volatility is intensifying geopolitical strife. The conflict between Israel and the Palestinians is just the latest example. Another is the war in Ukraine. When last year Russia stopped pumping its gas west after the EU imposed sanctions on it in the wake of its aggression, demand for liquefied natural gas (LNG) rocketed. The European supermajors' trading arms were among those rushing to fill the gap, making a fortune in the process. They raked in a combined \$15bn from trading LNG last year, accounting for around two-fifths of their trading profits, according to Bernstein.

This could be just the beginning. A recent report from McKinsey, a consultancy, models a scenario in which regional trade blocs for hydrocarbons emerge. Russian fuel would flow east to China, India and Turkey rather than west to Europe. At the same time, China is trying to prise the Gulf's powerful producers away from America and its allies. All that is creating vast arbitrage opportunities for traders.

Another reason to expect persistent volatility is climate change. A combination of increasing temperatures, rising sea levels and extreme weather will disrupt supply of fossil fuels with greater regularity. In 2021 a cold snap in Texas knocked out close to 40% of oil production in America for about two weeks. Around 30% of oil and gas reserves around the world are at a "high risk" of similar climate disruption, according to Verisk Maplecroft, a risk consultancy.

Then there is the energy transition, which is meant to avert even worse climate extremes. In the long run, a greener energy system will in all likelihood be less volatile than today's fossil-fuel-based one. It will be more distributed and thus less concentrated in the hands of a few producers in unstable parts of the world. But the path from now to a climate-friendlier future is riven with uncertainty.

Some governments and activist shareholders are pressing oil companies, especially in Europe, to reduce their fossil-fuel wagers. Rystad Energy reckons that partly as a result, global investment in oil and gas production will reach \$540bn this year, down by 35% from its peak in 2014. Demand for oil, meanwhile, continues to rise. “That creates stress in the system,” says Roland Rechtsteiner of McKinsey.

This presents opportunities for traders, and not just in oil. Mr Rechtsteiner notes that heavy investment in renewables without a simultaneous increase in transmission capacity also causes bottlenecks. In Britain, Italy and Spain more than 150-gigawatts'-worth of wind and solar power, equivalent to 83% of the three countries' total existing renewables capacity, cannot come online because their grids cannot handle it, says BloombergNEF, a research firm. Traders cannot build grids, but they can help ease gridlock by helping channel resources to their most profitable use.

Europe's three oil supermajors are already dealing in electric power and carbon credits, as well as a lot more gas, which as the least grubby of fossil fuels is considered essential to the energy transition. Last year they had twice as many traders transacting such things than they did in 2016. Ernst Frankl of Oliver Wyman estimates that gross profits they generated rose from \$6bn to \$30bn over that period. Other green commodities may come next. David Knipe, a former head of trading at BP now at Bain, a consultancy, expects some of the majors to start trading lithium, a metal used in battery-making. If the hydrogen economy takes off, as many oil giants hope, that will offer another thing not just to produce, but also to buy and sell. ■



梧桐

为什么该让铜医生退休了

这种红色金属不再能为投资者指明全球经济状况

众所周知，医生都不大情愿挂起听诊器退休。但是，每个医师的职业生涯都会迎来技术衰退的那一刻，这时候温和地推一把，让他们离场，对他们和他们的病人来说都是最好的选择。这一点同样适用于金融世界里的“大夫”，它们诊断市场健康状况的能力也会随时间而变化。现在，此类医生当中最杰出的一位——“铜医生”，可能就要走到事业的尽头了。

铜是制造各种配件、管道和电线的关键金属，作为全球工业健康状况的风向标，在华尔街赢得了“铜医生”的绰号。铜价飙升被视为经济复苏的先兆，暴跌则预示着经济衰退，或者至少是制造业衰退。

那么目前是什么情形？制造业似乎萎靡不振。全球工业产值同比仅增长0.5%，远低于过去二十年来2.6%的平均增速，发达国家正处于工业衰退之中。2015年也发生了类似规模的动荡，导致铜价暴跌约四分之一。然而，今年迄今为止铜价仅下跌了6%。2025年到期的铜期货价格保持平稳，2026年到期的还略有上涨。

惯常的经验法则被打破在中国最为凸显，这里每年消耗全球铜供应量的一半以上。鉴于中国房地产市场遭受重创，你可能会以为铜价劫数难逃。毕竟，曾经是铜需求大户的房地产投资已经同比下降了9%。但奇怪的是，今年中国对铜的需求却增长了10%左右。

究其原因，能源系统正在发生翻天覆地的变化。据高盛称，中国今年将安装约150吉瓦的太阳能发电容量，是去年装机量的近两倍，而太阳能发电要使用大量的铜。储能也需要铜。抽水蓄能电站就是一例。这种方法把水从一个水库转移到另一个水库，用来储存过剩的风电和光电，抑或用于释放这些能量。中国的抽水储能容量已达到50吉瓦，占全球总容量的30%。另有89吉瓦容量在建，这将需要大量的铜。

其他国家也在斥巨资推进绿色转型，相关立法将推高对铜的需求。金融数据公司标普全球（S&P Global）预测，到2035年，精炼铜的需求量将翻一番，达到4900万吨。电池、能源传输、太阳能电池、交通运输都需要这种金属。一辆电动汽车含铜50多公斤，是传统汽车用量的两倍多。全球各地旨在减少排放的新规将引导消费者选择电动汽车，而不是含铜较少的传统汽车。在欧洲，从2035年起将禁止销售新的燃油车。

因此，供应将空前紧张，意味着铜价飙升将不再是工业机械制造商、建筑公司、电子产品制造商等部门的乐观情绪的指标。对铜的需求上升将越来越多地反映出政客对更环保的能源的追求，有时也反映出对能源进口的依赖减少。

在往常，建设全新的电力网络至少也是一个预示着更多经济活动即将到来的信号。然而能源转型的目的是取代现有活动，而不是新增。就能源基础设施而言，中国今年新增的太阳能投资在满负荷运转时可产生150吉瓦时的能量，相当于每小时近9万桶石油。这意味着中国不再需要从海外生产商购买这部分能源。其结果很可能对地球有益，但对经济活动总量并没有太大影响。

鉴于铜需求的增长中有很一大块已锁定，且在很大程度上依照法律指令推进，随着时间的推移，铜价将越来越难以反映全球经济的状况，而越来越多地反映能源转型的状况。因此，铜价仍然值得关注，但原因已经不同。原本是投资者通过铜价窥见全球经济状况，取而代之的是政策制定者从中了解其绿色政策的进展。“铜医生”退休或许是个伤感的时刻，但故事仍在继续。 ■



Buttonwood

Why it is time to retire Dr Copper

The red metal no longer tells investors much about the global economy

DOCTORS ARE famously reluctant to hang up their stethoscopes. But a time comes in the career of every medic when their skills fade, and a gentle push is the best thing for them—and their patients. The same applies for the metaphorical physicians of the financial world, whose ability to diagnose the market's health changes over time. Now the end may be nigh for the most illustrious of all such physicians: Dr Copper.

Copper, a metal crucial to the construction of all manner of fittings, pipes and wires, has earned its nickname on Wall Street owing to its role as a bellwether for the health of global industry. A surge in copper prices is taken as an early sign of an economic upswing; a big drop is a portent of recession, or at the very least a manufacturing downturn.

So what is going on at the moment? Manufacturing looks peaky. Global industrial output is up by just 0.5% year on year, well below the average of 2.6% over the past two decades, and the rich world is in an industrial recession. A wobble of a similar scale in 2015 sent copper prices plunging by about a quarter. Yet so far this year they are down by only 6%. Futures maturing in 2025 are flat, and those maturing in 2026 are up a bit.

The breakdown in the usual rules of thumb is most striking in China, which consumes over half of the world's annual copper supply. Its stricken housing market might have led you to think the metal was doomed. After all, investment in property, once a key driver of copper demand, is down by 9% year on year. Curiously, though, Chinese demand for the metal is up by around 10% this year.

The explanation for this lies in the radical shifts that are under way in the energy system. China will install around 150 gigawatts (GW) of copper-intensive solar-energy capacity this year, according to Goldman Sachs, a bank, almost double the amount it installed last year. And methods for storing energy require the metal, too. Pumped-storage hydropower is one example. This involves moving water from one reservoir to another, either to hoard excess energy from wind and solar power or to release it. China already has 30% of the world's hydropower-storage capacity, at 50GW. Another 89GW of capacity is being built, which will require vast amounts of copper.

Other countries are also spending big on the green transition, and putting in place legislation that will increase appetite for the metal. S&P Global, a financial-data firm, suggests that demand for refined copper will almost double by 2035, to 49m tonnes. Batteries, energy transmission, solar cells, transport—all need the metal. An electric car contains over 50 kilograms of the stuff, more than twice the amount used in a conventional vehicle. Across the world new rules, intended to reduce emissions, will steer consumers towards electric vehicles and away from their copper-light predecessors. In Europe sales of new petrol-powered cars will be banned from 2035.

The squeeze on supplies will therefore be historic, meaning that sky-high copper prices will no longer be indicative of optimism on the part of industrial machinery-makers, construction firms, electronics manufacturers and the like. Instead, rising demand for copper will increasingly reflect a desire among politicians for more environmentally friendly energy, and sometimes also a reduced dependence on imports.

In normal times, building an electrical network from scratch would at least be a signal of greater economic activity to come. However, the energy transition is intended to replace existing activity, rather than add to it. In

the case of energy infrastructure, China's new solar investment this year can generate 150 gigawatt-hours of energy when working at full pelt, which is equivalent to almost 90,000 barrels of oil per hour. That is energy which China now does not need to purchase from overseas producers. The result may well be good for the planet, but it will not have much effect on aggregate economic activity.

With so much of the growth in demand for copper locked in, and proceeding in large part according to legal diktat, the metal's price will over time say less and less about the state of the global economy, and more and more about the state of the energy transition. Copper prices will still be worth watching, then, albeit for different reasons. Investors wanting a hint about the state of the global economy will be replaced by policymakers wanting a sense of how their green policies are faring. Dr Copper's retirement may be a sad moment, but it is not the end of the story. ■



培训日

中国正在世界各地培训工程师

它的技术学校不像孔子学院那样有争议

中国官员经常以夸张的言辞谈论推动全球基础设施建设的“一带一路”倡议。10月17日到18日，中国领导人习近平在北京举行了一场大规模高峰论坛，为中国政府津津乐道的这一“世纪工程”庆祝十周年。近来，这样热火朝天的宣传掩盖了一个尴尬的现实。自2020年以来，中国已经缩减了这一工程的规模，因为各国政府越来越难以偿还中国的基础设施贷款。

不过近年来，这一工程的一个组成部分静悄悄地取得了成功。自2016年以来，中国在二十多个国家（大多为较贫穷国家）建立了27所职业学院。这些“鲁班工坊”（以公元前五世纪的一位传奇木匠命名）在人工智能、电动汽车、铁路运营和机器人等领域培训了数千名学生。最新一批工坊之一于9月4日在肯尼亚的梅鲁理工大学（Meru University of Science and Technology）揭牌。

这并不是为了做慈善。鲁班工坊推广中国想要输出到发展中国家的技术和标准。肯尼亚的这所新工坊所用的设备将来自中国通讯巨头华为。因为担心华为的设备会帮助中国监听，美国想要把它排除在盟友的移动网络之外。华为（它否认了美国的指控）帮助建设了肯尼亚的移动网络，现在正与该国最大的电信运营商合作推广5G服务。

鲁班工坊还帮助缓解了对“一带一路”的忧虑。参与其中的各国政府有时抱怨赢得本国基础设施项目的公司太过依赖来自中国的工人和物资。一些鲁班工坊现在提供与“一带一路”项目直接相关的培训。吉布提的鲁班工坊已经为一条通往埃塞俄比亚的新铁路培训了员工。这条40亿美元的铁路由中国建设并出资，但自2018年投入运营以来一直难以盈利。

鲁班工坊计划类似于中国更早时候为扩大影响力而开办的500多所“孔子学院”，这些学院在全球各地的大学里教授普通话。许多孔子学院因被指进

行政政治宣传和压制异见而关闭，但迄今为止，鲁班工坊并没有引发同样的争议。这在一方面是因为鲁班工坊专注传授职业技能，另一方面是因为中国在开设这些工坊之前花了更多时间与东道国政府协商。“与孔子学院不同，鲁班工坊实际上是由国家而异，因为各个东道国所需要的技能都不一样。”美国智库大西洋理事会（Atlantic Council）的邱芷恩说。她认为这些工坊证明了中国正在回应对“一带一路”的批评而并没有放弃其核心目标，例如输出技术。

鲁班工坊与美国、日本和其他富裕国家向南方世界提供的培训竞争。例如德国指导了100多个国家如何复制其著名的职业教育体系。不过鲁班工坊不太一样，它不仅提供教学，还提供设备，还拥有自己的品牌。

鲁班工坊项目在启动时是由天津市政府主导的，这座邻近北京的大城市以技术培训闻名（中国鼓励地方政府支持“一带一路”倡议并从中受益）。第一所鲁班工坊（如图）于2016年在泰国建成，使用由天津一家化工企业赠送的设备。有一段时间，鲁班工坊不仅出现在贫穷国家，也出现在富裕国家。从2018年到2020年，在伦敦附近的克劳利学院（Crawley College）里的鲁班工坊教授中餐烹饪；葡萄牙的一个工坊至今提供电气自动化和工业机器人方面的培训。这个项目并不总是局限于“一带一路”的参与国：在对这一倡议心怀疑虑的印度的金奈（Chennai）也有一所鲁班工坊。

不过后来，这个项目似乎被中央政府采用。项目扩大到引入天津之外的培训提供机构和公司，而且与习的对外政策有了更明确的联系。2018年，习承诺在非洲开设十所鲁班工坊；自那以后已有十二所工坊在非洲设立。今年5月，他向中亚各国领导人承诺要在中亚开设更多工坊（那里的第一所工坊于去年12月在塔吉克斯坦开办）。

中国将补贴鲁班工坊多长时间以及它们会在多大程度上兑现承诺，还有待观察。有一些是存疑的，比如在备受战火摧残的马里，一个工坊在教中医。但在目前，它们提供了令人耳目一新的一例，表明中国政府听得进批评，并能从错误中汲取教训。 ■



Training days

China is educating engineers around the world

Its technical schools are less controversial than its Confucius Institutes

CHINESE OFFICIALS often talk of the Belt and Road Initiative, a global infrastructure building spree, in hyperbolic terms. On October 17th and 18th Xi Jinping, China's leader, hosted a big summit in Beijing to celebrate the tenth anniversary of what the government likes to call the “project of the century”. Lately this hype has masked an awkward reality. Since 2020 China has scaled back the scheme as governments have found it harder to repay Chinese infrastructure loans.

Yet in recent years one part of the project has stood out as a quiet success. Since 2016 China has set up some 27 vocational colleges in two dozen countries, mostly poorer ones. These “Luban Workshops” (named after a fabled carpenter from the fifth century BC) have trained thousands of students in fields including artificial intelligence, electric vehicles, railway operations and robotics. One of the newest workshops opened on September 4th at Meru University of Science and Technology in Kenya.

The purpose is not charity. Luban workshops promote technology and standards that China wants to export to developing countries. Gear for the new workshop in Kenya will come from Huawei, a Chinese telecoms giant America would like to see excluded from its allies' mobile networks, for fear its kit could assist Chinese spying. Huawei (which denies America's allegations) helped build Kenya's mobile network and is now working with its biggest telecoms provider to roll out 5G services.

The workshops also help assuage worries about the Belt and Road. Participating governments sometimes complain that the companies which

win its infrastructure projects rely too much on labour and supplies from China. Several Luban workshops now provide training directly related to Belt and Road projects. One in Djibouti has trained employees of a new rail line to Ethiopia. That \$4bn railway was built and financed by China but struggled to make a profit after opening in 2018.

The Luban programme has echoes of China's earlier drive to expand its influence by opening more than 500 "Confucius Institutes" to teach Mandarin in universities around the world. Yet so far it has avoided the controversies that have dogged those institutes, many of which closed after being accused of promoting propaganda and stifling dissent. This is in part because the Luban workshops focus on technical skills and in part because China has spent more time consulting host governments before setting them up. "Unlike Confucius Institutes, Luban workshops are actually different in each country, because of the different skills that are demanded by host countries," says Niva Yau of the Atlantic Council, an American think-tank. She sees them as evidence that China is responding to criticism of Belt and Road without abandoning core goals, such as exporting its technology.

The workshops compete with training that America, Japan and other rich countries offer countries in the global south. Germany, for example, has given more than 100 countries guidance on how to copy its famed system of vocational education. The Luban workshops are unusual, though, in providing equipment as well as teaching, and in having their own brand.

When the Luban programme began it was led by the local government in Tianjin, a big city near Beijing that was known for technical training (local authorities have been encouraged to support and profit from Belt and Road). The first workshop (pictured) opened in Thailand in 2016; it used equipment sent by a Tianjin chemical company. For a time Luban workshops cropped up in rich countries as well as poor ones. Between 2018 and 2020 a workshop at Crawley College, near London, taught Chinese

cuisine; one in Portugal still offers training in electrical automation and industrial robots. The programme was not always restricted to Belt and Road participants: India (a sceptic) has a Luban workshop in Chennai.

More recently, however, the programme appears to have been co-opted by China's central government. It has grown to involve training providers and companies from outside Tianjin, and been linked more explicitly to Mr Xi's foreign policy. In 2018 Mr Xi pledged to open ten workshops in Africa; a dozen have since opened there. In May he promised leaders of Central Asian countries that China would set up more workshops in their region (the first opened in Tajikistan last December).

It remains to be seen how long China will subsidise Luban workshops, and how far they will live up to their promise. Some are questionable, such as one in war-torn Mali that teaches traditional Chinese medicine. But for the moment they represent a refreshing example of China's government listening to critics—and learning from its mistakes. ■



“芯”情不佳

韩国芯片制造商缓了一口气

但地缘紧张局势和中国发展本土芯片制造带来的压力将增加

对于韩国两大芯片制造商三星电子和SK海力士来说，今年是焦虑的一年。去年10月，美国限制向中国出口先进芯片制造设备，试图让中国无法为武器系统采购或生产芯片。这两家依赖中国为生产基地和市场的韩国企业获得了一年的豁免期，但它们还是为豁免到期后的日子忧虑不安。

10月9日，它们稍微舒了一口气。韩国政府宣布，通过与美国的“密切合作”，豁免将改为无限期。然而，中美科技战不可预测，中国也尝试扶持本国芯片制造商，意味着韩国最重要的产业可能仍需要把目光转向中国以外的地方。

2022年，芯片约占韩国出口总额的19%，高于其他任何产品。存储信息的存储芯片占芯片总出口的近60%，韩国公司在全球市场上的份额也大致是这个比例。在中国设厂是其雄霸市场的关键。三星的NAND芯片有40%在中国生产，SK有20%的NAND芯片和40%的DRAM芯片在中国生产。对这两家公司来说，中国都是个巨大的市场，分别占它们2021年销售额的16%和44%。因此，这次的豁免价值巨大，让它们能继续向自己的在华工厂输送零部件。

SK集团会长崔泰源表示“不可能放弃中国市场”。然而，即便获得无限期豁免，在中国生产芯片也可能变得更困难。延长豁免期的规则细节尚未公布，但假如其中限制了使用某类设备，韩国公司就可能在某个节点后难以再升级改造工厂。日本和荷兰对半导体技术的出口限制仍然有效，三星和SK海力士使用了这些技术。此外，公司若想要获得美国《芯片法案》(CHIPS Act，旨在鼓励半导体制造商在美设厂)提供的税收激励，就可能受制于该法案对在华扩产所设的限制。

中国对韩国芯片的需求也不确定。中国经济在新冠疫情后复苏乏力，半导

体公司因此积压了大量芯片，今年韩国半导体对华出口随之下降。而且中国一直在注资发展自己的半导体产业。所以，即使因美国出口管制被切断了与全球芯片制造设备供应链的联系，中国内存芯片龙头制造商长江存储也挺了过来。该公司今年将建成一座新工厂，以国产设备而非外国设备来生产。在韩国央行6月对韩国半导体企业的调查中，近56%的受访企业表示，不利的市场状况、中国的产业政策及其芯片产业的进步意味着韩国的出口水平不太可能恢复。

中美科技战的不可预测性造成了进一步风险。韩国官员喜欢说，这场争斗突显出美国和韩国相对亲密的关系。它也揭示了美国在制定产业政策时常常不征求盟国意见。去年8月，美国推出了《通胀削减法案》（Inflation Reduction Act），鼓励电动汽车和电池制造商把供应链从中国转向美国，这尤其令韩国感到震惊。假如美国再出台类似的举措来阻碍中国半导体发展，三星和海力士可能将又一次面临连带损害。

出于这些原因，三星和海力士可能会减少依赖在华生产。两者都已开始考虑在美国和韩国开设更多工厂。尽管这两个国家都为芯片制造商提供了优惠条件，但美韩的制造成本仍高于中国。这就是芯片制造商——最终还有它们的客户——日益面对的新现实。 ■



Chipping away

South Korean chipmakers get a reprieve

But the pressure from geopolitical tension and China's domestic manufacturing drive will increase

IT HAS BEEN an anxious year for Samsung Electronics and SK Hynix, South Korea's leading chipmakers. Last October America restricted exports of advanced chipmaking equipment to China in an attempt to cripple its ability to procure or produce chips for weapons systems. The South Korean firms, which rely on China as both a manufacturing base and market, received a year-long exemption, but fretted about what might happen after it expires.

On October 9th their minds were put somewhat at ease. South Korea's government announced that, thanks to "close co-operation" with America, the waivers would become indefinite. Yet the unpredictability of the Sino-American tech war and China's attempts to bolster domestic manufacturers mean South Korea's most important industry may still have to look beyond China.

Chips made up some 19% of South Korea's total exports in 2022, more than any other product. Memory chips, which store information, make up almost 60% of that total, and South Korean companies control about the same percentage of the global market. Factories in China are key to this dominance. Samsung manufactures 40% of its NAND chips in the country, while SK makes 20% of its NAND chips and 40% of its DRAM chips there. China is a big market for both, accounting for 16% and 44% of their respective sales in 2021. So the exemption is hugely valuable; it allows the firms to keep sending spare parts to their factories in China.

Chey Tae-won, the head of SK Group, has said it is "not possible to give

up the Chinese market". Yet even with the exemption it may be harder to make chips there. The details of the extended regime are not public, but if they constrain the use of specific types of equipment it might be difficult for South Korean companies to upgrade their factories beyond a certain point. Japanese and Dutch export restrictions on semiconductor technology used by Samsung and SK Hynix remain in place. And if companies want to receive tax incentives offered by America's CHIPS Act, a law designed to encourage semiconductor manufacturers to set up shop in America, they may be constrained by limits it puts on the expansion of production in China.

Chinese demand for South Korean chips is also uncertain. China's sluggish economic recovery from the pandemic, and the stockpiles of chips that semiconductor firms have built up as a result, mean South Korean exports of semiconductors to China are down this year. And China has been pumping money into its own semiconductor industry. As a result YMTC, China's memory-making champion, has survived being cut off from global chipmaking tool supply chains by American export controls. It is due to complete a new factory this year, relying on Chinese machine tools instead of foreign ones. Almost 56% of South Korean semiconductor firms surveyed by the Bank of Korea in June said unhelpful market conditions, China's industrial policy and its advancing chip industry mean export levels are unlikely to recover.

The unpredictability of the Sino-American tech war creates further risk. South Korean officials like to say the row highlights the relative closeness of America and South Korea. It also reveals America's tendency to design industrial policy without consulting allies. Its roll-out last August of the Inflation Reduction Act, which incentivises EV and battery manufacturers to reroute supply chains away from China and towards America, was a particular shock to South Korea. If America makes another such move to hamstring China's semiconductor development, Samsung and SK could

again face being collateral damage.

For these reasons, both firms will probably try to reduce their dependence on China as a manufacturing location. Both are already looking to open more facilities in America and South Korea. Manufacturing costs are higher there than in China, despite the inducements both countries are offering chipmakers. That is the new reality chipmakers, and ultimately their customers, will increasingly face. ■



光刻经验

佳能试图打破阿斯麦对芯片制造设备的垄断

祝它好运

芯片制造设备的供应商很少引起人们的注意。不过当10月13日佳能推出一款新设备时，许多投资者都转头看向了它。原因很容易理解。这家制造光学设备的日本公司称，其“纳米压印”光刻机可以蚀刻在最先进的微芯片中使用的那种最小的晶体管。迄今为止，这样的创举一直是荷兰光刻机制造商阿斯麦（ASML）的专利。佳能希望最终能制造两纳米芯片，进一步抢占阿斯麦的业务。

阿斯麦在尖端芯片供应链上的垄断地位可能被打破，这件事非常有趣。在高度集中的半导体行业，阿斯麦长期享有最大的垄断地位。全球最大的三家芯片制造商——英特尔、三星和台积电——完全依靠它的极紫外（简称EUV）光刻技术来生产尖端的微处理器。智能手机以及计算云所在的强大的数据中心服务器使用这些微处理器。

阿斯麦的EUV设备是用高功率激光器将电子线路图蚀刻到硅晶片上。相比之下，佳能的替代方案是使用图案模具直接把芯片设计印制到这些硅晶片上。理论上，这让它可以制作更精细的图案。而且因为涉及的步骤更少，不需要昂贵的激光器和超光滑的镜片，价格可能比EUV光刻便宜得多。受纳米压印消息的影响，阿斯麦的股价下跌了超过2%，佳能的股价则上涨了近2%。

在实际操作中，佳能面临的难度不小。半导体研究公司SemiAnalysis的迪伦·帕特尔（Dylan Patel）指出，纳米压印光刻容易出现瑕疵，因为让硅晶片和模具对齐需要很高的精度。这种技术在处理复杂的芯片设计时还不太有效，包括人工智能模型中使用的处理器的设计，因为其中涉及很多层的化学沉积。帕特尔预测，佳能的设备将用于制造一部分层数较少的存储芯片，而不是先进的“逻辑”芯片，后者用来处理信息而不是存储信息。

即使佳能能够克服所有这些技术障碍，芯片制造商也可能极不情愿用佳能的机器取代它们的成套EUV设备。为了最大限度地降低缺陷芯片的比例，芯片制造工厂（简称晶圆厂）是高度标准化的。因为阿斯麦长期以来都是尖端芯片领域的唯一选择，这种标准化意味着晶圆厂是围绕阿斯麦的机器设计的，这些机器有一辆双层巴士那么大。芯片制造商目前在世界各地大举建造的晶圆厂不会突然转向纳米压印光刻技术。研究公司高德纳

（Gartner）的高拉夫·古普塔（Gaurav Gupta）认为，佳能的设备可能需要五年时间才会被用于大规模生产，而且它们必须首先证明自己的能力。

佳能有机会加速推进的一个地方是中国。自2019年以来，由于美国的出口管制，中国公司被禁止购买阿斯麦的EUV光刻机，因为这些机器都要依赖产自美国的部件。中国自主研发光刻机的道路也困难重重。而目前美国的限制并未明确包括纳米压印技术。这让佳能可以自由地把这一技术卖给日本海对岸的客户——至少目前是这样，也许还会持续更久。目前还不清楚这家日本公司的设备是否包含足够多的美国技术，以致日后也会落入美国对华限制措施的范围。在佳能发布新设备之时，恐怕没有谁的脖子伸得比华盛顿和北京的国家安全鹰派更长了。 ■



Lithography lessons

Canon tries to break ASML's grip on chipmaking tools

Good luck with that

PURVEYORS OF CHIPMAKING tools seldom attract attention. Yet many investors' heads turned on October 13th, when Canon unveiled a new piece of kit. It is easy to see why. The Japanese company, which makes optical equipment, claims that its “nanoimprint” lithography machine can etch the very smallest transistors used in the most advanced microchips. Such feats have hitherto been the preserve of ASML, a Dutch manufacturer of lithographic tools. Canon hopes to eat further into ASML's business by eventually cranking out two-nanometre chips.

The possibility of breaking ASML's stranglehold on the supply chain for cutting-edge chips is intriguing. The firm has long enjoyed the biggest monopoly in the concentrated semiconductor industry. The world's three biggest chip manufacturers—Intel, Samsung and TSMC—depend entirely on its extreme-ultraviolet (EUV) technology to produce the cutting-edge microprocessors that go into smartphones and the powerful data-centre servers on which the computing cloud lives.

ASML's EUV rigs use high-powered lasers to etch electrical blueprints onto circular silicon discs. Canon's alternative, by contrast, directly stamps chip designs on such wafers using a patterned mould. In theory, this allows it to make more detailed patterns. And because it involves fewer steps and avoids the need for expensive lasers and supersmooth mirrors, it could be much cheaper than EUV lithography. ASML's share price dipped by more than 2% and Canon's rose by nearly as much on the nanoimprint news.

In practice, Canon has its work cut out. Dylan Patel of SemiAnalysis, a

semiconductor-research firm, points out that nanoimprint lithography is prone to defects because of the precision required to align wafers and moulds. The technique is also not yet effective in dealing with complex chip designs, including for processors used in artificial-intelligence models, that involve many layers of chemical deposits. Mr Patel predicts that Canon's tool will be used for making parts of memory chips, which have fewer layers, rather than for advanced "logic" chips, which process information rather than store it.

Even if Canon can overcome all these technical hurdles, chipmakers may be loth to replace their EUV kit with its machines. Chip fabrication plants (fabs for short) are highly standardised in order to minimise the share of chips that turn out faulty. Since ASML has long been the only game in town for cutting-edge chips, that standardisation means that fabs are being designed around its machines, which are the size of a double-decker bus. The fabs that chipmakers are currently busy putting up around the world will not suddenly switch to nanoimprint lithography. It may take five years for Canon's tools to be used in mass production, thinks Gaurav Gupta of Gartner, a research firm, and only once they have proved themselves.

One place where Canon could make headway more quickly is China. Since 2019 Chinese companies have been prevented by America's export controls from buying ASML's EUV machines, since they all rely on bits and bobs of American origin. It has also struggled to develop lithography machines of its own. The current American restrictions do not, however, explicitly cover nanoimprint technology. That leaves Canon free to sell it to customers across the Sea of Japan—at least for the time being and perhaps for longer. It is unclear whether the Japanese firm's machines include enough American know-how to ever fall under America's anti-Chinese strictures. Probably no necks craned more at Canon's announcement than those of national-security hawks in Washington and Beijing. ■



自由交流

以色列的战时经济暂时还能应付

冲突持续越久，压力越大

哈马斯把以色列拖入战争不到三周，战事已对该国经济造成打击。以色列谢克尔兑美元汇率跌至十多年来新低，促使以色列央行出售300亿美元的外汇储备以支撑谢克尔。该国债务违约保险的价格也直线上升。从建筑商到餐馆，企业纷纷停业。10月19日，以色列财政部宣布计划增加国防开支并为失业者提供生活补助。四天后，该国央行把今年的经济增长预期从3%下调至2.3%。

战争打的不仅是军事实力，也是经济实力，因此这一切战事之上就有了一个重要问题：以色列能否承受住经济上的痛楚？自2005年撤出加沙地带以来，以色列与哈马斯冲突不断，但对评估这次战争的影响并没有多少指导意义。以往每次冲突花费数十亿谢克尔（仅占GDP的很小一部分）的军事和维修开支。这些冲突并未对以色列的经济构成威胁，其人均收入长期位居中东地区前列。

哈马斯在10月7日发动的袭击规模很大，加上很可能引发后续冲突，促使经济学家深入历史。1973年，“赎罪日战争”的军备和征召20万预备役军人的开支把以色列推向了财政崩溃的边缘。据以色列央行估计，单2002年这一年“巴勒斯坦起义”（从上世纪80年代末至本世纪初不断爆发的巴勒斯坦暴动）就耗掉了3.8%的GDP。

要躲避灾难性后果，以色列官员必须直面三大挑战。首先是就业。以色列没有足够的人力兼顾经济和战争。自10月7日以来，军方已动员36万多名预备役军人，占全国劳动力的8%，征召规模超过了1973年。大多数人离开了工作岗位，给经济造成巨大缺口。更糟糕的是，这些新兵属于以色列最富生产力的劳动者。据以色列慈善机构创业国度（Start-Up Nation）估计，十分之一的科技业员工被征召入伍。相比成员主要为富裕国家的经合

组织（OECD）的平均水平，以色列科技业员工的生产率要高出四分之一，而其他经济部门的生产率却要低五分之二。只有极少数预备役军人来自抵制就业的极端正统派犹太人社区。

劳动力短缺还有另一个原因。以色列的许多低技能工作由来自约旦河西岸的巴勒斯坦人承担，其中约有20万人在以色列或犹太人定居点工作。但约旦河西岸爆发动乱意味着许多工人被禁止跨境，他们也可能开始罢工。据国际货币基金组织（IMF）的数据，在2000年至2005年发生第二次巴勒斯坦起义期间，巴勒斯坦工人紧缺是以色列经济增长的最大障碍之一。

此外，由于以色列的劳动力市场极度吃紧，几乎没有劳动者可以替代预备役军人和巴勒斯坦人。该国央行过去几个月一直加息以求让经济降温，其数据显示目前以色列的失业率为3.2%。严格的劳动法让企业只能雇用临时工来替代服兵役的员工，而这不是什么有吸引力的选项。投资者担心资本会从以色列的“硅溪”涌回美国加州的“硅谷”。据创业国度估计，该国有70%的科技公司都在苦苦支撑。风险在于，战争结束时，供人们回来就业的岗位会减少。

政策制定者面临的第二个挑战是居民消费的崩溃。事态不确定以及对反复袭击的忧惧让人们改变了消费习惯，选择待在家中。近三周以来餐馆和购物中心空空荡荡，即便有员工可继续营业也没了顾客。旅游业是以色列在科技业之外的另一个主要产业，现在已迅速停摆。与加沙和黎巴嫩交界地带的城镇被整体清空，经济活动戛然而止。为支持商家，因战事遭受损失的企业（最大的企业除外）都将获得类似疫情时的补助以支付固定成本。增值税的缴纳也已延期。以前在如今被视为不安全地区工作的工人将获得救济金。

这给以色列的政策制定者带来了最后的挑战：管理战事的财政成本。救助企业、支付预备役军人的工资以及把整个村庄的居民迁入酒店将要付出成本。要在今年为地面进攻提供资金并在明年为以色列储备足够的武器以确保安全，将必须巨幅增加国防开支。

以色列现在的债务约占GDP的60%，对像它这样的富裕国家而言，这个比例不算高。即使战争持续到今年年底，这一比例预计也不过上升至62%。以色列央行拥有1700亿美元的充足外汇储备。而且美国也会提供帮助，前提是总统拜登的140亿美元军事援助计划能获国会批准。然而冲突持续时间越长，风险就越大。据预测，2024年以色列的基本赤字占GDP比例将从3%跃升至8%。在哈马斯发动袭击之前，以色列的经济就已经岌岌可危，经过今年前八个月的艰难日子，9月的政府收入下降了8%。如今借贷成本在上升，税基在崩溃。战事拉长将意味着更多破坏，而重建的成本不会便宜。

以色列政府不会永远应付得了这庞大开支，这也是该国一批政客坚持认为应立即对加沙发动地面进攻的原因之一。尽管在接下来的几个月里居民和企业将获得慷慨的财政支持，但战事正导致以色列经济的劳动力、资本和专业技能快速流失，无法及时补充。过去，其他经济体为求军事胜利可能经受了更大得多的破坏，但对这一次以色列被迫承受代价的人来说，这并没有什么安慰作用。 ■



Free exchange

Israel's war economy is working—for the time being

The longer the conflict lasts, the greater the pressure

LESS THAN three weeks since Hamas plunged Israel into war, conflict is taking a toll on the country's economy. The shekel has sunk to its lowest level against the dollar in more than a decade, prompting Israel's central bank to sell \$30bn of foreign-exchange reserves to prop up the currency. The price of insuring the country's debt against default has rocketed. Firms from builders to restaurants have shut. On October 19th the finance ministry outlined plans to ramp up defence spending and provide for those pushed out of work. Four days later the central bank cut its growth forecast for the year from 3% to 2.3%.

Since war is not just fought by military forces, but also by economic ones, an important question hovers over all this activity. Can Israel withstand the economic pain? The country's clashes with Hamas since withdrawing from Gaza in 2005 do not provide much of a guide. In each case billions of shekels—a mere fraction of GDP—were spent on the military and repairs. The conflicts did not pose a threat to the country's economy, which has long had one of the highest incomes per person in the Middle East.

The scale of Hamas's attacks on October 7th, and the likely ensuing conflict, is therefore pushing economists to the history books. In 1973 the cost of weapons and drafting 200,000 army reservists for the Yom Kippur war brought Israel to the brink of financial collapse. The country's central bank reckons that, in 2002, a single year of intifada (Palestinian uprisings that ran intermittently from the late 1980s to the 2000s) cost 3.8% of GDP.

To dodge disaster, Israeli officials must face up to three challenges. The first

is employment. There are not enough workers to support both the economy and the war. Since October 7th the armed forces have mobilised more than 360,000 reservists, or 8% of the country's workforce—a bigger call-up than in 1973. Most have left jobs, producing an enormous hole in the economy. Worse, the recruits are some of Israel's most productive workers. Start-Up Nation, an Israeli charity, reckons that a tenth of tech workers have been called up. Workers in the industry are a quarter more productive than the average in the OECD club of mostly rich countries. By contrast, those in the rest of the economy are two-fifths less productive. Just a handful of reservists are from ultra-Orthodox communities in which employment is shunned.

There is another source of labour shortages. Many of Israel's low-skilled jobs are done by Palestinians from the West Bank, some 200,000 of whom work in either Israel or its settlements. But unrest in the West Bank means that many workers are not being allowed across the border, and they may begin to strike. During part of the second Palestinian intifada, which lasted from 2000 to 2005, missing Palestinian workers were one of the biggest brakes on Israeli growth, according to the IMF.

Moreover, there are few workers with which to replace reservists and Palestinians, since Israel's labour market is ultra-tight. According to the central bank, which has spent the past few months raising interest rates to cool the economy, unemployment is at 3.2%. Strict labour laws mean that firms can only hire temporary replacements for those on military duty—not an attractive option. Investors worry about capital flooding away from "Silicon Wadi" and back to its Californian namesake. Start-Up Nation reckons that 70% of tech firms are struggling to function. The risk is that, when the war finishes, there will be fewer jobs to which to return.

A second challenge for policymakers is the collapse of private consumption. Amid uncertainty and fear of repeat attacks, people have changed their

consumption habits by staying at home. For nearly three weeks, restaurants and shopping malls have been empty. Those with the workers to open have discovered there are few customers. Tourism, Israel's main business aside from tech, has screeched to a halt. Entire towns along the border with Gaza and Lebanon have been cleared out, putting a stop to economic activity. In order to support firms, all but the biggest businesses that suffer because of the war will receive covid-style grants to cover fixed costs. VAT payments have been deferred. Workers who used to toil in areas now deemed unsafe will get handouts.

That brings the final challenge for Israeli policymakers: managing the fiscal costs of conflict. Rescuing businesses, paying reservists and housing the population of entire villages in hotels will take its toll. An enormous increase in defence spending will be required in order to finance a ground invasion this year, and stock Israel with enough weapons to feel secure next year.

Israel's debt is currently at around 60% of GDP, a modest ratio for somewhere so rich. Even assuming that the war continues to the end of the year, it is forecast to rise to a mere 62%. The central bank has a healthy \$170bn of foreign-exchange reserves. On top of this, America will help, assuming that President Joe Biden is able to unlock the \$14bn he is asking for in military aid from Congress. Yet the longer the conflict continues, the more risks will grow. In 2024 Israel's primary deficit is forecast to jump from 3% of GDP to 8%. The country's economy had been on the rocks before Hamas's attack. The government's revenues were down by 8% in September, after a tough first eight months of the year. Now the cost of borrowing is rising and the tax base is crumbling. A longer war will mean more destruction, and reconstruction will not come cheap.

The government will not be able to pay its way for ever, which is one reason why a chorus of local politicians insists that a ground invasion of Gaza

ought to proceed straight away. Although, in the next few months, households and firms will receive generous financial support, conflict is draining labour, capital and expertise from Israel's economy faster than it can be replaced. Other economies may have withstood far greater damage in pursuit of military victories in the past, but that will be little consolation to those forced to bear the costs in Israel this time around. ■



嗜睡

人为什么要睡觉？以及其他关于睡眠的未解之谜

新书《黑暗地图》探究活跃的睡眠研究领域【《黑暗地图》书评】

《黑暗地图》，肯尼斯·米勒著。阿歇特出版社；432页；32.50美元。
Oneworld出版社；18.99英镑。

这件事鸟儿会做。蜜蜂会做。人也会做，尽管往往做得不如所愿。猫头鹰在白天也做。即使是秀丽隐杆线虫——由几千个细胞组成的原始蛔虫——也做一种看起来极相像的事。这就是睡觉，一种古老而普遍的经验。

但是，在某种程度上正是因为睡眠太过司空见惯了，很长一段时间里科学家都没有察觉到这个课题。只是在过去约半个世纪里，它才引起了研究者的潜心钻研。科学记者肯尼斯·米勒（Kenneth Miller）的新书记录了这个领域短暂但迷人的历史。

本书围绕四位科学家的人生与辛勤工作展开。该领域的奠基人是纳撒尼尔·克莱特曼（Nathaniel Kleitman），他的影响最为深远。他是犹太人，出生于现在的摩尔多瓦，1915年为躲避俄国人的大屠杀而移居美国，之后在芝加哥大学设立了开创性的睡眠研究项目。

本书的开头部分最为单薄，因为还没有什么成熟的科学研究可以讲述。大量篇幅花在了人物生平细节和对克莱特曼经历的描述上。但故事很快就加快了节奏。从发现快速眼动期和昼夜节律（支配人类日夜的生物钟），讲到睡眠剥夺的影响（至少对实验动物可能是致命的）。它还探究了做梦的目的（如果有的话）。

在这一切的背后，读者可以感受到心理学作为一门科学的缓慢成熟。脑电图仪等监测脑电活动的新技术让研究人员可以直接研究大脑，而不是试图通过大脑主人的行为来推断大脑的活动。

米勒善于发现精彩的科学故事。克莱特曼最著名的实验之一就是在一个黑暗的洞穴里待了32天，试图揭示人体内的昼夜节律时钟的极限。作者乐此不疲地展示研究工作的真实过程，包括各种令人难堪的细节。

其中一节描述了在巴伐利亚的村庄一个专门建造的实验设施里进行的更现代、更定量的昼夜节律研究。这个实验室有两套公寓，没有窗户，也没有时钟，里面的人无法获知外界状况。受试者在那里住了几个星期，可以随时醒来或睡下，但始终插着直肠温度计，长长的电线将这些温度计连接到墙上的插座。

书里也有严肃的一面。倒班工作会干扰人体的内部时钟，增加患上心脏病和糖尿病等疾病的风险。米勒解释了医学界如何缓慢认识到睡眠呼吸暂停这种常见疾病及其可能造成的伤害。它是由睡眠中气道反复塌陷造成的。患者每晚都要忍受数百次缺氧（当身体本能反射迫使睡眠者拼命呼吸空气时，就会出现特有的喘息和鼾声）。

如果不及时治疗，睡眠呼吸暂停会让人疲惫不堪，甚至更糟。米勒讲述了一对兄妹的病例，他们都患有睡眠呼吸暂停。哥哥最终通过在喉咙上开一个小孔而被治愈，但多年的夜间缺氧对妹妹造成了不可逆的脑损伤。

科学发现往往又会引发新的问题。这就是为什么科学类书籍鲜有干净利落的结尾，这本书也不例外。尽管过去50年来取得了长足进步，但科学家仍不清楚睡眠到底有何用。睡眠如此普遍，表明它极为重要。但是，为什么进化要让动物必须花费大量时间失去知觉、无法对威胁做出反应——这仍然是研究人员试图解开的谜题。不过，对于任何有兴趣提出正确的问题的人，米勒的书都是一个很好的起点。 ■



Sleepy heads

Why do people sleep? And other unanswered questions

A new book, “Mapping the Darkness”, explores the active world of sleep research

Mapping the Darkness. By Kenneth Miller. Hachette Books; 432 pages; \$32.50. Oneworld Publications; £18.99

BIRDS DO IT. Bees do it. People do it, though often less than they would like to. Owls do it in the daytime. Even *Caenorhabditis elegans*, a primitive roundworm made up of a few thousand cells, does something that looks an awful lot like it. Sleep is an ancient, universal experience.

But partly because it is so commonplace, for a long time sleep was a subject that scientists had not woken up to. It is only in the past half-century or so that it has attracted the attention of dedicated researchers. A new book from Kenneth Miller, a science journalist, sets out to chronicle the field's short but fascinating history.

The book is organised around the life and hard work of four scientists. The patriarch of the field is Nathaniel Kleitman, whose presence looms largest. A Jewish man born in what is now Moldova, he emigrated to America in 1915, escaping Russian pogroms before setting up a pioneering sleep-research programme at the University of Chicago.

The early pages of the book, before there is much in the way of established science to describe, are the weakest. A good deal of time is spent on biographical details and pen portraits of the world through which Kleitman moved. But the story soon picks up. It roams from the discovery of rapid-eye-movement (REM) sleep and circadian rhythms—the biological clocks that govern humanity's days—to the effects of sleep deprivation (which can be fatal, at least in lab animals). It also probes the purpose, if any, of dreams.

Underlying it all is a sense of psychology's slow maturing as a science. New technologies such as electroencephalographs, which monitor electrical activity in the brain, have offered practitioners the ability to study brains directly, rather than trying to infer what they are doing from the behaviour of their owners.

Mr Miller has a good eye for a great scientific story. One of Kleitman's best-known experiments involved spending 32 days in a dark cave as he worked to shed light on the limits of the body's inbuilt circadian clock. The author is happy to show research as it is really done, indignities and all.

One section describes a more modern, quantitative sort of circadian-rhythm research that took place in a purpose-built facility in a Bavarian village. The lab sported two apartments, with no window or clocks to clue their occupants into what was happening outside. Test subjects lived there for weeks, free to wake and doze whenever they liked—but never free from the rectal thermometers that were attached to wall sockets by long cables.

There is a serious side, too. Shift work interferes with the body's internal clocks and raises the risk of illness, including heart disease and diabetes. Mr Miller explains medicine's slow recognition of sleep apnea, a common affliction, and the damage it can inflict. It is caused by the airway repeatedly collapsing during sleep. Sufferers endure hundreds of episodes of oxygen deprivation every night (the characteristic gasping and snorting comes when a bodily reflex forces sleepers to take a desperate breath of air).

If left untreated, sleep apnea can lead to crippling exhaustion or worse. Mr Miller relates the case of a brother and sister who both suffered from the condition. The brother was eventually cured by having a small hole cut in his throat, but years of oxygen deprivation at night had caused irreversible brain damage in his sister.

Discoveries often lead to new questions in turn. That is why neat, tidy endings are hard to achieve in science books; this one is no different. Despite all the progress of the past 50 years, scientists are still unsure what sleep is for. The fact it is so widespread suggests it is vital. But why evolution would see fit to produce animals that must spend large amounts of their time insensate and unable to respond to threats is still a mystery researchers are trying to solve. For anyone curious about asking the right questions, however, Mr Miller's book is a good place to start. ■



加密货币的未来

币安会转向光明面吗？

FTX垮台后，赵长鹏必须决定是否接受配合监管

“加密货币界的卢克·天行者和达斯·维达。”据信迈克尔·刘易斯（Michael Lewis）在新作《走向无限》（Going Infinite）中这样形容山姆·班克曼-弗里德（Sam Bankman-Fried）和赵长鹏（见上图）之间的激烈对抗。班克曼-弗里德是已破产的加密货币交易所FTX的创始人，刘易斯这本书以他为主角，记叙了他的成败起落；赵长鹏是其对手公司币安（Binance）的掌门人。

在班克曼-弗里德的交易所因资产负债表出现80亿美元的窟窿而倒闭之前，这个比喻看起来很贴切。这两人掌控着全球最大的两家加密货币交易所。他们均以名字首字母缩写广为人知：“SBF”和“CZ”。SBF年轻有才，看上去认同要与监管机构友好相处，有点少年得志的味道。而CZ好像是他暗淡的陪衬物。为免受辖区国家法律的约束，CZ的交易所“无处可寻”。币安一直被美国司法部门调查，怀疑它存在洗钱和违反刑事制裁的行为。CZ曾投资FTX，后来两人反目成仇。SBF公开指责CZ的法律问题，而CZ发布的一条推文很可能推动触发了FTX被挤提。

现在，随着FTX退出舞台，SBF被控多项欺诈行为（他拒不认罪）而受审，CZ似乎成为了加密货币界的终极悍将。币安完全称霸加密货币交易（见图表）。按交易量计算，多达40%至50%的交易都是在该平台上进行的。10月11日，CZ在巴林接受本刊采访时谈到，现在的首要问题是币安将如何演变。

自加密货币交易所诞生以来，现有金融法规一直对它们不太适用。从被交易的资产的性质来看，它们实际上是交易所、券商和结算公司的混合体。如果说加密货币交易所在很大程度上不受监管，至少部分原因是政府少有专门的立法来监管它们。

但是，在FTX崩塌后，情况开始改变。世界各地的立法机构和监管机构纷纷针对该行业制定新法律或开展打击行动。这对加密货币交易所有两大影响。首先，监管机构希望确保这些交易所不会像FTX那样不当处理或挪用客户资金。其次，他们想确保交易所不会助长金融犯罪。

CZ坚称客户可以信任其交易所。他说，币安的架构与FTX“有太多不同之处”。该公司满足过客户大量赎回的要求，包括在强烈波动的市场上。他指出，美国的金融监管机构证券交易委员会（SEC）花了很长时间调查币安是否存在此类不当行为。但SEC拿不出“任何证据”证明币安有混用用户资金，CZ说，“这实际上帮助证明了我们的清白”。SEC对币安的其他指控（包括未经许可发行证券）尚待法庭审理。

然而对币安而言，第二项要求可能更加棘手。12月，路透社报道称，美国司法部的检察官在是否起诉该公司洗钱或违反制裁的问题上存在分歧。另一家新闻机构彭博社称，币安于2021年撤回在它当时总部所在地新加坡申请运营交易所牌照，一定程度上是因为该公司无法遵守严格的反洗钱规定。SEC引用了币安一名前雇员提供的证据，他承认币安自认是“无牌证券交易所”，而且“永远不想被监管”。

CZ驳斥这不过是“一名前员工的私下言论”，并称这“远非事实”。他指出，币安是“全球牌照获取最全的加密币交易所”，被获准在亚洲、欧洲和中东的18个国家开展业务（其美国分公司在44个州开展业务）。现在，币安似乎在努力向各地当局卖乖。其发言人证实，近日，为遵守国际制裁法，币安冻结了“少量为支持哈马斯而募捐的账户”。

该公司如今面临的考验在欧洲。美国正在打击加密货币，短期内不大会通过新法律。相比之下，欧洲立法机构已制定了名为《加密资产市场监管法案》（MiCA）的法律框架，已于今年6月生效。加密币交易所可在现有许可牌照下继续运营到2026年，除非按该法案的要求被喊停——该框架要求交易所有严格的反洗钱和反恐怖主义融资政策。CZ说，除了这些政策外，要获得全面牌照还意味着当局会考察“你的钱包基础架构、安全性、客户支持政策、退款政策。它们会全面考察你的整个业务”。

加密货币交易所不能再辩称自己之所以不合规是因为没有相关政府法规可遵循。如果不能符合欧洲的标准，那就显示币安是不愿或无法遵守明确的法律。在《星球大战》中，尤达警告卢克·天行者，转向黑暗面更容易积累或运用力量。在光明面运营会更为困难。 ■



Crypto's future

Will Binance come over to the light side?

With FTX crushed, CZ must decide whether to go along with regulation

“THE LUKE SKYWALKER and the Darth Vader of crypto.” That is how Michael Lewis, author of “Going Infinite”, a recent book about the rise and fall of Sam Bankman-Fried, founder of FTX, a now-bankrupt crypto exchange, is supposed to have described the intense rivalry between his subject and Changpeng Zhao (pictured), the boss of Binance, a rival firm.

Until Mr Bankman-Fried’s exchange collapsed with an \$8bn hole in its balance-sheet, the analogy seemed apt. The two men controlled the two largest crypto exchanges in the world. Both were known by acronyms: “SBF” and “CZ”. Young, talented and seemingly in favour of playing nice with regulators, SBF was something of a wunderkind, and CZ was his shadowy foil. Keen to avoid being pinned down by national laws, his exchange was based “nowhere”. Binance had long been under investigation for possible money-laundering and criminal-sanctions violations by America’s justice department. CZ had invested in FTX before the two turned on each other. Then SBF publicly goaded CZ about his legal problems, and a tweet by CZ probably helped set off the run on FTX.

Now, with FTX out of the picture and SBF on trial, charged with various kinds of fraud, which he denies, CZ looks a lot like the last man standing in crypto. Binance utterly dominates crypto trading (see chart). A whopping 40-50% of it by volume takes place on the platform. The big question, which CZ discussed in an interview with *The Economist* in Bahrain on October 11th, is how Binance will now evolve.

For as long as crypto exchanges have existed, financial laws have been ill-

suited to them. Given the nature of the assets that are traded, they are in effect hybrids of exchanges, brokers and settlement firms. If crypto exchanges were largely unregulated that was at least partly because few laws had been written to govern them.

But, in the wake of FTX's collapse, the situation is starting to change. Legislators and regulators around the world are rushing to pen new laws or crack down on the industry. This has two big implications for exchanges. First, regulators want to make sure that they are not mishandling or improperly using customer funds, as FTX did. Second, they want to ensure that exchanges are not facilitating financial crimes.

CZ insists that customers can trust his exchange. "There are so many ways" Binance is structured differently to FTX, he says. The firm has met heavy redemption requests from clients, including in choppy markets. He points out that the Securities and Exchange Commission (SEC), America's financial regulator, spent a long time investigating Binance for this kind of misconduct. The regulator could provide "zero evidence" that Binance was commingling user funds, says CZ, "which actually helps us to prove that we don't do it." Other complaints by the SEC, including that the company issued securities without a licence, are still to be heard in court.

Yet it is the second requirement that might turn out to be trickier for Binance. In December Reuters, a news service, reported that prosecutors at America's justice department were split on whether or not to charge the firm with money-laundering or sanctions violations. According to Bloomberg, another news service, Binance withdrew its application to become a licensed exchange in Singapore in 2021, where it was based at the time, in part owing to its inability to comply with strict anti-money laundering rules. The SEC quotes evidence from a former employee, who admitted that the company thought it was an "unlicensed securities exchange" and "did not want to be regulated, ever".

CZ dismisses this as “private chat by an ex-employee”, and adds it “was not the right thing by far”. He notes that Binance is “the most licensed crypto firm in the world”, with permission to operate in 18 countries across Asia, Europe and the Middle East (its American arm operates in 44 states). Binance now appears to be playing nice with various authorities. A spokesperson confirms that in recent days it has frozen “the small number of accounts” soliciting donations in support of Hamas, to comply with international sanctions laws.

The test for the firm now will be in Europe. America is cracking down on crypto, and is unlikely to pass new laws soon. By contrast, European legislators have written a “Markets in Crypto-Assets” or “MiCA” framework, which entered into force in June. Exchanges can keep operating under existing licences until 2026, unless refused under MiCA, which will require strong policies against money-laundering and terrorist financing. CZ says that, in addition to such policies, a full licence means that authorities look at “your wallet infrastructure, your security, your customer support policies, your refund policy. They look at your whole business.”

A crypto exchange can no longer argue that it cannot comply with national rules because they do not exist. Failing to meet Europe’s standards would reveal that Binance does not want, or is unable, to follow even clear laws. In “Star Wars”, Yoda warns Luke Skywalker that it is easier to amass or wield power by turning to the Dark Side. It is harder to operate in the light. ■



未来水世界

图瓦卢为本国消失做准备

一个沉没的国家还是国家吗？

三十多年来，太平洋岛国图瓦卢（Tuvalu）一直恳请工业化国家减少温室气体排放。三十多年来，全球气温一直在上升。图瓦卢政府警告称，到本世纪末，该国国土可能会被水淹没。“这是一个从地球表面消失的问题。”该国总理纳塔诺9月表示。所以现在图瓦卢提出了另一个问题：如果这种情况发生，该国如何继续存在？

纳塔诺政府已经修改了宪法，坚称该国将“永久”存在，即使国土不复存在。修改后的宪法于10月1日生效，新的措辞本身并不会带来太多改变。根据国际法，一个国家必须有实体领土和永久居民。但没有人考虑过气候变化导致一国丧失这些特质后的场景，律师巴尔·卡马（Bal Kama）说。卡马为图瓦卢修宪提供了建议。图瓦卢希望其他受气候变化威胁的国家能效仿它的做法，这样国际法就有可能改变。

图瓦卢政府谈到把该国变为一个“数字国家”，这样即使国民分散到其他国家，也能在线上为其提供服务、保留文化传统。它考虑为其岛屿生成一个3D场景，网络用户可以在其中漫步。所有这些计划带来了更多问题而非答案。

图瓦卢政府特别想要明确的是，它预期保留对如今图瓦卢周边海域的权利。算上距其海岸线200海里（370公里）以内的“专属经济区”，太平洋岛国有权捕鱼和采矿的海域比非洲还大（见地图）。领导人担心如果领土中的某些或全部岛屿消失，他们会失去这些权利，还有价值数十亿美元的金枪鱼业。

所以图瓦卢的修宪申明它的海洋边界会与它的国家地位一起继续存在。图瓦卢政府想要邻国接受它的专属经济区会永远存在。其他太平洋岛国也绘制了它们的海洋区域，并立法声明海平面上升不会影响它们的专属经济

区。图瓦卢会不会被淹没尚不确定，但该国政府正在准备救生筏。■



Waterworlds

Tuvalu plans for its own disappearance

Is a country still a country if it sinks?

FOR OVER three decades the Pacific island country of Tuvalu has implored industrialised countries to cut their greenhouse-gas emissions. For over three decades global temperatures have ticked up. Tuvalu's government warns that its territory could slip underwater by the end of the century. "It's a matter of disappearing from the surface of this Earth," Kausea Natano, the prime minister, said in September. So Tuvalu is now asking a different question: how can it continue existing if that happens?

Mr Natano's government has amended the constitution to assert that the country will exist "in perpetuity" even if its landmass does not. The new wording, which came into effect on October 1st, will not on its own change very much. Under international law, a country must have a physical territory and permanent population. But no one has considered what happens if climate change strips a state of those qualities, says Bal Kama, a lawyer who advised the government on its constitutional changes. Tuvalu hopes that if other vulnerable countries follow its lead, international law could change.

The government talks about turning Tuvalu into a "digital nation" that could provide services and preserve cultural traditions online even were its people dispersed to other countries. It speculates about creating a 3D version of its islands that web users could ramble around. All these plans raise more questions than answers.

The government is especially keen to make explicit that it would expect to retain its claim on the waters surrounding present-day Tuvalu. Combine the

“exclusive economic zones” (EEZs) that stretch 200 nautical miles (370km) from their coasts, and Pacific island countries have rights to fish and mine an area of ocean bigger than Africa (see map). Leaders fear that they will lose those rights—and a tuna industry worth billions—if any or all of the islands that make up their territories disappear.

So Tuvalu’s constitutional change states that its maritime boundaries would endure with its statehood. The government wants neighbours to accept that its EEZ will exist forever. Other Pacific governments have also mapped their maritime zones and passed laws asserting that rising sea levels will not affect their EEZs. It is not yet certain that Tuvalu will go under. But its government is readying the rafts. ■



换鞋底

年轻消费者为什么爱勃肯鞋

古老的德国凉鞋制造商上市了

在大热影片《芭比》里，勃肯鞋不仅仅是一双鞋。它是不由女孩掌控的现实世界的象征。它被强调为一种单调乏味的款式，与芭比精致完美的细高跟鞋形成对比。在影片的结尾，这位金发女主角穿上这款软木凉鞋——那标志性的双绑带是芭比粉色的——走进了新生活，她不再是一个洋娃娃，而是一个准备好全力以赴施展所长的女人。

把高跟鞋换成波状鞋底的平底鞋的不止芭比。现实生活中的年轻人也是如此。勃肯鞋的营收在过去三年里翻了一番，达到14亿美元。去年它近一半的销售额是拜二三十岁的买家所赐。这在一定程度上要归功于巧妙的产品植入——社交媒体上对勃肯鞋的提及在7月《芭比》首映前后达到了创纪录的高点。疫情后全面追求休闲和舒适的时尚是一个很大的因素，尤其是在千禧一代和Z世代中。这推动了其他笨笨丑丑的休闲时尚鞋的销售，比如毛茸茸的UGG靴子或Croc洞洞鞋。

小年轻们觉得酷的东西在一些投资者眼中就是热门。10月10日，勃肯鞋在纽约证券交易所完成IPO，融资15亿美元，公司估值约为90亿美元。

尽管勃肯鞋跟漂亮沾不上边——上世纪80年代，德国孩子们被迫穿着勃肯鞋上学，哀叹它们的丑陋——但勃肯鞋的制造商已经成功地把自己变成了一个令人向往的品牌。它与法国奢侈品巨头路威酩轩集团（LVMH）旗下的高级时装品牌迪奥合作，推出售价1100美元的联名款。由LVMH支持的私募股权公司L Catterton在2021年收购了勃肯鞋的多数股权，这可能有所帮助。LVMH老板伯纳德·阿尔诺（Bernard Arnault）的家族控股公司曾表示会在IPO中购买总价值高达3.25亿美元的勃肯鞋股票，并提名阿尔诺的一个儿子进入公司董事会。

也许是受奢侈品投资方的影响，勃肯尚无扩大产能的计划；自1774年约翰·

亚当·勃肯斯托克 (Johann Adam Birkenstock) 开始做鞋以来，该公司一直坚持几乎全部生产都在德国进行（只有部分软木底在葡萄牙生产）。通过限制产量来制造稀缺性，是兜售专享权的高端品牌一个历史悠久的策略。它们那些穿着高定服装的客户往往对价格上涨不敏感。

过去几年里，勃肯鞋成功地把价格推高了一些，但其收入的增长也来自出货量的增加。目前还不清楚在不吓跑顾客的情况下，它能把这些凉鞋的价格提高到多少。投资者已经在小心迈步了。其股价在上市首日下跌了 13%。 ■



Selling your sole

Why young consumers love Birkenstocks

The ancient German sandal-maker goes public

IN THE BLOCKBUSTER “Barbie” film, the Birkenstock is more than a shoe. It is a symbol of the real world not run by girls. It is introduced as a deliberately drab antithesis of Barbie’s perfect stiletto. By the film’s end the titular blonde is wearing the cork sandal—with the hallmark double-strap in her signature pink—as she walks into her new life, no longer a doll but a woman ready to put her best foot forward.

Barbie is not the only one swapping heels for contoured soles. So are real-life youngsters. Birkenstock’s revenues have doubled in the past three years, to \$1.4bn. Almost half of last year’s sales came courtesy of buyers in their 20s and 30s. Some of that is down to clever product placement—social-media mentions of Birkenstocks reached a record high in July around the time of the “Barbie” premiere. A lot more has to do with a post-pandemic fashion for all things casual and comfortable, especially among Millennials and Gen-Zs, which has boosted sales of other ungainly casual-chic footwear, such as furry Ugg boots or Croc sandals.

What is cool with the kids proved hot with some investors. On October 10th Birkenstock raised \$1.5bn in an initial public offering (IPO) on the New York Stock Exchange, valuing the firm at around \$9bn.

Although Birkenstocks are far from beautiful—German children forced to wear them to school in the 1980s bemoaned their ugliness—their maker has managed to turn itself into an aspirational brand. It has collaborated with Dior, a high-fashion brand controlled by LVMH, a French luxury behemoth, to make \$1,100 mules. It probably helped that L Catterton, a private-equity

firm which bought a majority stake in 2021, is backed by LVMH. The family holding company of LVMH's boss, Bernard Arnault, said it would buy up to \$325m-worth of Birkenstock shares in the IPO and nominate one of Mr Arnault's sons to its board.

Perhaps owing to the influence of its luxury backers, Birkenstock has no plans to increase production capacity; ever since Johann Adam Birkenstock started making shoes in 1774, the company has insisted on maintaining almost all its production in Germany (only some of the cork soles are made in Portugal). Engineering scarcity by limiting output is a time-honoured strategy for high-end brands that peddle exclusivity. Their couture-pocketed customers tend to be insensitive to price rises.

Birkenstock has managed to push up prices a bit in the past few years, but revenue growth also came from increased shipments. It is unclear how much more expensive it can make its sandals without putting off its customers. Investors are already watching their step. Its share price slipped by 13% on its first day of trading. ■



戈尔丁金曲

克劳迪娅·戈尔丁获得诺贝尔经济学奖

她的研究推翻了有关性别平等的假设

十月九日上午，美国国家经济研究局（National Bureau of Economic Research）向全世界的经济学家发表了一篇工作论文，题为《为什么女性赢得了权利》（Why Women Won）。在这篇论文中，哈佛大学的克劳迪娅·戈尔丁（Claudia Goldin）论述了美国女性如何在职场和家庭中获取了平等权利。非常应景的是，几个小时后，就传来了戈尔丁获得本年度诺贝尔经济学奖的消息，获奖理由是增进了“我们对女性劳动力市场结果的理解”。

戈尔丁是第一个获得哈佛经济系终身教职的女性，现在她又是第三位获得诺贝尔经济学奖的女性。总的看来，她的研究全面展现了过去两百年劳动力市场上性别不平等的历史。在讲述这一历史时，她推翻了两方面的假设：历史上的性别关系，以及在今天争取更多平等需要做什么。

在戈尔丁之前，经济学家曾认为经济发展带来了更平等的环境。实际上，戈尔丁的研究显示，工业革命把已婚女性赶出了劳动市场，因为生产从家庭转向了工厂。在于1990年发表的研究中，她展示了只有到了服务业岗位激增和高中教育得到发展的20世纪，我们更为熟悉的模式才开始出现。西方经济体的规模和女性劳动参与率之间的关系是一条U型曲线——这是戈尔丁的经典成果。

戈尔丁的研究还打碎了其他一些迷思。她的丈夫劳伦斯·卡茨（Lawrence Katz）也是她的同事，对她查阅档案资料填补女性就业历史数据空缺的能力惊叹不已。女性就业率等简单的统计数据并不准确，因为在调查中，女性可能会回答“我是家庭主妇”——戈尔丁指出——哪怕她们是在管理家族企业。如果加以修正就会有不同结果，比如已婚白人女性的就业率在1890年是12.5%，是之前认为的五倍。

她的发现还显示，性别工资差距的缩小是阵发性的。1820年至1850年，女性工资相对男性工资出现上升，然后1890年至1930年再次上升，到1980年至2005年间大幅上升。是什么推动了这些阵发性的上升？前两次远在同工同酬运动发起之前，是由劳动力市场的变化造成的：第一次是在工业革命期间；第二次是在办公室文员等白领就业激增的时期。

对于20世纪末出现的第三次也是最重要的一次上升，戈尔丁强调了预期的作用。如果一个年轻女性对于自己何时和是否生育子女有更多决定权，并且对女性有宽广的就业面更有信心，她就可能对未来投入更多，比如延长在校学习时间。戈尔丁和卡茨在2002年发表的研究详细阐述了避孕药的例子，避孕药于1960年被批准使用，让女性更能够掌控生育子女的决定。从1967年到1979年，20和21岁女性中预计自己在35岁仍然就业的比例从35%上升到80%。

预期对于雇主也很重要。尽管男女工资差距在1900年代初缩小，但因歧视而非工作类型导致的那部分差距却在扩大。戈尔丁说，一个重要因素是决定工资的方式。工作过去是和产出挂钩——比如编织了多少件衣服。但在工业化以后，越来越多的工人是领取定期工资，这在一定程度上是因为衡量一个人的产出变得更为困难了。因此更模糊的因素变得更为重要，比如推断一个工人会在岗位上做多久。这对女性不利，因为雇主预期她们会在生育子女后离职。

自2005年以来，男女工资的差距几乎没有变化。对此，戈尔丁的研究质疑了依旧责怪工资歧视的流行说法。在2021年出版的一本书中，她把问题归咎于“贪婪的”工作，例如咨询顾问或律师，在这些工作中，长时间（且不规律的）工作会得到更高回报。

她解释了这些工作与所谓的“育儿惩罚”之间的关系。“让我们假设有一对律师夫妇，两人同样有才华。”戈尔丁解释说。一旦有了孩子，“他们就认识到没法让两人都那么长时间地工作了”。女性花更多时间照料孩子，这是性别工资差距往往在第一个孩子出生后扩大的原因。父母两人可以都去做不那么辛苦耗时的工作，但这样一来家庭的总收入就会减少，她解释

说。

戈尔丁的研究为经济学家和政策制定者提供了启示。对于经济学家，这些研究显示了历史的重要性。戈尔丁的获奖是诺贝尔经济学奖在罗伯特·福格尔（Robert Fogel）于1993年获奖后首次颁给主要研究经济史的成果，福格尔曾是戈尔丁的导师。在戈尔丁的研究之前，很多学者认为历史性别工资差距的问题是无解的，因为相关数据太过稀缺。然而她一再证明，从历史档案中挖掘数据能让研究人员令人信服地回答那些之前被认为是他们无法解答的重大问题。

对于政策制定者来说，戈尔丁的研究证明性别不平等的解决方法因时因地而异。在20世纪初的美国，公司禁止雇用或留用已婚女性。《1964年民权法案》（Civil Rights Act of 1964）禁止了这种做法，给出了政策上的应对。今天性别工资差距依然存在是因为“贪婪的工作”和育儿常规，而不是简单的雇主歧视。在过去，戈尔丁曾提出更灵活的工作安排可能是解决这一问题的一个办法。也许，探明如何实现这种灵活度会是她的下一幕精彩演出。■



Golden Goldin

Claudia Goldin wins the Nobel prize in economics

Her work has overturned assumptions about gender equality

ON THE MORNING of October 9th the National Bureau of Economic Research circulated a working paper to economists around the world entitled “Why Women Won”. In the paper, Claudia Goldin of Harvard University documents how women achieved equal rights in American workplaces and families. Rather fittingly, a few hours later, Ms Goldin was announced as the winner of this year’s economics Nobel prize, for advancing “our understanding of women’s labour-market outcomes”.

Having been the first woman to be granted tenure at Harvard’s economics department, Ms Goldin is now the third woman to have won the subject’s Nobel prize. Taken together, her research provides a comprehensive history of gender labour-market inequality over the past 200 years. In telling this history, she has overturned assumptions about both historical gender relations and what is required to achieve greater equality in the present day.

Before Ms Goldin’s work, economists had thought that economic growth led to a more level playing field. In fact, Ms Goldin showed, the Industrial Revolution drove married women out of the labour force, as production moved from home to factory. In research published in 1990 she demonstrated that it was only in the 20th century, when service-sector jobs proliferated and high-school education developed, that the more familiar pattern emerged. The relationship between the size of Western economies and female-labour-force participation is U-shaped—a classic Goldin result.

Ms Goldin’s research has busted other myths, too. Lawrence Katz, her colleague and husband, marvels at her ability to trawl archives to fill gaps in

the historical data on women's work. Simple statistics, such as the female employment rate, were mismeasured because when surveyed, women might respond "I'm a housewife", notes Ms Goldin, even if they managed the family business. Once corrected, the employment rate for white married women, for example, was 12.5% in 1890—five times greater than previously thought.

Her findings also showed that the gender wage gap narrowed in bursts. Women's wages rose relative to men's in 1820-50 and then again in 1890-1930, before shooting up in 1980-2005 (see chart). What drove these bursts? The initial two came well before the equal-pay movement and were caused by changes in the labour market: first, during the Industrial Revolution; second, during a surge in white-collar employment for occupations like clerical work.

For the third and most substantial drop, in the late 20th century, Ms Goldin emphasises the role of expectations. If a young woman has more say over when and whether she will have a child, and more confidence that women can work in a wide range of jobs, she may invest more in the future, such as by staying in school for longer. In work published in 2002 Ms Goldin and Mr Katz detailed the example of the contraceptive pill, which was approved in 1960, and gave women more control over decisions about children. Between 1967 and 1979 the share of 20- and 21-year-old women who expected to be employed at 35 jumped from 35% to 80%.

Expectations also matter for employers. Although the pay gap narrowed in the early 1900s, the portion driven by discrimination, rather than job type, grew. An important factor, says Ms Goldin, was changes in how payment was decided. Wages used to be tied to output—how many clothes were knitted, for instance. But after industrialisation, workers were increasingly paid periodically, in part because measuring an individual's output became trickier. Therefore more ambiguous factors grew in importance, such as

ideas about how long a worker would stay on the job. This penalised women, who were expected to quit when they had children.

Since around 2005 the wage gap has hardly budged. Here Ms Goldin's work questions popular narratives that continue to blame wage discrimination. Instead, in a book published in 2021, Ms Goldin blames "greedy" jobs, such as being a consultant or lawyer, which offer increasing returns to long (and uncertain) hours.

She explains how such work interacts with the so-called parenthood penalty. "Let's say there are two lawyers, equally brilliant," explains Ms Goldin. Once children arrive, "they realise that they both can't work these gruelling hours." Women spend more time raising children, which is why the gender pay gap tends to open up after a first child. Both partners could take on less demanding jobs, but then the couple would earn less as a unit, she explains.

Ms Goldin's research holds lessons for economists and policymakers. For the former group, it shows the importance of history. Ms Goldin's prize is the first economics Nobel awarded for work largely in economic history since Robert Fogel, her former adviser, triumphed in 1993. Before Ms Goldin's research, many academics considered questions about historical gender pay gaps to be unanswerable because of a paucity of data. Yet she has repeatedly demonstrated that digging through historical archives allows researchers to credibly answer big questions previously thought beyond their reach.

For policymakers, Ms Goldin's research demonstrates that fixes for gender inequality vary depending on time and place. In early 20th-century America, companies barred married women from obtaining or retaining employment. A policy response came with the Civil Rights Act of 1964, which banned such behaviour. Today, wage gaps persist because of greedy

jobs and parental norms, rather than because of straightforward employer discrimination. In the past, Ms Goldin has suggested more flexibility in the workplace could be a solution to the problem. Perhaps working out how to achieve it will be her next act. ■



绿灯行

碳定价如何征服世界

目前它已覆盖了全球四分之一的碳排放，而且这一比例还在快速上升【深度】

要想限制全球变暖，世界必须尽快放弃化石燃料——这几乎是人类的共识。但困难之处在于如何做到。经济学家长期都支持欧洲在2005年推出的碳定价机制。给碳定价可以让市场找到减排成本最低的温室气体，从而让社会以最低的成本应对气候变化。包括不少美国政客在内的其他人则担心，这样的体系会因提高消费者成本而遭到抵制。在总统拜登的领导下，美国另辟蹊径，正拿出数千亿美元来打造绿色供应链。

然而，值得注意的是，随着碳定价在富国和穷国都得到推广，世界其他地区越发向欧洲看齐。以世界第九大排放国印尼为例，尽管印尼每年排放6.2亿吨二氧化碳当量，且它飙升的能源消耗几乎有一半来自煤炭，但该国仍不失环保雄心。9月26日，在印尼首个碳交易市场的启动仪式上，总统佐科大谈它作为碳交易中心的前景，多家本地银行也适时从一家地热能源公司争相购买碳信用额。今年2月，印尼还启动了一个碳排放交易机制，要求大型燃煤发电厂在排放超过阈值时必须购买碳排放许可。

简而言之，即使在那些更多以排放国而非环保先锋知名的国家，情况也在发生变化。到2023年初，碳定价覆盖了全球23%的温室气体排放，而2010年时这一比例仅为5%。随着更多国家开始认识到碳定价的好处，以及这类机制扩大覆盖面，未来几年碳定价的推广只会加速。根据国际货币基金组织的数据，目前已有49个国家建立了碳定价体系，另有23个国家正在考虑中。10月1日，欧盟推出了一项开创性的政策，名字很枯燥，叫“碳边境调节机制”（CBAM）。该机制规定，到2026年，将开始对欧盟所有进口商品征收碳排放费，这会让欧洲企业有强烈的动机去推动其全球供应商变得环保。

目前碳定价以三种路径传播。首先，各国政府正在打造新的碳市场以及开

征新的碳税。印尼就是一个范例。如果一切按计划进行，印尼的碳市场最终会与碳税协同起来。今年4月，日本启动了一个全国性的自愿碳补偿市场，该市场将与东京现有的地方性“总量管制与交易”政策并行。该市场的参与者——约占日本排放的40%——必须公布并设定排放目标。随着时间的推移，该体系将更加严格，能源行业碳排放配额的拍卖预计将于2033年开始。与此同时，越南正在打造碳排放交易体系，预计2028年上线。在该体系中，超过排放阈值的公司需要通过购买碳信用额来抵消排放。

其次，已经建立了碳市场的国家正在升级政策。今年9月，中国的国家气候战略中心宣布，它的碳排放交易体系（规模为全球最大）将从只关注燃煤发电厂的碳排放强度，转向同时关注它们的碳排放强度和总量。该体系还将与一个不活跃的碳信用市场打通，允许发电厂通过购买可再生能源、植树造林或红树林恢复等碳信用额来履行义务。澳大利亚在2014年废除了其原有的碳定价，改革了此前缺乏效力的名为“保障机制”的体系。从今年7月开始，占澳大利亚排放量28%的工业设施必须参照基准线，每年将排放量减少4.9%。未能达标的企业必须购买碳补偿，其交易价格约为每吨20美元。

碳市场扩大的最后一个路径是通过跨境体系。欧盟的方案显然最为先进。在CBAM的试行期，铝、水泥、电力、化肥、氢气、钢铁等的进口商将需要申报“隐含碳排放”，即生产和运输过程中产生的排放。之后，从2026年开始，进口商必须支付一笔税费，补足这些排放在欧盟机制中的碳成本与出口商在其国内市场支付的碳价格之间的差额。一些行业的免费排放许可也将被逐步取消，住房和交通运输行业也将被纳入碳市场。

这些机制中有很多尚需时日才能产生影响。亚洲的很多机制都很薄弱，无法带来实质性的变化，因为它们的碳价格定得太低——远低于欧盟目前约90欧元（95美元）的价格，而90欧元的价格也只是接近于气候经济学家估计的碳排放的社会成本。例如，中国碳排放交易体系所覆盖的燃煤发电厂中有一半因排放强度低于全国平均而面对负碳价，意味着它们在燃烧污染燃料时实际上得到了补贴，智库能源与清洁空气研究中心（Centre for Research on Energy and Clean Air）的劳里·米利维尔塔（Lauri

Myllyvirta) 表示。他指出，该机制也未能刺激从煤炭转向其他能源。

在世界范围内，环保活动人士批评一些公司利用碳补偿来尽情“漂绿”，假扮自己是环境友好企业。一些机制也难以证明自己确实促进了减排。去年，由澳大利亚国立大学的安德鲁·麦金托什 (Andrew Macintosh) 领导的一个专家小组认为，在澳大利亚的碳定价机制中，那些被用作碳信用的重新造林要么并没有实施，要么就是实施了也和购买碳信用来抵消排放并无关系。此后的一份独立审查报告对该机制的运作方式提出了改革建议。

然而，即便是有限的碳定价体系也有助于改变行事方式，原因很简单——它们鼓励对排放进行监控。中国的碳排放交易体系自两年前启动以来，弄虚作假屡见不鲜——据称有咨询公司帮助企业制作虚假煤样。今年早些时候，官员们宣布打击此类行为，他们现在对数据质量感到满意。尽管美国没有碳定价，但美国的公司同样有动力监控排放。总统拜登提出了一项规定，要求所有向联邦政府出售产品的企业必须公开碳排放量，并制定减排计划。许多大公司主动设定了净零排放目标，作为营销活动的一部分。全球最大的公司苹果就承诺，到2030年让自己的供应链完全实现碳中和。

现在，一个更有力的激励措施促使世界各地的工业企业精准追踪自己的碳足迹，那就是CBAM。欧盟的最终目标是解决“碳泄漏”问题。在CBAM推出之前，欧盟的碳价格意味着与那些脱碳计划不够雄心勃勃的非欧盟国家相比，欧盟内的行业面临着额外的成本。这变相鼓励了进口商从欧盟外部采购原料，即使这些原料排放更高。作为补偿，欧盟向工业生产商发放了排放许可。随着CBAM的逐步实施，这些许可将被逐步取消。

在试行期，CBAM对于向欧盟出口的出口商来说，只是增加了一个额外障碍（又称“非关税壁垒”）。要符合其要求，欧洲公司必须报告其进口产品的隐含碳排放量。如果没有这类数据，进口商必须使用欧盟提供的参考值。为了鼓励外国公司改变其行事方式并证明自己减少了排放，欧盟提供的参考值是基于欧盟内部污染最严重企业的排放量而制定的。

碳边境关税可能会开始在各处出现。澳大利亚政府不久前宣布对“碳泄漏”

发起审查，届时将考察碳边境关税方案的可行性。2021年，美国和欧盟暂停了一场由时任总统特朗普发起的贸易争端，就“全球可持续钢铝协议”展开谈判。美国希望能与欧盟这个贸易伙伴一道对高污染的钢铁生产商征收共同对外关税。由于美国没有国内碳定价，这样的政策将违反世贸组织的规则。但如果欧盟和美国不能达成协议，特朗普时代的关税和欧盟的报复性措施就会恢复。

碳定价会产生多米诺骨牌效应。一旦一个行业受制于碳定价，受影响的企业自然会希望其竞争对手也要面对同样的规则。因此，燃煤发电厂的老板会进行游说，以保证燃气发电厂在同样的条件下经营。商品出口国的政府也有动机确保本国企业在国内支付碳价格，而不是在国外支付碳关税。如果亚洲的工厂反正都要在CBAM等体系的推动下减少排放，那么其政府若不自己实施碳定价，就等于白白放弃了获取最大优势的机会。

问题是多米诺骨牌倒塌的速度够不够快。例如，几乎没有针对住宅或汽车排放的碳排放交易体系，因为这会让消费者直接感受到痛苦。在决定推出碳定价体系，以及随后的扩大覆盖面、加大力度的过程中，政策制定者得到了大多数经济学家的坚定支持——而且他们的推进速度比人们普遍意识到的要快得多。然而，如果未来的政策制定者想要把气候变化的影响降到最低，他们将别无选择，只能进一步加大这些措施的干预力度。要做到这一点，他们还必须赢得选民的支持。 ■



Green light

How carbon prices are taking over the world

A quarter of global emissions are now covered, and the share is rising fast

IF GLOBAL WARMING is to be limited, the world must forget fossil fuels as fast as possible—that much almost everyone agrees upon. How to do so is the complicated part. Economists have long favoured putting a price on carbon, a mechanism Europe introduced in 2005. Doing so allows the market to identify the cheapest unit of greenhouse gas to cut, and thus society to fight climate change at the lowest cost. Others, including many American politicians, worry that such schemes will provoke a backlash by raising consumer costs. Under President Joe Biden, America is instead doling out hundreds of billions of dollars to turn supply chains green.

Yet, remarkably, the rest of the world is beginning to look more European—with carbon prices spreading in countries both rich and poor. Take Indonesia, the world’s ninth-biggest polluter. Although it releases 620m tonnes of carbon-dioxide equivalent a year, with almost half its soaring energy consumption coming from coal, the country has green ambitions. On September 26th, at the launch of its first carbon market, Joko Widodo, the president, talked up its prospects as a hub for the carbon trade, and local banks duly snapped up credits from a geothermal-energy firm. The country also introduced an emissions-trading scheme in February, which requires large coal-fired plants to buy permits for emissions above a threshold.

In short, even in countries better known as polluters than green leaders, things are shifting. By the beginning of 2023, 23% of global emissions were covered by a carbon price, up from just 5% in 2010. The spread will only accelerate over the coming years as more countries come round to the

advantages of carbon pricing, and schemes expand their reach. According to the IMF, 49 countries have carbon-pricing schemes, and another 23 are considering them. On October 1st the EU launched a groundbreaking policy under a dreary name. The “carbon border adjustment mechanism” (CBAM) will, by 2026, start to levy a carbon price on all the bloc’s imports, meaning that European companies will have a strong incentive to push suppliers around the world to go green.

The spread of carbon prices is happening in three ways. First, governments are creating new markets and levies. Indonesia is one example. If all goes to plan, its market will eventually be combined with a carbon tax. In April Japan launched a voluntary national market for carbon offsets, which will work alongside an existing regional cap-and-trade policy in Tokyo. Participants, accounting for 40% or so of the country’s pollution, will have to disclose and set emissions targets. Over time the scheme will become stricter, with auctions of carbon allowances for the energy industry due to begin in 2033. Meanwhile, Vietnam is working on an emissions-trading scheme to be established in 2028, in which firms with emissions above a threshold will need to offset them by buying credits.

Second, countries that already have established markets are beefing up their policies. In September China’s National Climate Strategy Centre announced that its emissions-trading scheme, the largest in the world, will move from focusing only on the carbon intensity of coal power plants, to focusing on both their intensity and total emissions. The scheme will also be linked with a dormant carbon-credit market, allowing power plants to meet obligations by purchasing credits for renewable power, planting forests or restoring mangroves. Australia, which scrapped its original carbon price in 2014, has reformed a previously toothless scheme known as the “safeguard mechanism”. Since July industrial facilities that account for 28% of the country’s emissions have had to reduce them by 4.9% a year against a baseline. Those that fail must buy offsets, which trade at a price of around

\$20 a tonne.

The final way that carbon markets are spreading is via cross-border schemes. The EU's programme is by far the most advanced. In CBAM's pilot phase importers of aluminium, cement, electricity, fertiliser, hydrogen, iron and steel will need to report "embodied emissions" (those generated through production and transport). Then, from 2026, importers will have to pay a levy equivalent to the difference between the carbon cost of these emissions in the EU's scheme and any carbon price paid by the exporter in their domestic market. Free permits for sectors will also be phased out, and the housing and transport industries will be brought into the market.

Many of these schemes will take time to have an impact. Lots in Asia are flimsy, with prices set too low to lead to substantive change—well below the EU's current price of around €90 (\$95), which is itself only approaching climate economists' estimate of the social cost of carbon. For instance, half the coal plants covered by China's emissions-trading scheme face a negative carbon price, meaning that they are in effect paid to burn the dirty fuel, since their emission intensity is below the national average, says Lauri Myllyvirta of the Centre for Research on Energy and Clean Air, a think-tank. The scheme, he notes, also fails to create an incentive to shift from coal to other sources of power.

Across the world, activists criticise the ability of companies to use offsets to indulge in what they term "greenwashing", where firms falsely present themselves as environmentally friendly. Some schemes also struggle to prove that they have led to emissions reductions. Last year a team of academics, led by Andrew Macintosh of Australian National University, argued that reforestation used as carbon credits in Australia's scheme either did not happen or would have happened irrespective of payments for offsets. An independent review has since recommended changes to how the scheme works.

Yet even carbon-pricing programmes that are limited will still help change behaviour, for the simple reason that they encourage the monitoring of emissions. After its launch two years ago, China's emissions-trading scheme was dogged by fraud, with consultants alleged to have helped firms fake coal samples. A crackdown was announced by officials earlier this year, who are now satisfied with the quality of the data. Despite the absence of a carbon price, American firms also face incentives to monitor emissions. President Biden has proposed a rule that all businesses selling to the federal government must disclose emissions and have plans to reduce them. Many large firms have set voluntary net-zero targets as part of their marketing efforts. Apple, the world's largest, has pledged to make its supply chain entirely carbon neutral by 2030.

Industrial firms around the world now face a still greater incentive to accurately track their carbon footprints: CBAM. The EU's ultimate goal is to tackle "carbon leakage". Before CBAM's introduction, Europe's carbon price meant that domestic industries faced an extra cost compared with those in countries with less ambitious decarbonisation plans. This gave importers an incentive to source material from abroad, even if such inputs were dirtier. To compensate for this, the EU handed out permits to industrial producers. These will now be phased out as CBAM is phased in.

During the pilot phase, CBAM simply presents an extra hurdle (or a "non-tariff barrier") for exporters to the bloc. To comply, European firms must report the embodied emissions of their imports. If such data do not exist, importers must use reference values provided by the EU. In order to nudge foreign companies to change their behaviour and prove that their emissions are lower, these are based on the emissions of the dirtiest firms in the bloc.

Carbon border tariffs may themselves start to multiply. In Australia the government recently announced a review into "carbon leakage", which will examine such an option. In 2021 America and the EU paused a trade dispute,

begun by President Donald Trump, by starting negotiations on a “Global Arrangement on Sustainable Steel and Aluminium”. America wants the two trading partners to create a common external tariff on polluting steel producers. Since it does not have a domestic carbon price, such a policy would break the World Trade Organisation’s rules. But if the EU and America do not come to an agreement, the Trump-era tariffs and the EU’s retaliatory measures will be reinstated.

There is a domino effect to carbon pricing. Once an industry is subject to a carbon price, affected businesses will naturally want their competitors to face the same rules. Therefore owners of coal power plants will lobby to ensure that gas power plants operate on a level playing field. Governments in exporting countries also have an incentive to ensure that their domestic firms pay a carbon price at home rather than a tariff abroad. If Asia’s factories are pressed to reduce their emissions anyway by schemes such as CBAM, then its governments are leaving money on the table by not levying a carbon price of their own.

The question is whether the dominoes will fall sufficiently quickly. Almost no emissions-trading schemes are aimed at emissions from residential property or cars, for instance, where consumers would really feel the pain. In choosing to introduce carbon-pricing schemes, and then to make them broader and more muscular, policymakers have most economists firmly on their side—and are proceeding much faster than is commonly realised. Yet future policymakers will have little choice but to make such measures even more intrusive if they want to minimise the effects of climate change. For that to happen, they will have to win over voters, too. ■



【首文】人口结构

亚洲大片地区未富先老

即使是穷国也必须开始为老龄化筹谋

一个国家劳动年龄人口激增是好事情。这样就有很多劳动人口供养相对较少的孩子和退休人员。只要劳动力市场能够吸收飙升的求职者，人均产出就会上升。这可以促进储蓄和投资，从而推动经济增长、提高生产率以及加速发展。然而，对于未能抓住这一机遇的国家来说，结果可能很严峻——许多发展中国家可能很快就会看到这一点。

来看看泰国。它正在快速老龄化。2021年，泰国65岁及以上人口占比跨过了14%这一通常被视为进入“老龄社会”的门槛。很快，泰国就会像日本、韩国和大多数西方国家一样面临劳动力供应减少，而如果不采取特别措施，将面对生产率和经济增长乏力。然而，有别于日本和其他国家，泰国不是发达国家，它在2021年的人均GDP仅为7000美元。它还没变富裕就已经衰老了。当日本的老年人口占比处于类似水平时，其富裕程度大约是今天泰国的五倍。

这是泰国未来发展的一大障碍。为了保护其变得老迈而有大批穷人的国民，泰国政府将不得不在医疗保健和养老金上投入更多资金。这会让政府更加难以在能提高生产率的技能和基础设施方面做投资。许多发展中国家都将步泰国的后尘。在问题最严重的亚洲，印尼和菲律宾看起来也将以低于富裕国家当年的收入水平步入老龄社会。斯里兰卡的平均收入比泰国低三分之一，它将在2028年步入老龄社会。

未富先老的国家要么没能抓住人口机遇，要么老龄化的速度过快，亦或两者兼而有之。从1960年到亚洲金融危机前夕的1996年，泰国经济以年均7.5%的速度增长。尽管这一增速很亮眼，但仍低于日本繁荣时期两位数的增长速度。与此同时，由于预期寿命的提高和其他因素，泰国老龄化的速度很快。20年间，泰国老年人占总人口的比例翻了一番，从7%增至

14%。日本用了24年才经历了同样的变化，美国用了72年，西欧大部分国家用了一个多世纪。

人口快速老龄化和经济增长缓慢在发展中国家普遍存在。越南的富裕程度只有泰国的一半，老龄化的速度却比泰国还要快。印度一直是世界上经济增长最快的国家之一，但其增速还是不及泰国繁荣时期的水平。在2010至2020年的十年里，印度的年均经济增速为6.6%。

由此得出的一个结论是，劳动年龄人口激增的国家需要想方设法从中谋求更多的经济增长。印度眼下机不可失。莫迪领导下的印度有一个强势的亲商政府，它很可能还会赢得明年的大选。印度国内对于私有化和放宽外国投资规定等可能提高印度经济增长率的措施已有共识。这样的改革将有助于印度利用西方正将供应链移出中国的机会。如果印度需要一个警世故事来证明其行动的正确性，只需要看看自己迅速老龄化的南部各邦。在喀拉拉邦（Kerala），60岁及以上人口的比例已经达到了17%。

另一个结论是，发展中国家需要更早开始为老年社会做规划。它们应该改革养老金制度，包括提高退休年龄。应该培育金融市场，提供长期储蓄和医疗保险方面的多种选择。它们应该为规范的私营社会照护创造条件。它们还应该更努力地提高女性的劳动参与率——在印度，这一比例只有可怜的24%，是全球平均水平的一半。让更多女性就业将扩大人口红利，并有助于应对一个现实问题——女性通常比男性寿命更长，但储蓄和养老金却比男性少，因此在老年时很容易陷入困顿。

最后，发展中国家应该记取富裕国家的前车之鉴，对移民问题采取务实的态度。尽管这可能会遇到政治上的阻力，但这往往是延长过渡期最简单的方法。曼谷的建筑工地上已经充斥着来自缅甸的非法移民。泰国的政客或许可以通过向他们提供正式身份把他们引向更富生产力的工作。

印度在这方面提供了一个更积极的范例。印度的国土面积相当于一个洲的大小，它的繁荣就是由国内移民推动的。印度上一次人口普查是在2011年，当时统计总共有4.5亿国内移民。许多人从贫穷的北部前往较繁荣的

南部和西部以把握新机会，同时也越来越多地填补了南部日益年迈的劳动力留下的空缺。这一令人鼓舞的例子说明相对不受限的劳动力市场大有可为——这对于日本、泰国乃至世界各地的政府都是一个启示。■



Demography

Large parts of Asia are getting old before they get rich

Even poor countries must start planning for an ageing population

A BULGE IN A country's working-age population is a blessing. Lots of workers support relatively few children and retired people. So long as the labour market can absorb a surge of job-seekers, output per head will rise. That can boost savings and investment, leading to higher economic growth, more productivity gains and developmental lift-off. Yet for countries that fail to seize this opportunity, the results can be grim—as many developing countries may soon discover.

Consider Thailand. It is rapidly greying. In 2021 the share of Thais aged 65 or over hit 14%, a threshold that is often used to define an aged society. Soon Thailand will, like Japan, South Korea and most Western countries, see a dwindling supply of workers and, without extraordinary measures, flagging productivity and growth. Yet unlike Japan and the rest, Thailand, with a GDP per person of just \$7,000 in 2021, is not a developed country. It has got old before it has got rich. When Japan had a similar portion of oldies, it was roughly five times richer than Thailand is today.

This is a big obstacle to Thailand's future development. To protect its ageing citizens, many of whom are poor, Thailand's government will have to spend more on health care and pensions. This will make it harder to invest in productivity-boosting skills and infrastructure. And where Thailand goes, many developing countries will follow. In Asia, where the problem is most advanced, Indonesia and the Philippines are also likely to become aged societies at lower income levels than was the case in the rich world. Sri Lanka, where the average income is a third lower than Thailand's, will become aged by 2028.

Countries that age before growing rich have failed to seize their demographic opportunity, or aged out of it too rapidly, or suffered both problems. Between 1960 and 1996 (just before the Asian financial crisis), Thailand's economy grew at an average annual rate of 7.5%. That was impressive, but below Japan's double-digit clip in its boom years. Meanwhile, thanks to improving life expectancy and other factors, Thailand has aged fast. The share of oldsters in its population doubled, from 7% to 14%, in two decades. It took Japan 24 years to undergo the same change, America 72, and much of western Europe over a century.

Rapid ageing and slower growth are widespread in the developing world. Vietnamese are about half as rich as Thais and ageing even faster. India's economy has been one of the world's fastest-growing, yet not as fast as Thailand's during its boom. In the decade to 2020 India grew at an average annual rate of 6.6%.

One conclusion is that countries with a working-age bulge need to wring more growth out of it. India may never have a better chance than the present. Under Narendra Modi it has a strong, pro-business government, which is likely to win re-election next year. There is a consensus on the measures, including privatisation and looser foreign-investment rules, that could raise its growth rate. Such reforms would help India take advantage of Western efforts to shift supply chains out of China. If India needs a cautionary tale to justify action, it need look no further than its own rapidly ageing southern states. In Kerala 17% of the population is 60 or older.

Another conclusion is that developing countries need to start planning for old age earlier. They should reform their pension systems, including by raising retirement ages. They should nurture financial markets, providing options for long-term saving and health insurance. They should create conditions for well-regulated private social care. And they should try harder to increase female participation in the labour force; in India it is a wretched

24%, half the global average. Getting more women into jobs would extend the demographic dividend and help deal with the fact that women live longer than men, but tend to have more meagre savings and pensions, and so are vulnerable in old age.

Finally, developing countries should learn from the errors of rich ones by taking a pragmatic view of immigration. Hard as this can be politically, it is often the easiest way to extend the transition. Building sites in Bangkok already throng with illegal Burmese immigrants. By formalising them, Thai politicians could usher them into more productive roles.

India provides a happier example of this. A continent-size country, its boom is fuelled by internal migration. Its last census, in 2011, counted 450m internal migrants. Many travel from the poor north to the more prosperous south and west, to seize new opportunities and, increasingly, to take up those being vacated by the south's ageing workers. It is an inspiring illustration of what relatively unfettered labour markets can do—and a lesson for Japan, Thailand and governments everywhere. ■



经济学人视频

马斯克的驱动力是什么？（下）

在展示了如何让太空旅行更便宜、让电动车更性感之后，他认为自己可以解决任何问题。



The Economist Film

What drives Elon Musk? - Part 2

Having shown how to make space flight cheap and how to make electric cars sexy, he's decided that he can solve anything.



野兽家园

从神话到艺术，熊一直令人着迷

一本新书讲述了八个熊种的故事以及它们的困苦【《八种熊：神话般的过往与危险的未来》书评】

《八种熊：神话般的过往与危险的未来》，格洛丽亚·迪奇著。W.W.诺顿出版社；272页；30美元和25英镑。

当迈克尔·邦德（Michael Bond）在1950年代写作《小熊帕丁顿》（A Bear Called Paddington）的初稿时，他说这个戴着帽子的主人公小熊来自“最黑的非洲”。邦德的文学经纪人哈维·乌纳（Harvey Unna）很喜欢这个故事，但他发现了一个错误：非洲没有熊。“孩子们知道这个，或者应该知道这个。”乌纳写道。“亚洲、欧洲和美洲有很多熊，有不少是在证券交易所。”他补充说。邦德把帕丁顿的出生地改成了“最黑的秘鲁”，赋予了它秘鲁眼镜熊的形象。

在神话里和人们的心中，熊有着特殊的地位。孩子们从小就听帕丁顿、小熊维尼和三只熊的故事，收到毛绒泰迪熊作为礼物。或许是因为熊能像人一样两腿站立，人们一直对熊感到亲近。熊出现在古代绘画中、星座名字里（大熊星座，也就是北斗七星）和外交谈判中。像中国那样向友好国家“派发”熊猫的做法古已有之：1252年，挪威国王哈康四世（King Haakon IV）送给英格兰国王亨利三世一只北极熊，这只熊从此就在泰晤士河里游泳捕鱼。

《八种熊》（Eight Bears）探究了熊与人之间特有的奇妙关系和摩擦。作者格洛丽亚·迪奇（Gloria Dickie）是路透社的记者，她游历全球，带读者踏上了一趟扣人心弦的独特的寻熊之旅。她穿戴得像个“被关押的蓝精灵”，在中国一个大熊猫研究中心做志愿者；在加拿大走进北极的冰天雪地，寻找北极熊；在秘鲁徒步跋涉，希望能见到帕丁顿的同类；穿行在印度的村庄间，探访被懒熊咬伤的人，这种熊的名字掩盖了它们的攻击性。

世界上只有八种熊，而猫科动物有41种，灵长类动物有超过500种。这种简洁令人愉快，但迪奇却笔调沉郁。濒危的不只是北极熊，大多数熊种都面临栖息地被破坏和气候变化的威胁。例如熊猫，它一天要吃掉约18公斤竹子，但农业扩张威胁着它们的口粮供应。砍伐森林破坏了懒熊（印度最致命的野生动物）的栖息地。在干旱期，懒熊会到处寻找水源，引发了与人类的冲突，在被懒熊攻击后，人会进行“报复性杀戮”。

迪奇推断，只有三种熊能活过本世纪末：美洲黑熊、棕熊和熊猫。（世界上的熊猫不到2000只，但中国已开始认真保护熊猫。）

这本书是关于熊的，但也是关于人的一一它揭示了人性的两面性。一面是人的残忍。“斗熊”是把熊拴起来，强迫它和狗打斗，这在英国曾经是一种流行的观赏性运动，直到1835年才被列为非法。（伊丽莎白一世非常喜欢斗熊，她在1585年驳回了英国议会禁止斗熊的提议。）尽管“舞熊”于1972年在印度被列为非法，但这种表演一直存在。人们杀死母懒熊，抢走懒熊幼崽，打断小懒熊的牙齿，有时还给它们戴上带钉子的嘴套，迫使它们“因恐惧和绝望而手舞足蹈”，给人以“欢乐的假象”。

在其他地方，熊因为它们的胆汁而被奴役。在越南（养熊是非法的）和中国（养熊不违法），人们以笼子圈养马来熊和亚洲黑熊，用一种近乎酷刑的方法从它们的胆囊中提取胆汁。由此得来的胆汁因其抗炎功效被誉为“液体黄金”出售。熊很聪明，这就更加让囚禁熊的做法令人不安。研究人员发现黑熊能够区分不同的动物，甚至还能计数。

但人也有好的一面。人们正在建立能实现人熊共存的系统，从熊“监狱”（当动物过于接近人类聚集区时，就会把它们送去那里）到防熊垃圾箱和储物柜等。世界各地有很多人在努力拯救熊，改善它们的生存状况，可见在人与兽的故事中还是有一些美好之处的。■



Where the wild things are

From myth to art, bears have long captivated people

A new book tells the story of eight bear species and their travails

Eight Bears: Mythic Past and Imperilled Future. By Gloria Dickie. W.W. Norton; 272 pages; \$30 and £25

WHEN MICHAEL BOND wrote his first draft of “A Bear Called Paddington” in the 1950s, he described his hat-clad protagonist as hailing from “darkest Africa”. Bond’s literary agent, Harvey Unna, liked the story but spotted an error: no bears lived in Africa. “Children either know this or should know this,” Unna wrote, adding that, “There are plenty of bears in Asia, Europe and America, and quite a few on the stock exchange.” Bond changed Paddington’s origins to “darkest Peru”, modelling him on the spectacled bear from there.

Bears occupy a special place in myth and mind. Youngsters are read stories about Paddington, Winnie-the-Pooh and the three bears and are presented with stuffed teddies. Perhaps also because bears can stand erect on two legs, resembling humans, people have long felt drawn to them. Bears have featured in ancient paintings, constellation names (ursa major, otherwise known as the Big Dipper) and diplomatic negotiations. China’s parcelling out of pandas to allies has precedent: in 1252 King Haakon IV of Norway gave Henry III a polar bear, which spent its days swimming and fishing in the River Thames.

“Eight Bears” explores the wonder and friction that characterise the relationship between bruins and people. The author, Gloria Dickie, a journalist for Reuters, travels around the world, bringing readers on a riveting and unique sort of bear hunt. She dresses up like an “imprisoned

“smurf” to volunteer at a panda-research centre in China, ventures into arctic temperatures to find polar bears in Canada, hikes in Peru in the hope of seeing Paddington’s ilk and wanders through villages of India to meet people mauled by sloth bears, whose name belies their aggression.

There are just eight bear species, compared with 41 types of felines and more than 500 primates. This offers pleasant concision, but Ms Dickie’s tone is sombre. Polar bears are not the only ones on thin ice; most bear species are threatened by habitat destruction and climate change. Pandas, for example, need to eat about 18kg of bamboo a day, but agricultural expansion imperils their food supply. Deforestation has destroyed the habitat of sloth bears (India’s most deadly wild animal). During droughts they roam in search of water, sparking conflict with people, who pursue “revenge kills” after bear attacks.

Ms Dickie concludes that only three bear species are likely to thrive past the end of this century: American black bears, brown bears and pandas. (There are fewer than 2,000 pandas, but China has started to take panda preservation seriously.)

This book is about bears but also about people, revealing two opposing sides of human nature. One is people’s cruelty. “Bear-baiting”, in which bruins were tied up and forced to fight with dogs, was a popular sport in Britain, made illegal only in 1835. (Elizabeth I so enjoyed bear-baiting that she overruled Parliament’s attempt to ban it in 1585.) Although outlawed in India in 1972, “bear dancing” has persisted. People kill mother sloth bears and kidnap cubs; they then bash out their teeth and sometimes use muzzles with nails, forcing them into a “dance of fear and desperation” that offers “the illusion of merriment”.

Elsewhere bears are enslaved for their bile. In Vietnam (where bear farming is illegal) and China (where it is not), sun and moon bears are kept in cages.

Bile is extracted from their gall bladders in a process akin to torture. The resulting “liquid gold” is sold for its anti-inflammatory properties. Bears’ imprisonment is made all the more disturbing by their intelligence. Researchers have observed that black bears can distinguish between animals and even gauge numbers.

But people also have a more positive side. They are building systems that allow for co-existence, from bear “jails” (where creatures are sent if they come too close to population centres) to bear-proof garbage bins and lockers. Many people around the world are trying to save and improve bears’ lives, proving there is some beauty in this story of beasts and humans. ■



学术现实

中美科学家也在脱钩

这会落得两败俱伤

中国的崛起可以从很多方面衡量。中国是世界第二大经济体、最大的制造国和最大的债权国。2021年，中国到达又一里程碑。这一年，中国科学家发表的论文数量首次超过美国或欧盟同行（见图表1）。提升的不仅是数量。《自然》杂志出版方编制的自然指数（Nature Index）追踪全球最有声望的健康和自然科学期刊的投稿情况，显示中国科研人员在自然科学论文发表上排名第一，总排名第二。

毫无疑问，这在中国是值得庆祝的，但在美国，这消息可能就不那么令人高兴了。中国的崛起越发令美国沮丧，尤其是中国的科技实力日增。在前任共和党总统特朗普和现任民主党总统拜登治下，美国实施了关税、限制规则和补贴措施，目的是打击中国的高科技企业，同时扶持本国企业。中国做出报复，针对一些美国大型科技企业采取行动。二十年前，政客们支持全球化和自由贸易。而现在，“脱钩”、国家安全和“友岸外包”成了热门话题。

学术界也未能幸免。两国的新规和冰冷的政治关系令科研人员更难开展合作。8月，美国同意将1979年签署的一项具里程碑意义的科学合作协议暂时延长六个月。美国多名政客希望完全废除这一协议，他们在一封公开信中声称，美国与中国科研人员合作是在“为自己的毁灭推波助澜”。

紧张关系可从数据中读出。2020年，中美两国科研人员联合撰写的论文数量首次下降。第二年（有数据可用的最近一年）再次下降，但在英国等其他国家仍在上升。美国发给中国学生和学者的签证数量也在下降，仅为2015年高峰时的三分之一左右（见图表2）。无论在政治还是科研上，两国都渐行渐远。

1979年签订的《中美科技合作协定》（Science and Technology

Agreement) 是中美建交后签署的首个双边条约。多项具里程碑意义的研究在其框架下展开。1983年启动的一项长期项目追踪了28.5万名中国女性，帮助证明了叶酸可以预防脊柱裂这种罕见的先天缺陷。如今，叶酸已被添加到面粉、面包、谷物和其他主食中；孕妇被鼓励多摄入叶酸。流感研究方面的合作有助预测每年流感的流行毒株，改进疫苗。

即使互为竞争对手的超级大国也会赞同医学研究是件好事。但中国在计算、材料科学和人工智能等其他科学领域的进步却让美国的政策制定者感到不安。批评者认为，中国的科研进步得益于美国的学术透明和技术诀窍，但中国并不总是投桃报李。质疑者还指出中国的“军民融合”政策，也就是仔细审视民用研究成果，从中找到任何可能的军事用途。

中国反驳称，美国对国家安全的担忧导致在美国高校的华裔科研人员受到不公平针对。常引发不满的是美国司法部的“中国行动计划”（China Initiative）。该计划于2018年至2022年实施，调查涉嫌充当中国技术间谍的事件。但落实的案件似乎不多。至少有150名华裔学者被调查，但只有少数人被定罪，有的不过是经费欺诈等较轻罪名。

有些调查已成为公开上演的闹剧，例如陈刚案，他是一位备受赞誉的华裔机械工程专家，现就职于麻省理工学院。陈刚于2021年被捕，休了一年的学术假才摆脱所有指控。还有一些科研人员被所在大学解雇，并列入禁飞名单。学者们表示，这项计划导致了怀疑和不信任的氛围。

另一边，中国也有自己的国家安全顾忌，这同样会阻碍合作。近年来出台的规定几乎完全禁止出口许多不同类型的数据。例如，官方禁止非中国实体收集基因组数据。如果在政府部门没有熟人关系，外国社会科学研究人员鲜少能接触到中国的经济和社会调查。相关规定很含糊，即使是乐于与海外同行合作的科研人员也不清楚哪些信息可以分享，哪些不可以。

关系降温会使双方的日子都更难过。中国学者将更难在美国的大学取经，而美国高校在几乎所有学科的排名中都仍然名列前茅。而鉴于中国现在本身也是个科学强国，在多个领域拥有顶尖研究人员，美国的科研也将受影

响。

在数据提供商科睿唯安（Clarivate）追踪学术信息的乔纳森·亚当斯（Jonathan Adams）表示，合作的好处是“显著的”，而且对美国机构的益处比对中国的略微更多一些。亚利桑那大学的珍妮·李（Jenny Lee）和约翰·豪普特（John Haupt）在2020年发表的一项研究发现，如果剔除与中国科学家合撰的论文，美国在科学和工程领域发表的论文数量在2014年至2018年间略有下降。

美国在科学领域的领先地位至少在一定程度上是因为它能吸引世界顶尖人才。疫情前，美国高校里科学、技术、工程和数学专业的研究生约有16%是中国公民。今天的研究生往往将成为明天的教授。像陈刚一样，许多中国学生在完成学业后选择留在美国。这才是美国领导人应该热切鼓励的事情。 ■



It's all academic

American and Chinese scientists are decoupling, too

That will be bad for both countries

THERE ARE lots of ways to measure China's rise. It is the world's second-biggest economy, its biggest manufacturer and its biggest creditor. In 2021 it passed another milestone. That year, for the first time, Chinese scientists published more papers than their counterparts in America or the European Union (see chart 1). It is not just the quantity that is improving. The Nature Index, run by the publishers of the journal of the same name, tracks contributions to the world's best-regarded health and natural-sciences journals. Chinese researchers rank first in the natural sciences, and second overall.

Cause for celebration, no doubt, in Beijing. In Washington, though, the news may have been less welcome. America increasingly dismayed by China's rise—and especially its growing scientific and technological prowess. Under Donald Trump, the previous Republican president, and Joe Biden, the current Democratic one, it has imposed tariffs, rules and subsidies designed to hobble China's high-tech firms while boosting its own. China has retaliated, moving against some big American tech companies. Twenty years ago, politicians endorsed globalisation and free trade. Now “decoupling”, national security and “friend-shoring” are the hot topics.

Academia is not immune. New rules and chilly politics in both countries are making it harder for researchers to collaborate. In August America agreed on a temporary, six-month extension for a landmark scientific co-operation agreement signed in 1979. Several American politicians want the deal scrapped entirely, claiming in an open letter that, by collaborating with

Chinese researchers, America was “fuelling its own destruction.”

The strains can be seen in the figures. In 2020 the number of papers jointly written by American and Chinese researchers fell for the first time. It fell again the following year, the most recent for which data are available, though it is still rising for some other countries, such as Britain. The number of visas America awards to Chinese students and academics is down as well, to around a third of its peak in 2015 (see chart 2). Scientifically as well as politically, the countries are drawing apart.

The Science and Technology Agreement, as the 1979 pact is called, was the first bilateral treaty signed between America and China after they re-established diplomatic relations. Several landmark studies have come under its umbrella. A long-running project following 285,000 Chinese women, begun in 1983, helped demonstrate that folic acid could prevent spina bifida, a rare birth defect. These days folic acid is added to flour, bread, cereal and other staple foods; pregnant women are encouraged to take more. Co-operation in influenza research helps anticipate which strains of flu are likely to be dominant each year, improving vaccines.

Even superpower rivals can agree that medical research is a good thing. But China’s advances in other areas of science, such as computing, materials science and AI, have made American policymakers uneasy. Critics argue that science in China has benefited from American academic transparency and know-how—but that China has not always returned the favour. Doubters also point to China’s policy of “civil-military fusion”, in which the fruits of civilian research are scrutinised for any useful military applications.

China retorts that America’s worries about national security have led to the unfair targeting of Chinese researchers at American universities. One frequent target of complaint is the Department of Justice’s “China Initiative”,

which ran between 2018 and 2022 and was designed to investigate alleged instances of Chinese technological espionage. But cases seem to have been thin on the ground. The initiative investigated at least 150 academics of Chinese origin, but managed to secure only a handful of convictions. Some were for less offences such as grant fraud.

Some of the investigations have become very public fiascos, as with the case of Gang Chen, a well regarded mechanical engineer of Chinese origin who is now at the Massachusetts Institute of Technology. Dr Chen was arrested in 2021. He spent a year on academic leave before all the charges against him were dropped. Other researchers have been sacked by their universities and found themselves on no-fly lists. Academics say the initiative led to an atmosphere of suspicion and mistrust.

China, meanwhile, has national-security concerns of its own, which can likewise impede co-operation. Rules introduced in recent years all but prohibit the export of many different kinds of data. Officials have banned the collection of genomic data by non-Chinese entities, for instance. Foreign social-science researchers are rarely given access to economic and social surveys without a friend in the government. The rules are vague, leaving even researchers keen to work with colleagues overseas unsure what they are allowed to share.

A cooling of ties will make life harder for both sides. Chinese academics will find it harder to get experience in American universities, which still dominate the world rankings in almost every subject. And because China is now a scientific power in its own right, with cutting-edge researchers in several fields, American science will suffer, too.

The benefits of collaboration are “significant,” and benefit American institutions slightly more than Chinese ones, says Jonathan Adams, who tracks academic information at Clarivate, a data provider. A study published

in 2020 by Jenny Lee and John Haupt at the University of Arizona, found that, when papers co-written with Chinese scientists were excluded, the number of American publications in science and engineering fell slightly between 2014 and 2018.

America's scientific pre-eminence has been built at least partly on its ability to attract the world's best. Before the pandemic around 16% of graduate students in science, technology, engineering and mathematics at American universities were Chinese. The grad students of today often become the professors of tomorrow. Like Dr Chen, many Chinese students choose to stay in America after completing their degrees. That is something America's leaders should be keen to encourage. ■



【首文】重启成功

微软强势回归的经验教训

对人工智能的大胆押注可能会帮助它超越苹果，成为全球市值最高的公司

“这有点像是回到了90年代。”微软老板萨蒂亚·纳德拉（Satya Nadella）9月21日在纽约的一个产品发布会上欢呼。他指的是这个软件巨头的辉煌岁月，当时Windows操作系统无处不在，利润飙升，收入惯常以每年超过30%的速度增长。微软一度成为全球市值最高的公司。但成功孕育了自满。到2010年代初期，微软销售增长放缓，利润率缩水。

本世纪20年代，微软迎来了新的全盛期。纳德拉将云计算而不是Windows定为公司的核心，帮助削减了成本并提高了利润。微软的营业利润率从2014年的29%上升到43%，是美国收入最高的50家非金融公司中最高的。投资者似乎很高兴。自2021年11月货币政策收紧的前景引发科技股抛售以来，微软的股价压过了除苹果以外的所有主要对手。

现在，纳德拉正在推进另一次大胆的重组，这次是围绕人工智能（AI）展开的。微软现在已成为人们使用AI工具的首选公司，这在很大程度上要归功于它对ChatGPT背后的创业公司OpenAI的投资。若回到一年前，大多数观察人士会说这个领域的首选公司是谷歌的母公司Alphabet或Facebook的母公司Meta。AI可能会推动微软的地位继续攀升，帮助它从苹果手中夺回全球最大公司的桂冠。它非凡的重塑为企业提供了广泛的经验教训。

其一是忧虑多疑。当史蒂夫·鲍尔默（Steve Ballmer）在2000年从比尔·盖茨手中接过帅位时，Windows对微软来说是神圣不可侵犯的。因此，微软没能把握智能手机和云计算等科技领域的大转型。它本来很容易就会步柯达或黑莓的后尘。但纳德拉痛苦地意识到了公司的落后，在他的领导下，微软对具有前景的新技术变得高度警觉。这为它在AI上迅速行动做好了准备。

另一个经验是，企业并不需要自己去发明创造。微软一直擅长研究如何捆

绑销售别人创造的技术。在纽约的发布会上，公司推出了类似ChatGPT的助手“Copilots”，用于各种软件产品。其核心是将OpenAI工具的功能与亚马逊开创的云计算商业模式相结合。

微软现在想把类似的打法应用到它的游戏业务中。它计划将自己的云技术与动视暴雪的游戏资产和专业技术结合起来。英国反垄断机构已经传达出对微软收购动视暴雪乐见其成，这项收购现在看起来可能性更大了。

相比之下，痴迷于发明创造的谷歌自2018年以来在它列入“其他赌注”的“登月”项目上累计亏损了240亿美元。亚马逊也在具有科幻色彩的技术上投入了大量资金，但到目前为止还未能赢得客户。亚马逊智能手机的3D显示屏是个哑弹，它的手掌扫描技术在杂货店里的接受度也很低。这两家公司还都在无人机送货方面砸下巨资。

最后一个教训是，受制于股市能形成约束创始人所需的纪律。Meta的老板扎克伯格为构建他的虚拟现实梦想已经损失了400亿美元，而且还打算花费更多。他之所以能这么干，是因为双重股权结构赋予了他61%的投票权。同样，谷歌的创始人谢尔盖·布林和拉里·佩奇在Alphabet拥有51%的投票权，这或许可以解释为什么Alphabet一直难以在搜索业务之外蓬勃发展。相比之下，苹果和微软的历史更悠久，不再由创始人主导，价值也高得多。

当然，反例肯定是有。有时候，创始人的痴迷会变成摇钱树。而忧思重重可能会让人分心。但微软是这样一个罕见的例子：一个庞然大物已经完成了一次成功再造，而且（如果它在AI上的押注得到回报的话）还可能进一步领先。它精彩的复出值得研究。 ■



Reboot successful

The lessons from Microsoft's startling comeback

A bold bet on AI could help it overtake Apple as the world's most valuable firm

"IT IS KINDA like the Nineties are back," crowed Satya Nadella, the boss of Microsoft, at a product launch in New York on September 21st. He was referring to the glory days of the software giant, when its Windows operating system was ubiquitous, profits were soaring and revenues routinely grew by more than 30% a year. For a while Microsoft became the most valuable company in the world. But success bred complacency. By the early 2010s sales growth had slowed and profit margins had shrunk.

In the 2020s Microsoft enjoyed a new heyday. Mr Nadella has put cloud computing at the centre of the firm, rather than Windows, which has helped trim costs and boost profits. The company's operating margin has fattened from 29% in 2014 to 43%, the highest among America's biggest 50 non-financial firms by revenue. Investors seem happy. Since the prospect of tighter monetary policy triggered a sell-off in tech stocks in November 2021, Microsoft's share price has beaten all its big rivals bar Apple.

Now Mr Nadella is charging ahead with another bold reorganisation, this time around artificial intelligence (AI). Thanks in large part to its investment in OpenAI, the startup behind ChatGPT, Microsoft has become the go-to firm for AI tools. A year ago most observers would have said that was Alphabet, Google's parent company, or Meta, Facebook's parent. And AI may propel Microsoft higher still, helping it reclaim the crown as the world's biggest company from Apple. Its remarkable reinvention holds wider lessons for businesses.

One is to be paranoid. When Steve Ballmer took over from Bill Gates in 2000,

Windows was sacrosanct at the firm. As a result, Microsoft failed to exploit big shifts in technology, such as the emergence of the smartphone and cloud computing. It could have easily gone the way of Kodak or BlackBerry. But under Mr Nadella, who was painfully conscious of the company's laggardly status, Microsoft became hyper-alert to promising new technologies. That prepared it to move quickly on AI.

Another lesson is that firms do not need to do the inventing themselves. Microsoft has been adept at working out how to bundle and sell technologies created elsewhere. At the event in New York the firm launched "Copilots", ChatGPT-like assistants, for various software offerings. At their core sit the capabilities of OpenAI's tools combined with a cloud-computing business model pioneered by Amazon.

Microsoft now wants to apply a similar formula to its gaming business. It plans to combine its cloud technology with the gaming assets and expertise of Activision Blizzard, its acquisition of which seems more likely now that Britain's trustbusters have signalled that they are happy with the deal.

Compare this approach with that of invention-obsessed Google, which has made a cumulative operating loss of \$24bn in its moonshot "Other Bets" business since 2018. Amazon, too, has invested heavily in technologies that have sci-fi appeal, but have so far failed to win over customers. Three-dimensional screens for its smartphone were a flop, and take-up of its palm-scanning technology at its grocery stores is sluggish. Both it and Google have thrown money at delivery drones.

A final lesson is that exposure to the stockmarket creates the discipline needed to rein in founders. Mark Zuckerberg, the boss of Meta, has already lost \$40bn building his virtual-reality dreams and plans to spend even more. He can do this because dual share classes give him 61% of voting rights. Similarly the founders of Google, Sergey Brin and Larry Page, hold

51% of the voting rights at Alphabet, which may explain why the company has struggled to thrive beyond search. Apple and Microsoft, by contrast, are older, no longer dominated by their founders—and far more valuable.

There are, inevitably, counter-examples. Sometimes a founder's obsession turns into a money-spinner. And too much paranoia can be a distraction. Yet Microsoft is the rare example of a behemoth that has already carried out one successful reinvention and—if its bet on AI pays off—could yet pull ahead further still. Its remarkable comeback is worth studying. ■



医疗淘金热

制药公司积极研发新一代减肥药

诺和诺德和礼来的竞争对手纷纷涌入

五年前，诺和诺德（Novo Nordisk）还是一家无趣的丹麦制药商，生产的糖尿病药物盈利稳定。唯一一次登上新闻头条是在人们抱怨胰岛素价格过高的时候卷入争议。接着在2021年，该公司对其糖尿病药物司美格鲁肽（商品名诺和泰）的一项试验显示，服用该药物的人体重减轻了，而且减得还不少——最多达到体重的15%。该药引发的兴奋让诺和诺德的新闻热度持续不减。它的市值在过去五年中几乎翻了两番，在9月达到4440亿美元，将奢侈品供应商LVMH从欧洲市值最高公司的宝座上挤了下来。诺和诺德的主要竞争对手礼来（Eli Lilly）有一款类似的药物替尔泊肽（商品名蒙扎罗），市值为5220亿美元，是2019年初的四倍多。

欢呼雀跃的不仅仅是投资者。不久前，摩根士丹利估计，到2030年，这类体重管理药物的全球年销售额可能达到540亿美元。现在它认为这个数字会是770亿美元。相比之下，去年的这类药物的销售额仅为24亿美元。大有发一笔的前景吸引来了一批模仿者，有大型制药公司，如安进（Amgen）、勃林格殷格翰（Boehringer Ingelheim）和辉瑞；不太大的制药公司，如江苏恒瑞医药和硕迪生物（Structure Therapeutics）；还有生物技术创业公司，如加州的Carmot Therapeutics、杭州的鸿运华宁和先为达生物。

在制药史上，并不是第一次出现某类药物乏人问津，直到一种成功药物出现才引发一场淘金热的情形。1987年氟西汀（商品名百忧解）的问世催生出许多竞争者，今天便有了五花八门的类似的抗抑郁药物。体重管理药物的新来者希望自己的药物能像百忧解的一些竞争对手一样，在先发者的基本上取得进步。

一项重要的改进将是让药物可以口服，而不是像蒙扎罗和诺和泰的减肥版

本Wegovy那样需要注射。辉瑞的danuglipron无需注射，正处于临床试验的第二阶段（必须经过三个阶段）。该公司预计将在今年晚些时候宣布进一步试验的计划。

制药公司还下了很多功夫限制药物的副作用。很多人使用目前市面上的减肥药物后出现了恶心的症状。这可能会导致一些患者停药——这是个问题，因为一旦不再施用，它们的脂肪抑制作用就会逐渐消失。诺和诺德正在试验添加一种名为胰淀素的激素，希望以此提高Wegovy的耐受性。

制药公司也在努力使这些药物更有效、更长效。研究人员正在测试它们是否能帮助病人对抗暴饮暴食以外的强迫行为，比如酗酒。此外，目前进行的一些试验正在考察它们是否能带来更广泛的健康益处。最近的一项试验表明，Wegovy能够将心脏病发作、中风和其他心血管疾病导致的死亡风险降低20%。

除了帮助人们减肥外，这些药物究竟还有多大用处仍不得而知。尽管Wegovy的试验显示很有前景，但根据分析公司Airfinity近期的估算，要防止一例心血管死亡，就需要让63人接受这种药物为期三年的治疗，总费用为110万美元。然而，更多关于这些药物的医疗效益的数据也可能增加它们的感知价值。

这反过来又会使它们更容易让那些买单的人接受，比如公共医疗保健系统或私人医疗保险公司。这些支付者对高昂的成本感到忧虑，特别是就当前的版本而言，这些药物必须无限期服用。在欧洲，其价格从每月170欧元到357欧元（180美元到375美元）不等。在美国，Wegovy的标价大约是每月1350美元。医疗保险公司很谨慎：到目前为止，1.1亿有肥胖问题的美国人中只有4000万人能通过他们的健康保险买到这些药物。

硕迪生物的老板雷蒙德·史蒂文斯（Raymond Stevens）说，定价的长期前景仍然不明朗。来自像他的公司这样的对手的竞争可能会迫使价格下降。另一方面，在药物递送或耐受性方面的创新可能又会使价格回升。短期倒是更容易预测。尽管礼来和诺和诺德都在努力提高产量，但在一个超重的

世界里，供不应求仍将继续。这就是稳健利润的妙方。 ■



A medical gold rush

Pharma's big push for a new generation of obesity drugs

Rivals to Novo Nordisk and Eli Lilly are piling in

FIVE YEARS ago Novo Nordisk was a boring Danish drugmaker whose diabetes medications were reliably profitable. The only time the company made headlines was when it was caught up in complaints about the high cost of insulin. Then in 2021 a trial of its diabetes drug, Ozempic (semaglutide), showed that people taking it lost weight. A great deal of weight—up to 15% of their body mass. Excitement about the drug has kept Novo Nordisk in the headlines. Its market value has nearly quadrupled in the past five years. Last month it reached \$444bn, handbagging LVMH, a purveyor of luxury goods, off its perch as Europe's most valuable company. Novo Nordisk's main rival, Eli Lilly, which has a similar drug called Mounjaro (tirzepatide), is worth \$522bn, more than four times what it was at the start of 2019.

It isn't just investors who are jubilant. Not long ago Morgan Stanley, a bank, estimated that global sales of such weight-management drugs could reach \$54bn annually by 2030. Now it puts the figure at \$77bn. By comparison, last year they raked in just \$2.4bn. The potential bonanza is attracting imitators. These include big pharma (for instance, Amgen, Boehringer Ingelheim and Pfizer), not-so-big pharma (Jiangsu Hengrui, Structure Therapeutics) and biotech startups (Carmot Therapeutics in California, Gmax Biopharm and Sciwind Biosciences in Hangzhou).

It is not the first time in pharmaceutical history that a class of drugs has been ignored, only to spur a gold rush when a successful medicine emerges. The arrival of Prozac (fluoxetine) in 1987 spawned many competitors, leading to the broad range of similar antidepressants available today. The

weight-management newcomers will be hoping their drugs can, like some of Prozac's rivals, improve on the first-movers.

One important improvement would be a drug that can be gulped down rather than injected, as Mounjaro and Ozempic's weight-loss version, Wegovy, need to be. Pfizer's needle-free option, danuglipron, is in the second phase of clinical trials (out of the necessary three). The company is expected to announce plans for further trials later this year.

A lot of effort is also going into limiting the drugs' side effects. The ones currently available make many people feel nauseous. That may lead some patients to stop taking them—a problem, given that their fat-suppressing effect wears off as soon as they are no longer administered. Novo Nordisk is experimenting with adding a hormone called amylin, which it hopes might make Wegovy more tolerable.

Efforts are under way, too, to make the drugs more effective and longer-acting. Work is going into testing whether they can help patients counteract compulsive behaviour other than overeating, such as alcoholism. And trials are being conducted to see whether they bring broader health benefits. One recent trial showed that Wegovy was able to reduce the risk of death from heart attacks, strokes and other cardiovascular causes by 20%.

Just how useful the drugs will prove beyond helping people lose weight remains unclear. Despite Wegovy's promising trial, Airfinity, a firm of analysts, recently calculated that 63 people would need to be treated with it over three years at a combined cost of \$1.1m to prevent one cardiovascular death. However, more data on the medical benefits of these drugs could also add to their perceived value.

This in turn would make them more palatable to those who foot the bill, such as public health-care systems or private health insurers. Those payers

are nervous about the high cost, particularly as the drugs must, in their current iteration, be taken indefinitely. In Europe prices range from €170 to €357 (\$180 to \$375) a month. In America the list price of Wegovy is about \$1,350 a month. Health insurers are cautious: so far only 40m of the 110m Americans with obesity have access to the drugs through their health insurance.

Raymond Stevens, boss of Structure Therapeutics, says that the long-run future of pricing remains hazy. Competition from firms like his could force prices down. On the other hand, innovations in delivery or tolerability could lift them back up. The short term is more predictable. Despite Eli Lilly's and Novo Nordisk's efforts to ramp up production, demand from an overweight world will continue to outstrip supply. That is a formula for healthy profits.





熊彼特

减肥药难敌食品巨头之威势

全球消费者沉迷致胖食品，一如依赖化石燃料

对于担心各种减肥法会影响食品行业的周期性恐慌，得细细咂摸，明辨其味。欲知缘故，让我们回到20年前的2003年。那一年，发明了以自己名字命名的流行饮食瘦身法的罗伯特·阿特金斯（Robert Atkins）在纽约一处结冰的路面上滑倒，之后不治身亡。这位低碳饮食之王彼时正值影响力巅峰。他所著的《饮食革命》（Diet Revolution）的销量甚至一度超过《哈利·波特》。他宣扬的信息不是节制饮食，而是纵情享受牛排、熏肉、鸡蛋和奶油等更精良的食物，这给芝加哥的牲畜饲养场带去了喜悦，让面包店和糖果店惶惶不安。小麦价格下跌。英荷食品巨头联合利华把销售萎缩归咎于阿特金斯饮食法。然而到2003年末，这股热潮迎来了和其创始人一样的结局，人们受够了这个饮食法带来的无聊乏味、口臭熏天和负面报道，它很快销声匿迹。“阿特金斯完蛋了。”一家报纸盖棺论定。

每个年代都会出现要避免摄入的新东西。上世纪70年代是卡路里，80年代是盐，90年代是脂肪，2000年代是碳水，2010年代是麸质和乳制品。但这次不一样，对吧？威胁食品、饮料和餐饮业的最新扫把星不是另一种饮食时尚，而是注射药物，例如2021年获批的减肥药威哥维（Wegovy），以及超出说明书规定用于减肥的抗糖尿病药物诺和泰（Ozempic）和蒙扎罗（Mounjaro）。除了刺激胰岛素分泌外，这些GLP-1药物还能让人产生饱腹感，抑制食欲，这对食品和饮料行业的影响与节制饮食类似，只是这次减肥的人们不大可能作弊。

这些药物的制造商诺和诺德（Novo Nordisk）和礼来（Eli Lilly）的投资者喜不自胜。软饮料和零食业的投资者就不那么开心了。最近几周，可口可乐、百事，还有沃尔玛、开市客等零售商的股价大跌。10月6日股市出现大幅抛售，专家马上把这与沃尔玛的一名高管在美国发布的言论联系起来，他说无记名数据显示消费者在购买减肥药的同时会减少购买食品。听

起来很像是二十年前联合利华那声惊呼的回声。但这十有八九是在混淆视听。

不难理解人们为什么往往会被“瘦身笔”注射剂的影响牵着走。肥胖不仅对患者个人造成困扰，还造成各种经济后果，包括医疗和保险费用上升以至工作效率降低，为监管部门在确保这些药物安全性的前提下支持其应用提供了令人信服的理由。GLP-1药物现已供不应求；威哥维和诺和泰出现短缺，促使一些药商开始仿制。

这里有巨大的颠覆潜力。约70%的美国人有肥胖或超重问题，到2035年，估计全球将有一半人有此类问题；治疗可能意味着大大减少摄入卡路里。就某些食品类别而言，肥胖不仅是不健康需求的后果，还几乎是一种先决条件；美国人称为糖果的食品中有超过三分之一主要由超重者消费，他们每周都暴食许多棒状、袋装和盒装糖果。从理论上讲，颠覆的潜力简直高上天了。杰富瑞（Jefferies）的研究显示，假如乘客平均体重下降能减少飞机燃料消耗，连航空公司也能从减肥药中获益。

然而，目前大多数预测都是基于猜测。更细致的分析不仅要计算肥胖者的绝对数量，还要考虑谁有医疗保险资格而谁没有，以及人们接受治疗的意愿、药物副作用的影响、停药率和停药后体重反弹的风险。投资公司盛博的亚历克西娅·霍华德（Alexia Howard）尝试拨开数字迷雾，她预测在未来五年，假如有十分之一的美国成年人使用减肥药，卡路里的总体需求量每年下降将不超过0.5%。正如她所说，这完全不是什么“末日情景”，不过加工食品和甜食的制造商所受的冲击可能要大于其他食品制造商。

食品行业的价值超过万亿美元，其中的中坚公司已传承几代人，他们绝不会无所作为，任由他人决定自己的命运。最新出来淡化所受影响的是百事的老板拉蒙·拉瓜尔塔（Ramon Laguarta）。10月10日，他表示公司正关注减肥药的发展，但预计它们影响不了促进其零食业务发展的任何长期趋势，如城市化、忙碌生活，以及日益壮大的中产阶级。当然，必要时公司也可以“转向”，他补充道。其他加工食品公司则指出，更小的单位包装和更健康的食品等趋势已经与GLP-1式饮食习惯相契合。此外，大型食品公

司可以利用自身影响力微妙地就新型减肥药物的成本和安全性提出质疑。老牌食品公司如此树大根深，要摆脱致肥食品不比戒掉化石燃料的瘾容易多少。

那为什么股市会暴跌？最佳答案是，当前的情况可能比食品饮料行业愿意承认的要糟糕。百事第三季度的销售额和利润超过分析师的预期，但主要得归功于价格上涨。其销量较去年同期下降了2.5%。这一变化预示着一种令人担忧的周期性趋势。消费者在疫情期间和之后忍受了高物价，已经深受通胀的冲击。随着劳动力市场降温，许多美国人可能会手头变紧。尽管富裕人群继续在高档食品上和餐馆里挥金如土，但调查显示，其他人正选择购买更多主食，在家自己动手烹饪，吃掉剩饭剩菜。此外，食品公司不愿承认可能已经过度利用了自己的定价权。

对于股价疲软，这番解释没有全面对抗肥胖的说法更抢眼。但至少在未来一年里，消费者最关心的可能是怎样勒紧腰带，而非怎么减腰围。 ■



Schumpeter

Weight-loss drugs are no match for the might of big food

The world is as addicted to fattening foods as it is to fossil fuels

TO GET A sense of why periodic panics about the impact of weight-loss programmes on the food industry should be taken with a pinch of salt, sugar, butter and whatever else you fancy putting in your mixing bowl, go back 20 years to 2003. That was the year when Robert Atkins, the eponymous father of a popular diet, slipped on a sheet of ice in New York and died. The low-carb king was at the peak of his powers. One of his books, “Diet Revolution”, briefly outsold even “Harry Potter”. His message, not of abstinence but of indulgence in the finer things of life such as steak, bacon, eggs and cream, spread joy through the livestock pits of Chicago, and alarm through bakeries and confectioneries. Wheat prices fell. Unilever, an Anglo-Dutch food giant, blamed the Atkins diet for shrinking sales. Yet by late 2003 the craze had gone the way of its founder, snuffed out by a blend of boredom, bad breath and bad publicity. As one newspaper summed it up: “Atkins is toast.”

Every decade brings something new to avoid. In the 1970s it was calories; in the 1980s, salt; in the 1990s, fat; in the 2000s, carbs; in the 2010s gluten and dairy. But this time is different, isn’t it? The latest killjoys threatening the food, beverage and restaurant industries are not another dietary fad, but injectable medicines, such as Wegovy, approved in 2021 as an anti-obesity drug, and Ozempic and Mounjaro, anti-diabetes drugs used off-label for weight loss. Besides stimulating insulin production, the so-called GLP-1 medicines reproduce a feeling of fullness and suppress appetite in a way that has a similar effect in the food and drink aisles as dietary restraint, except people are less likely to cheat.

Investors in Novo Nordisk and Eli Lilly, which make the drugs, are delighted. Those in the soft-drinks and snacking businesses, less so. In recent weeks the share prices of Coca-Cola and PepsiCo, as well as of retailers like Walmart and Costco, have swooned. Pundits were swift to link a big sell-off on October 6th to comments by a Walmart executive in America who revealed that, according to anonymised data, those who bought weight-loss drugs also purchased less food. It sounded like an echo of the Unilever scare from two decades ago. In all likelihood, it is a red herring.

It is easy to see why people are inclined to get carried away by the impact of “skinny pen” injections. Besides being a curse upon whom it falls, the economic consequences of obesity, from higher medical and insurance costs to lower workplace productivity, provide a compelling case for regulatory support for the drugs, as long as they are safe. Demand for GLP-1s is already exceeding supply; there are shortages of Wegovy and Ozempic, leading some pharmacists to make copycat versions.

The potential for disruption is huge. About 70% of Americans are obese or overweight, and by 2035 it is estimated that half the world will be; treatment could represent mountains of forgone calories. In some food categories, obesity is not just a consequence of unhealthy demand but almost a prerequisite; more than a third of what Americans call candy is eaten by mostly overweight people bingeing on many bars, bags and boxes each week. Theoretically, the sky could be the limit. According to Jefferies, a bank, even airlines would benefit from anti-obesity drugs if falling average passenger weights enabled them to burn less fuel.

Yet for now most of the projections are based on guesswork. More painstaking analysis has to include calculations not just of absolute obesity numbers, but of who is and is not eligible for insurance, people’s willingness to submit to treatment, the impact if the drugs have side-effects, the drop-out rates and the risk of regaining weight once off the drugs. Alexia

Howard of Bernstein, an investment firm, takes a stab at sifting through the fog of numbers to forecast that over the next five years, if one-tenth of American adults take the drug, overall calorie demand would fall by no more than 0.5% a year. As she says, that is hardly a “doomsday scenario”—though makers of processed foods and sweets may suffer worse than others.

The \$1trn-plus food industry, stalwarts of which have been around for generations, will not sit idly by and let someone else decide their fate. On October 10th Ramon Laguarta, PepsiCo's boss, was the latest to play down the impact, saying that anti-obesity drugs were on the firm's radar but were not expected to affect any of the long-term trends boosting its snacks business, such as urbanisation, busy lives and a growing middle class. The firm could, of course, “pivot” if necessary, he added. Other processed-food companies have noted that trends such as smaller pack sizes and healthier foods already align with GLP-1-style eating habits. And big food could use its influence to subtly raise concerns about the cost and safety of the new drugs. With such deeply entrenched incumbents, weaning the world off fattening foods is unlikely to be much easier than ending its addiction to fossil fuels.

So why the stockmarket swoon? The best answer is that current conditions may be worse than the food-and-beverage industry likes to admit. PepsiCo's third-quarter sales and profits beat analysts' expectations, but mostly thanks to higher prices. Volumes fell by 2.5% compared with a year ago. This change signals a worrying cyclical trend. Consumers, who tolerated high prices during and after the pandemic, have been hit hard by inflation. With a cooling labour market, many Americans may soon face growing hardship. Though the well-off continue to splash out on fancy foods and restaurants, surveys suggest that the rest are buying more staples, cooking from scratch at home, and using up their leftovers. Moreover, food companies are reluctant to recognise that they may have overexploited their pricing power.

This is not as eye-catching an explanation for weak share prices as a full-on assault on obesity. But for the next year at least, belt-tightening rather than girth may well be the biggest thing on consumers' minds. ■



起重机、排水沟和汽车

汽车工人罢工会危及拜登的制造业繁荣吗？

来自美国工业复兴前线的报道【深度】

田纳西州的斯坦顿（Stanton）像是一个来自久远过去的地方。市政厅古色古香，酷似1960年代的杂货店。隔壁是一家罐头厂，居民在那里用公共炉灶制作汤和过冬吃的蜜桃酱。在历史上的大部分时间里，斯坦顿的主要收入来源一直是棉花种植，但后来棉花种植业逐渐萧条，许多小农场主相继离开。

然而，在棉花田间一些引人注目的事物在渐渐成形。美国三大汽车制造商之一的福特公司正在建设其历史上最大的工业园区，包括电动汽车工厂、电池工厂和供应商基地，投资额达56亿美元。破土动工一年后，数千英亩土地被混凝土和钢材覆盖。这座400人的小镇里唯一的饭馆是甜甜餐厅（Suga's Diner），身穿醒目亮色工装的建筑工人中午在这里吃炸鸡和鲶鱼。当福特于2021年宣布该项目时，餐厅外的一则告示哀叹鸡肉缺货。现在，贴在那里的是一则招聘启事，显示人手短缺。“我们都忙到脚不沾地。”店主莱萨·甜甜·塔德（Lesa “Suga” Tard）说。

堪萨斯州的德索托（De Soto）也是类似的情景。几十年前，该市的工业发展在一家军工厂停止运营后戛然而止。今年4月，松下一座耗资40亿美元的电池厂开工建设，是该州历史上最大的一笔投资。市长里克·沃克（Rick Walker）开着一辆皮卡前往占地9000英亩（3600公顷）的工地，指着正在将乡间道路变成四车道高速公路的挖掘机，数着正在搭建工厂二楼的起重机（共有九台），滔滔不绝地介绍着附近即将建造的一座巨大的太阳能发电厂。

沿着从五大湖延伸到墨西哥湾的美国“汽车走廊”的一段行驶几天，可以一睹正在创造中的工业历史。从半导体“晶圆厂”到太阳能发电厂，美国的各个工业领域都在经历投资热潮（见地图）。数据收集机构Atlas Public

Policy的数据显示，到2022年底，相关企业对美国电动汽车和电池工厂已宣布的投资累计达到2100亿美元，而在2020年底时为510亿美元。这已经推动了一轮建筑支出激增——自2021年底以来翻了一番。

有几个因素可以解释一些人所说的美国制造业复兴。美国总统拜登声称，这些投资热情主要得益于他的两项标志性政策《芯片和科学法案》（CHIPS and Science Act）以及《通货膨胀削减法案》（IRA）中的财政激励措施。各州和地方的补贴也有帮助。在竞争中胜过中国的愿望以及在疫情导致供应链混乱后的制造回流也是原因之一。对于像福特这样在IRA法案通过之前就决定在斯坦顿建厂的汽车公司来说，它们担心的是如果不能抓住电动化的主动权，它们在美国汽车制造业的主导地位将被电动汽车领跑者特斯拉夺走。

考虑到在一些沿海城市以外的美国人依旧对燃油汽车非常依恋，电动汽车和电池工厂的激增看起来可能像是在搞华而不实的形象工程。无论其商业逻辑如何，这些工厂都已经在全国性的辩论中扮演角色。在针对底特律三大汽车制造商克莱斯勒（属于Stellantis，其最大股东持有《经济学人》母公司的部分股权）、福特和通用汽车的罢工中，电动汽车和电池工厂是重要争议点。福特已经暂停了在密歇根州马歇尔（Marshall）的一座电池工厂的建设，要等到劳资纠纷解决之后再复工。拜登和他的前任及可能的总统竞争对手特朗普上月都访问了密歇根州，对罢工表示支持。

组织罢工的全美汽车工人联合会（以下简称UAW）担心这些新建工厂很难成立工会。事实上，几无证据表明汽车制造业正从工会普及度高的北方全面向对工会不太友好的南方迁移。在俄亥俄州牛津市的迈阿密大学（Miami University）研究该行业地理分布情况的詹姆斯·鲁宾斯坦（James Rubenstein）指出，几十年来，非美国汽车制造商一直在南方建厂。而现在，老牌汽车制造州与新兴汽车制造州的生产活动一样多。通用汽车的第一座电动汽车和电池联合工厂位于底特律，靠近该市在汽车制造业鼎盛时期遗留下来的满是涂鸦的废弃工厂。福特在马歇尔的项目距离这里两小时车程。“无论是俄亥俄河以北还是以南，每边得到的投资都不少。”鲁宾斯坦说。

因此，这些超大项目可能并没有在改变美国工业分布的地理大格局。但在地方层面，它们的影响却非同一般。这些项目纷纷落户多年来一直苦苦等待制造业复苏的衰落地区。这些地区有几个共同点。

首先，它们很早就划出了大片贫瘠土地用于工业发展。斯坦顿市市长艾伦·斯特宾斯基（Allan Sterbinsky）表示，该市几十年前为工业发展划出了4000英亩土地，田纳西州政府甚至在日本设立了办事处做推广。日本汽车巨头丰田探索性地前来打过一些交道。但斯特宾斯基说，是福特让该市的目标最终得以实现。在堪萨斯州，德索托十年前就开始对9000英亩土地重新规划，用于工业开发。

第二个共同特征是劳动力充足。尽管许多新工厂都位于偏远农村地区，但有大量工人在通勤距离内。一旦投入运营，福特工厂预计将雇用6000名工人，大约是斯坦顿目前区区400人口的15倍。厂区的一所技术学院以后还会培训未来的工人。目前，从距工厂约40分钟车程的孟菲斯（Memphis）不难招到工人，这个地方此前一直不在汽车行业的视野中。沃克表示，德索托在30分钟车程半径内的堪萨斯城等地有150万名潜在劳动力，因此松下要雇用4000名员工应该没有问题。

尽管地处偏远，这些新工厂仍将有助于美国汽车行业进一步形成集群，这是第三个共同特征。这有助于最大限度地降低沉重电池的运输成本。福特的韩国电池合作伙伴SK On的电池工厂也将建在斯坦顿。麦格纳（Magna）等汽车零部件供应商也将直接落户在福特的家门口。与松下和特斯拉在内华达州合作的超级工厂不同，松下在德索托的工厂将向多个客户供货，并生产不同类型的锂离子电池。

与此同时，这些项目将依赖当地丰富的清洁能源，这让它们与周边越来越多的风能和太阳能发电项目形成共生关系。堪萨斯大草原上遍布风力涡轮机，为该州提供了近一半的电力。跨州公用事业公司田纳西河谷管理局（Tennessee Valley Authority）正在大力投资新的太阳能和其他形式的发电能力，以满足南部地区因福特等项目而急剧增长的用电需求。

仍然有一些重大争议点。一是政府促进投资热潮的激励措施的成本和效果。福特和SK在肯塔基州也有两家在建的电池工厂，并已获得美国能源部92亿美元的有条件贷款。它们还希望能够获得IRA规定的电池生产税收抵免。除了可能有IRA的扶持，有报道称松下还将获得8.3亿美元的州税收抵免。

哥伦比亚大学全球能源政策中心（Centre on Global Energy Policy）的阿哈迈德·迈赫迪（Ahmed Medhi）和汤姆·莫伦豪特（Tom Moerenhout）的一份新报告计算得出，IRA税收抵免为电池制造商节省了30%以上的支出，有助于缩小美国与中国在电池生产成本上的差距。然而，政府在刺激投资方面的成功可能会使财政成本高于预期，而且还引发了与欧盟的“补贴战”。尽管它们可能会促进工厂城镇的发展，但补贴出自纳税人的口袋，而且从长远来看可能会削弱该行业的创新动力。德索托必须提供税收减免等措施来吸引松下，为免向竞争对手走漏风声，松下在几个月里甚至对市政府官员都没有亮明身份。

另一个问题是投资对环境和社会的影响。这些公司希望在劳动力需求不太高涨的地方开发未开垦地。但这可能会激起当地人的敌意，他们拒绝将田地改成工厂，并担心污染和过度使用当地资源的问题，即使这些项目是为了推动“绿色革命”。一些人还担心工业发展会破坏自己城镇的传统风貌，或推高生活成本。在德索托的一家咖啡馆，女服务员基拉·霍恩（Kira Horn）说夜间也不停工的起重机上的灯光让这片地带看起来“像一座城市”。尽管像她的老板（也是一名房地产经纪人）这样的人已经开始享受商业和房地产所带来的繁荣，但她的一些年轻朋友担心这会让他们买不起房。

然后是工会的问题。堪萨斯和田纳西都是工会普及度较低的州。通用汽车在田纳西州纳什维尔（Nashville）附近的一家工厂成立了工会，与此不同的是，福特斯坦顿工厂的工人不会自动被要求加入UAW。这引起了一些摩擦。6月，UAW主席肖恩·费恩（Shawn Fain）炮轰拜登政府在没有事先同意工资要求的情况下就向斯坦顿项目提供了资金。

9月22日，UAW决定仅在通用汽车和Stellantis的工厂扩大罢工，它表示与福特的谈判取得了进展，这让福特松了一口气。但福特不会愿意在斯坦顿做出太多让步。密歇根大学罗斯商学院的埃里克·戈登（Erik Gordon）表示，美国制造业的复兴将取决于自动化和劳动力。他表示，如果劳动力成本太高，底特律汽车制造商的电动汽车就将失去竞争力。

如果要像本地制造项目的拥护者所希望的那样重建美国企业的实力，复兴衰落的地区，就需要克服这些障碍。拜登采用补贴政策可能会给整个国家带来经济成本。但斯坦顿的前景看起来令人鼓舞，尽管现在还处于发展早期。福特的供应链就铺设在工厂门口，可能会吸引更多小企业聚集。市长斯特宾斯基的预测显示，由于福特的投资，斯坦顿的人口可能在短短十年内增长约20倍。他已经争取到对供水、污水处理和其他基础设施的投资以支持人口增长。他走遍了南部各州，学习如何将沉寂小镇变成吸引雄心勃勃的人们的热土。罐头厂和甜甜餐厅这样斯坦顿真正的南方瑰宝是一个良好的开端。 ■



Cranes, drains and automobiles

Will the auto workers' strike jeopardise Joe Biden's manufacturing boom?

A report from the front line of America's industrial revival

STANTON, TENNESSEE, looks like a place from a bygone age. The town hall quaintly resembles a 1960s grocery store. Next door is a cannery, where townsfolk use communal stoves to make soups and peach preserve for winter. For much of its history, Stanton's main source of income has been cotton farming, which was so depressed that many smallholders left.

Yet amid the cotton fields something remarkable is taking shape. Ford, one of America's three big carmakers, is setting up the biggest industrial complex in its history, including an electric-vehicle (EV) plant, a battery factory and a base for its suppliers, with an investment of \$5.6bn. A year after it broke ground thousands of acres have been covered with concrete and steel. Construction workers in high-vis jackets stomp into Suga's Diner, the only food joint in the 400-person town, for lunches of fried chicken and catfish. When Ford announced the project in 2021, the diner had a sign lamenting a shortage of chicken. Now a help-wanted sign points to a shortage of staff. "We are rushed off our feet," says Lesa "Suga" Tard, the owner.

It is a similar story in De Soto, Kansas. Its industrial activity was abruptly cut short decades ago when a munitions factory was mothballed. In April construction began on a \$4bn Panasonic battery plant, the largest investment in the state's history. Driving to the 9,000-acre (3,600-hectare) site in his pickup truck, Rick Walker, the mayor, points to diggers turning a country road into a four-lane highway, counts the cranes (nine of them) erecting the plant's second floor, and gushes about a giant solar farm due to

be built nearby.

A drive over several days down parts of America's "auto alley", which stretches from the Great Lakes to the Gulf of Mexico, provides a glimpse of industrial history in the making. The country is in the grip of an investment boom in everything from semiconductor "fabs" to solar farms (see map). By late 2022 firms had announced a cumulative \$210bn of investments in EV and battery factories in America, up from \$51bn at the end of 2020, according to Atlas Public Policy, a data gatherer. This is already fuelling a boom in construction spending, which has doubled since the end of 2021.

Several factors explain what some are calling America's manufacturing renaissance. President Joe Biden claims much of the bonanza is the result of financial incentives in the CHIPS and Science Act, and the Inflation Reduction Act (IRA), two of his signature policies. State and local giveaways also help. So does the desire to outcompete China, as well as reshoring after the supply-chain chaos of the pandemic. In the case of car firms like Ford, which decided to build in Stanton before the IRA was passed, the fear is that unless they seize the initiative on electrification, they will lose their dominance of American carmaking to Tesla, the EV front-runner.

Given how attached Americans outside a few coastal cities remain to their gas guzzlers, the surge in EV and battery factories may seem like white elephants in the making. Whatever their commercial logic, the factories are already playing a role in national debates. The EV and battery plants are important points of contention in a strike against Detroit's big three carmakers, Chrysler (part of Stellantis, whose biggest shareholder part-owns The Economist's parent company), Ford and General Motors (GM). Ford has paused construction of a battery plant in Marshall, Michigan, until the labour dispute is resolved. Both Mr Biden and his predecessor and likely presidential rival, Donald Trump, visited Michigan last month to support the strikes.

The United Auto Workers (UAW), the trade union behind the strike, worries that the new plants will be hard to unionise. In fact there is little evidence of a full-blown migration of carmaking from the unionised north to the less union-friendly south. James Rubenstein of Miami University, in Oxford, Ohio, who studies the industry's geography, notes that non-American carmakers have been building factories in the south for decades. And now the old carmaking states are seeing as much activity as the new ones. GM's first contiguous EV-and-battery plant is in Detroit, close to the dilapidated and graffitied factories left over from the city's heyday. Ford's project in Marshall is a two-hour drive away. "Everyone's getting a pretty fair share of the largesse, both north of the Ohio River and south," says Mr Rubenstein.

The megaprojects may not, then, be reconfiguring America's large-scale industrial geography. But at the local level, their impact is extraordinary. They are sprouting up in left-behind places that for years waited in frustration for a manufacturing revival to arrive. These places have several things in common.

First, they long ago earmarked huge spaces of unproductive land for industrial development. Allan Sterbinsky, mayor of Stanton, says the town set aside 4,000 acres for this purpose decades ago; the state government even set up an office in Japan to promote it. Toyota, a Japanese car giant, made a few exploratory approaches. But it took Ford to ensure that the town's ambitions could at last be realised, he says. In Kansas, De Soto started drawing up plans to rezone 9,000 acres for development a decade ago.

The second common feature is the availability of labour. Though many of the new factories are in rural backwaters, they have access to big pools of workers within commuting distance. Once up and running, Ford's operations are expected to employ 6,000 workers, about 15 times more than Stanton's meagre population. A technical college on site will in time train future workers. For now, it will be fairly easy to find them in Memphis,

which is about a 40-minute drive away, and which the car industry has hitherto overlooked. De Soto has 1.5m potential workers within a 30-minute radius, including Kansas City, so Panasonic should have no problem hiring 4,000 people, says Mr Walker.

The new factories will nevertheless contribute to further clustering in the American car industry—a third shared trait. This is helpful in order to minimise the cost of transporting heavy batteries. Ford will have SK On, its South Korean battery partner, on site in Stanton. It will also have car-parts suppliers, such as Magna, directly on its doorstep. Unlike the gigafactory in Nevada, where Panasonic has teamed up with Tesla, the Japanese firm's De Soto plant will supply more than one customer, and make different types of lithium-ion batteries.

The projects' dependence on copious sources of clean energy, meanwhile, makes them symbiotic with the proliferation of wind and solar developments nearby. The skyline along the Kansas prairies is thick with wind turbines, which generate almost half of the state's electricity. The Tennessee Valley Authority, a multi-state utility, is investing heavily in new solar and other forms of generation capacity to meet sharply rising electricity demand in the south because of projects like Ford's.

A few big bones of contention remain. One is the cost and efficacy of government incentives to promote the investment boom. Ford and SK, which are also building two battery factories in Kentucky, have conditionally been granted a \$9.2bn loan from the Department of Energy. They also hope to qualify for a battery-production tax credit under the IRA. Panasonic will reportedly receive \$830m in state-funded tax credits, as well as potential IRA support.

A new report by Ahmed Medhi and Tom Moerenhout, of the Centre on Global Energy Policy at Columbia University, calculates that the IRA tax

credits provide savings of more than 30% for battery manufacturers, helping bridge the gap between the cost of producing batteries in America and China. However, their success in stimulating investments may make their fiscal costs higher than projected. They are also triggering “subsidy wars” with the European Union. Although they might boost factory towns, the subsidies come at a cost to the taxpayer, and in the long term could blunt the industry’s incentives to innovate. De Soto had to offer tax breaks and the like to lure Panasonic, which for many months kept its identity secret even from town officials so as not to tip off competitors.

Another concern is the environmental and social impact of investments. Companies want to develop greenfield sites in places where demand for labour is not too fierce. But that can stir hostility from locals who resist turning fields into factories and worry about pollution and overuse of local resources, even in the service of a “green revolution”. Some also fear that industrial development will destroy the traditional character of their towns, or increase living costs. At a café in De Soto, Kira Horn, a waitress, describes how at night the lights on the cranes, which work around the clock, make the site look “like a city”. Although people like her boss, who is also an estate agent, are already relishing the business and property boom, some of her young friends worry that it will price them out of buying homes.

Then there is the union challenge. Neither Kansas nor Tennessee is a union-friendly state. In contrast to GM, which has a unionised factory near Nashville, Tennessee, Ford’s workers at Stanton will not automatically be required to join the UAW. This has caused friction. In June the UAW’s president, Shawn Fain, blasted the Biden administration for lending money to the Stanton project without agreeing wage requirements up front.

Ford caught a breather on September 22nd when the UAW decided to expand its strike only at factories run by GM and Stellantis, saying it had made progress in negotiations with Ford. But the carmaker will be loth to give

much ground on Stanton. Erik Gordon of the University of Michigan's Ross School of Business says that the revitalisation of American manufacturing will hinge on automation and labour. The Detroit carmakers' EVs will be uncompetitive if labour costs are too high, he says.

If America's entrepreneurial muscle is to be rebuilt and left-behind places revived, as the champions of local projects hope, these hurdles will need to be overcome. And Mr Biden's turn towards subsidies may bring with it economic costs for the country at large. But, though it is early days, the prospects for Stanton look encouraging. The presence of Ford's supply chain close to the factory floor is likely to lure more small businesses. The mayor's projections show that, as a result of Ford's investment, the town's population is likely to grow about 20-fold in just over a decade. Mr Sterbinsky is already securing investments in water, sewerage and other infrastructure to support the growth. He has toured southern states to learn how to turn sleepy places into creative hotspots that attract enterprising types. Stanton's genuine southern treasures, such as the cannery and Suga's Diner, are a good start. ■



熊彼特

再见了iPhone。生成式AI呼唤新设备

屏幕时代的黄昏已至？

当扎克伯格9月27日在门洛帕克（Menlo Park）登台，满面春风地发布Meta新产品系列时，这位Facebook掌门人也许多少是卖了个关子。他首先介绍的是Meta的虚拟现实（VR）头显Quest 3，这也可以理解，因为他对元宇宙的痴迷已经体现在了公司名字上。但接下来的消息才更让技术迷们兴奋：他宣布Meta将很快与雷朋（Ray-Ban）联手推出一款内置了人工智能（AI）虚拟助手的智能眼镜。这款眼镜不仅能看到、能听，还能回答佩戴者的提问。幸运的话，它不会有“幻觉”。

也许你对智能眼镜的概念不屑一顾。毕竟它们以前就曾被炒作过。但这一次Meta也许值得关注，因为生成式AI的先驱OpenAI在同一周宣布，其炙手可热的聊天机器人ChatGPT除了能用文字对话外，现在也能看、能听、能说了。此外，有消息称，OpenAI正与苹果前设计师乔尼·艾维爵士（Jony Ive）探讨为AI时代打造一款新的小设备。至于是何种形态尚不清楚。但如果是想要开发一款新的消费电子设备，使其更契合能看、能说、能听的AI，那么它很可能将不再依赖触摸屏。

智能手机已经够成功了。然而，只要与ChatGPT最新的音频化身之一Sky交谈几句，你就能感受到摆脱被智能手机支配的喜悦。笔者就亲身体验了一下，问Sky她认为什么会最终取代屏幕：是眼镜吗？“绝对是的！”她兴奋地说，“特别是那些具备增强现实（AR）和AI功能的眼镜。”当被问及这会不会是件好事时，她推荐了两本书，主题都是屏幕对现代生活的影响：美国作家尼古拉斯·卡尔（Nicholas Carr）的《浅滩：互联网如何改变我们思考、阅读和记忆的方式》（The Shallows: How the Internet is Changing the Way We Think, Read and Remember），以及已故法国哲学家让·鲍德里亚（Jean Baudrillard）的《屏蔽》（Screened out）。然后，在追问之下，她对这两本书做出了简洁精辟的总结，几乎没有片刻的犹豫。

还不能说她完全就像电影《她》（Her）中的斯嘉丽·约翰逊（Scarlett Johansson），但感觉就如同一位斯坦福大学的学者在你耳边轻声细语。

这一切都令人耳目一新。当对“基础”模型和其他令人匪夷所思的AI基础架构长达一年的兴奋之情开始消退之时，生成式AI又可能掀起新一波的消费技术浪潮。技术专家们正在争论什么才是聊天机器人时代电子设备的最佳“外形尺寸”。博客和播客网站Stratechery的本·汤普森（Ben Thompson）认为这具有划时代的意义：“正如互联网为智能手机这一突破创造了条件那样，一场硬件突破正在蓄势待发。”他写道，能与聊天机器人语音对话使Meta在AR眼镜和VR头显上的押注“说服力急剧增加”。

扎克伯格很早就预见到了这一点。他不顾投资者的疑虑，在VR和AR上投入了巨资。他仍然对元宇宙感到兴奋。在他最近参加播主莱克斯·弗里德曼（Lex Fridman）的线上访谈时这一点一目了然。这次访谈使用了VR工具，使他们的虚拟面孔栩栩如生，让人感觉就像两人同处一室一样。（弗里德曼打趣道，即使是两个出了名面无表情的人，也能逼真地再现他们的面部动作）。然而，扎克伯格在另一次采访中表示，生成式AI极大地加速了智能眼镜的应用场景，它的市场“毫无疑问”将比VR更大。他把AR眼镜比作手机，把VR头显比作台式机。他似乎希望这两个产品都能超越屏幕——他说屏幕占据的是“与我们现实具象生活完全不同的另一个位面”。

二维的电子屏幕并不会很快就被扔进垃圾堆。现有技术总是难以被整个驱逐出场。Meta旗下的WhatsApp、Facebook和Instagram等移动应用拥有数十亿用户，让ChatGPT这类AI的月访问量仍然相形见绌，而这些应用仍然依赖智能手机。正如投资公司盛博的马克·施穆利克（Mark Shmulik）所指出，在智能手机时代人们也从未停止使用个人电脑。而且，只有等到人们开始从商店购买智能眼镜之时，才能知道这种产品的吸引力到底有多大。

这种无所不见、无所不闻的聊天机器人的商业价值也需要时间来证明。要访问OpenAI那些能对话的虚拟化身，每月要花20美元；Meta的有AI加持的智能眼镜起价299美元。然而，开发这些产品在前期注定是亏损的。哪

怕真的可以通过广告或虚拟购物实现盈利，那也可能需要几年的时间。毕竟，Meta的惯用手法就是先推出消费产品，然后扩大规模，只有在产品获得大众采用后才开始赚钱。

与此同时，必须解决显而易见的安全担忧。与社交媒体相比，AI驱动的消费技术可能更具沉浸感，这可能会让一些人变得更加孤僻，或引发不健康的依恋。扎克伯格认为，AR和VR设备可以帮助人们走到一起。但施穆利克表示，投资者不会希望Meta走得太快。“他们最不希望看到的就是又发生负面公关事件，让他们再次被监管机构盯上。”他说。

去年此时，扎克伯格还同时在几条战线上奋力扑火，现在他却显得很有先见之明了。这在很大程度上要归功于生成式AI。Meta的基础模型LLaMA 2成了大热的开源模型，也为该公司实现消费科技的宏伟目标奠定了基础。苹果限制了Facebook和其他应用在iPhone上追踪数据，Meta的广告业务也因此受到打击，而智能眼镜和头显等新设备最终会让它们摆脱对iPhone的依赖。苹果正在推出自己的高端AR/VR头显，这对扎克伯格是一种间接的恭维。iPhone的制造商可能也察觉到了屏幕时代已近黄昏。■



Schumpeter

So long iPhone. Generative AI needs a new device

Is this the twilight of the screen age?

WHEN A BEAMING Mark Zuckerberg took the stage in Menlo Park on September 27th to announce a new array of Meta products, the Facebook supremo may have buried the lead. He began talking about Quest 3, Meta's virtual-reality (VR) headset, which is understandable considering that his obsession with the metaverse is now inscribed in his company's identity. Techies, though, were more excited by what came later: an announcement that Meta, in combination with Ray-Ban, would soon launch smart glasses incorporating an artificial-intelligence (AI) virtual assistant. The specs will be able to see and hear, as well as answer their wearers' questions. With luck, they will not hallucinate.

You can be dismissive of smart glasses. They have been hyped before. But lending Meta credibility this time is the fact that the same week OpenAI, the generative-AI pioneer, announced that its hit chatbot, ChatGPT, can now see, hear and speak, besides conversing by text. Moreover, it emerged that OpenAI was in talks with Sir Jony Ive, Apple's former designer, to create a new gadget for the AI era. What form it will take is still unclear. But if the idea is to build a new consumer-electronics device better suited to the back-and-forth of seeing, talking and listening AIs, there is a fair chance it will no longer be reliant on the touchscreen.

The smartphone has had a good innings. Yet you only need to talk to Sky, one of ChatGPT's new audio avatars, to feel the joy of freeing yourself from its tyranny. Your columnist got a taste when he asked Sky how she thought screens might eventually be replaced: Glasses? "Absolutely!" she enthused, "especially those equipped with augmented reality [AR] and AI". Asked

whether this would be a good thing, she recommended two books that explore the enormous impact that screens have had on modern life: "The Shallows: How the Internet is Changing the Way We Think, Read and Remember" by Nicholas Carr, an American writer, and "Screened out" by Jean Baudrillard, the late French philosopher. Then, when further prompted, she summarised each in crisp, insightful language with barely a moment's hesitation. It wasn't exactly Scarlett Johansson in "Her". But it felt like having a Stanford University intellectual murmuring in your ear.

This is all rather refreshing. Just as the year-long excitement over "foundational" models and other mind-boggling bits of AI infrastructure has begun to fade, along comes the chance that gen AI, to use the industry shorthand, will unleash an onslaught of new consumer technology. Tech pundits are debating the best "form factor" for the chatbot era. Ben Thompson of Stratechery, a blog and podcast, puts it in epochal terms: "There is a hardware breakthrough waiting to happen just like the internet created the conditions for the smartphone breakthrough to happen." The ability to talk and listen to chatbots makes Meta's bet on AR glasses and VR headsets "drastically more compelling", he writes.

Mr Zuckerberg was early to see this coming. He has ploughed a fortune into VR and AR despite misgivings from investors. He remains excited by the metaverse. This was clear from a remote interview he recently took part in with Lex Fridman, a podcaster, which used VR tools to make their virtual faces so lifelike they felt as if they were in the same room together. (As Mr Fridman quipped, it could reproduce realistic facial movements even from two famously inexpressive people.) And yet gen AI has so dramatically accelerated the use case for smart glasses, Mr Zuckerberg told another interviewer, that there is now "no question" they will be the bigger of the two markets. He likens AR specs to mobile phones and VR headsets to desktops. In both cases he appears to hope they will transcend screens, which he says inhabit "a completely different plane from our physical lives".

The two-dimensional screen is not headed for the scrap heap yet. Incumbent technologies are always hard to dislodge. Meta's mobile apps such as WhatsApp, Facebook and Instagram, with their billions of users, still dwarf AIs like ChatGPT in terms of monthly visits, and they remain dependent on smartphones. As Mark Shmulik of Bernstein, an investment firm, notes, the smartphone era has never stopped people from using PCs. Moreover, it will not be clear until people start buying the smart glasses from the shops how compelling a product they are.

The business case for the all-seeing, all-hearing chatbots will also take time to emerge. OpenAI charges \$20 a month for access to its family of talking avatars; Meta's AI-infused smart glasses will start at \$299. Yet developing them is bound to be lossmaking at first. If there ever is a case for monetising them via advertisements or virtual shopping, that will probably take years. Meta's modus operandi, after all, is to launch a consumer product, scale it up and start making money from it only if it is adopted by the masses.

In the meantime, obvious safety concerns must be tackled. Consumer technology powered by AI is likely to be more immersive than social media, potentially making it even more isolating for some, or triggering unhealthy attachments. Mr Zuckerberg argues that AR and VR devices could help bring people together. But Mr Shmulik says investors will not want Meta to move too fast. "The last thing they need is another negative PR event where they are back in the cross hairs of regulators," he says.

For now Mr Zuckerberg, who this time last year was fighting fires on several fronts, looks prescient. That is largely thanks to gen AI. Meta's foundational model, LLaMA 2, has been an open-source hit and is underpinning the firm's consumer-tech ambitions. New devices such as smart glasses and headsets could eventually free Facebook and others from their dependence on the iPhone, where Apple has hindered their ability to track data, hurting Meta's ad business. In a backhanded compliment to Mr Zuckerberg, Apple is

launching its own high-end AR/VR headset. The iPhone-maker, too, may be sensing the twilight of the screen era. ■



生存设计

一些人说人类寿命可无限期延长

何不在等待时尝试一下“精确诊断乡村俱乐部”呢？【专题《长命百岁》系列之八】

据传有这样一位布鲁斯音乐家，在他100岁生日当天，有人问及他几十年来抽烟喝酒的习惯，他答说，早知道要活这么久，会把自己身体照顾得更好些。与这位多半是杜撰出来的蓝调音乐家截然相反的一例是布莱恩·约翰逊（Bryan Johnson）。他多年来照料自己的程度之极致，不亚于前者一头扎进波本威士忌和沉沦于各种糟糕选择。他为了未来牺牲现在——而不是反过来——以此彻底颠覆了“一次性躯体理论”。

约翰逊和他的许多医生制定的日常制度让“生物圈二号”里的生活都显得太过奢侈放纵。一公斤蔬菜——全部在上午11点之前吃掉；持续45到60分钟的严格锻炼；以及100粒药片，包括二甲双胍和雷帕霉素。他的生命机能受到一般对实验室动物才会做的持续监控。他说自己的衰老速度是正常水平的69%。

约翰逊被称为世界上被测量最多的人。他有能力负担由医生、培训师和营养师组成的团队为他服务，因为出售他创立的电子支付公司Braintree使他的净资产超过1亿美元。然而，对于一般人来说，仍有一系列强度较低的选择。

其一是约翰逊积累的经验的精华版，可以在他的网站上找到，名为“蓝图项目”。尽管他免费提供这个方案，但他说实施它可能每月要花费1000到1500美元，包括食品杂货、补充剂、药物和培训师。

对于那些预算有限或倾向继续观望的人来说，总部位于纽约的Tally Health提供了一种价格只有十分之一的入门级产品。这家公司是领导了对sirtuins蛋白的早期研究的大卫·辛克莱（David Sinclair）的最新发明。其会员每季度接受一次面颊拭子测试，检查表观遗传甲基化水平，由此得出一个类似霍瓦斯时钟的生理年龄来与实际年龄做比较，并每日摄入包含非

瑟酮、槲皮素、白藜芦醇、亚精胺和 α -酮戊二酸的补充剂。含有 α -酮戊二酸这种分子的几种生化通路似乎让实验室小鼠寿命更长也更健康。

位于圣地亚哥的人类长寿公司（Human Longevity）收取更高的费用，为客户提供基因组完整测序和身体MRI扫描，以及一系列可能会让他们觉得自己像被连了电线的实验室老鼠的检测。他们会换来一份个人“长寿行动计划”，该公司将帮助他们付诸实施。

人类长寿公司由克雷格·文特尔（Craig Venter）和彼得·迪亚曼迪斯（Peter Diamandis）于2013年创立。文特尔在1990年代经营着人类基因组计划的一家私营竞争对手，迪亚曼迪斯是一名营销人员、企业家和全面的未来推动者。文特尔后来离开了，迪亚曼迪斯仍持有该公司的股份，但他的目光似乎已经转向了一个更花哨显眼的项目。他的新企业“生命之泉”（Fountain Life）提供了与人类长寿公司类似的一揽子服务，但还配备了游泳池和免费提供的蓬松柔软的毛巾——正如其营销文案中所说，“一个精确诊断的乡村俱乐部”。

迪亚曼迪斯对未来愿景的表述是这样的。眼下，人们应该“但求不死”。不死本身是一个不言而喻的目标，但在这里也是通向一个更远目标的手段。不死可以让顾客等到抗衰药物被证明有效和获批使用、衰老被遏止的那一天。这继而将帮助他们到达终极目标：通过表观遗传重编程逆转年龄。

这种策略可以追溯到奥布里·德格雷（Aubrey de Grey）的理念，这位留着惹眼大胡子的计算机科学家自1980年代以来一直活跃在该领域。通过玛士撒拉基金会（Methuselah Foundation）等机构和SENS（“掌控可忽略衰老策略”）等概念，他为塑造现代关于延长生命的观念贡献良多，但同时也给那些视之为古怪边缘追求的人们提供了材料（他因性行为不端指控而于2021年被解除了在SENS研究基金会的职务，他否认了所有指控）。他最热爱的概念之一是“长寿逃逸速度”：在未来某天，科学将能每年将人们的寿命延长超过一年。

迪亚曼迪斯试图向人们兜售通往这个令人向往的日子的有利位子，这当然

有值得怀疑之处。即使科学进展很快，新疗法获批所需的时间往往会对“生命之泉”里那些更年老的客户的生理机能产生影响。关于让人工智能来影响抗衰老进程的兴奋讨论（生命之泉围绕它大做文章）还没有产生多少看得见的果实，更别说到底有没有甜头的证明了。

已有许多创意和公司倒在通往不朽的道路两旁，怀疑情绪也随之增加。人类生长激素是另一种营养感应通路的一部分，曾被推崇为具有抗衰老作用。随后对动物的研究表明使用它实际上可能会适得其反。一些基于线粒体DNA损伤理论的抗氧化方法可能也会是这样的结果。

白藜芦醇引发的兴奋已经减弱。一些大张旗鼓开张的公司没了动静。Alphabet的子公司Calico Life Sciences在2013年之时就是今天的Altos，现如今已经完全退出了热门话题。超级富豪和偏冷门探索的结合催生的大型科学项目并不总有好结果。别忘了生物圈二号。

不过，对于短期结果的合理的怀疑倾向不应妨碍对中期的开放态度。眼下人们对于了解衰老的生物学基础产生了浓厚的兴趣。有一些已有的疗法几乎肯定可以用来延长健康年限，甚至还可能延长寿命，尽管由于缺乏正式的试验证据，还很难看出被吹捧的选择中哪些真的有效。还有一些有希望的研究方向可能会带来更大的突破。

进化无意寻求让人永远活着或无限期延长生命。但这不会阻止人们尝试实现它。在实践中是否可行则完全是另一回事了，因为人体包含数万亿个需要被逆龄或更新的细胞。但是，追求较小收益的不那么宏伟的措施仍可能收获成果。单凭这一点无疑就值得一试。 ■



A design for living

Some claim human lifespans can be lengthened indefinitely

Why not try a “country club for precision diagnostics” while you wait?

THERE IS A story about a blues musician who, when questioned on his 100th birthday about his decades of smoking and drinking, responded that if he'd known he was going to live so long, he'd have taken better care of himself. Bryan Johnson is that apocryphal bluesman's polar opposite. He has been taking care of himself for years to a degree as remarkable, in its way, as the deepest devotion to bourbon and bad choices. By sacrificing the now for the future, rather than the other way around, he turns disposable-soma theory on its head.

The daily regime which he and his many doctors have devised makes life in Biosphere 2 look sybaritic. A kilogram of vegetables, all before 11am, rigorous workouts lasting 45-60 minutes, and 100 pills, including metformin and rapamycin. His vital functions are subjected to the sort of continuous scrutiny more usually associated with laboratory animals. He says he is ageing at 69% of the normal rate.

Mr Johnson, who has been described as the most measured man in the world, can afford the team of medics, trainers and dieticians who minister to him because selling Braintree, an electronic-payments company which he founded, left him with a net worth of more than \$100m. For mere mortals, however, a range of less intensive options are available.

One is a distillation of Mr Johnson's accumulated experience, available on his website as “Project Blueprint”. Though he makes it available for free, he says implementing it could cost \$1,000-1,500 a month, including groceries, supplements, drugs and trainers.

For those on a budget, or who would prefer to have their hands held, an entry-level product at around a tenth of that price is offered by Tally Health, based in New York. Tally is the latest brainchild of David Sinclair, who led early research on sirtuins. Members get a quarterly cheek-swab test to check levels of epigenetic methylation, thus providing a Horvath-clock-like age to compare with a client's chronological age, and a daily supplement containing fisetin, quercetin, resveratrol, spermidine and alpha-ketoglutarate, a molecule involved in several biochemical pathways which seems to give lab mice longer, healthier lives.

For a more substantial fee, Human Longevity, in San Diego, offers customers full sequencing of their genomes and MRI scans of their bodies as well as a suite of other tests likely to leave them feeling like wired-up lab rats; for this they get a personal "longevity action plan" which the company will help them implement.

Human Longevity was founded in 2013 by Craig Venter, who, in the 1990s, ran a private rival to the Human Genome Project, and Peter Diamandis, a marketer, entrepreneur and all-round future-booster. Dr Venter later left, and though Mr Diamandis still has a stake in the business, his gaze seems to have shifted to a glitzier proposition. Fountain Life, his new venture, offers a similar package of goodies to that of Human Longevity, but with swimming pools and fluffy towels thrown in: "a country club for precision diagnostics", as it says in its marketing literature.

Mr Diamandis's stated vision of the future goes like this. For now, people should concentrate on not dying. Not dying is an obvious end in itself, but in this context it is also a means to a further end. Not dying gets the customer through to the moment when senolytic drugs are proved and approved and ageing curtailed. That in turn sees them through to the ultimate goal: age reversal via epigenetic reprogramming.

This approach can be traced to the ideas of Aubrey de Grey, a computer scientist with a remarkable beard who has been active in the field since the 1980s. Through entities like the Methuselah Foundation and concepts like SENS (Strategies for Engineered Negligible Senescence) he did much to shape modern ideas about life extension while also providing some succour to those who saw it as a weird fringe pursuit. (Mr de Grey was relieved of his position at the SENS Research Foundation in 2021 after allegations of sexual misconduct, all of which he denies). One of his pet ideas is “longevity escape velocity”, a future state where science is extending people’s lifespans by more than a year every year.

There is certainly room for scepticism about Mr Diamandis’s attempts to sell people an inside track to that longed-for day. Even if the science were to come good quickly, the time it takes for new medical treatments to be approved tends to be measured in periods that will challenge the physiology of Fountain Life’s more elderly customers. Excited talk of bringing AI to bear on the matter (Fountain Life makes a hoo-ha about its use) has yet to produce much of a pudding, let alone one that provides any proof.

Scepticism is increased by the number of defunct ideas and firms that litter the verges of the road to immortality. Human growth hormone, which is part of another nutrient-sensing pathway, was once promoted as having anti-ageing effects. Subsequent work on animals suggests using it might actually be counterproductive. The same may be true of some of the anti-oxidant approaches built on theories about mitochondrial-DNA damage.

The excitement over resveratrol guttered. Companies founded with much fanfare have lapsed into obscurity. Calico Life Sciences, a subsidiary of Alphabet, which was the Altos of its day in 2013, has fallen completely out of the conversation. Grand science projects born of entanglements between the very wealthy and the not entirely mainstream do not always end well. Remember Biosphere 2.

A reasonable tendency to short-term scepticism, though, should not preclude medium-term open-mindedness. There is now a serious interest in understanding the biological underpinnings of ageing. There are treatments available which can almost certainly be used to extend healthspans, and possibly even lifespans, even though a lack of formal trial evidence makes it hard to see which of the touted options actually work. And there are promising lines of inquiry which may lead to bigger breakthroughs.

Evolution has no interest in seeing people live for ever, or even indefinitely. But that will not stop people trying. Whether it is feasible in practice is another thing altogether, for bodies contain trillions of cells that will need either rejuvenation or renewal. But less heroic measures towards smaller gains may yet yield fruit. And that alone is surely worth the effort. ■



必先利其器

对抗衰老需要装备良好的细胞

保持正确数量的正确蛋白质【专题《长命百岁》系列之七】

细胞的机构几乎完全由蛋白质组成：每个蛋白质都是一条氨基酸链，折叠时呈现出特定的形状。其中一些的形状旨在识别其他分子，有时将两个不同的分子结合在一起，从而催化它们之间的反应。其他的形状则用于将DNA、RNA或其他蛋白质分子切割成块。细长的蛋白质组装在一起形成杆和丝，为细胞结构提供细胞骨架；其他的则在膜上形成孔隙。但无论做什么，首先都必须将蛋白质折叠成正确的形状。

在很大程度上，大多数蛋白质会自行折叠。但有些需要其他蛋白质（称为“分子伴侣”和“折叠酶”）的帮助。这两种情况都可能出错。基因组突变或RNA处理不当可能导致蛋白质链在一个或多个位置出现错误的氨基酸，导致折叠得很糟糕。或者，分子伴侣和折叠酶本身也可能会犯错误。这些错误折叠的蛋白质不仅无法正常工作，而且如果大量产生，它们还有可能让细胞的修复和清除机制难堪重负。

以正确的比例为细胞提供正确的蛋白质并使之处于最佳状态的过程就是“蛋白质稳态”。对这一过程的控制如果受损，无论何时发生都是有害的，有时甚至非常严重。错误折叠的蛋白质的累积引发了多种最严重的老年疾病，包括阿尔茨海默病和帕金森氏症。错误折叠的蛋白质也会导致白内障，虽然可以治疗，但它仍然是全世界失明的主要原因之一。

对抗这类疾病的可能性解释了为什么修复蛋白质稳态是Altos硅谷园区的核心业务。该项目由彼得·沃尔特（Peter Walter）负责，在加入Altos之前，他是负责识别细胞中所谓的综合应激反应（ISR）的人员之一。

顾名思义，ISR对多种形式的压力做出反应，包括饥饿、感染和过多的活性氧。它的主要作用之一是确保这些压力不会扰乱细胞的蛋白质稳态。如果情况不正常，ISR会减慢蛋白质的生成速度，从而减轻分子伴侣和折叠

酶的负担。如果事情真的偏离轨道，它就会按下自毁按钮，启动细胞凋亡。

Altos的运营安保使得我们很难判断沃尔特博士和他的同事们是否取得了任何进展。但ISR并不是获得蛋白质稳态的唯一方法。另一种方法是微自噬，这是一种清除受损和多余蛋白质的过程。波士顿的Life Biosciences公司在研究表观遗传重编程的同时也在涉足微自噬。

除了折叠蛋白质之外，分子伴侣还将它们折叠出错的蛋白质传递给细胞机器中称为溶酶体的部件，后者将这些蛋白质分解以便回收氨基酸。但这个垃圾处理系统是“一次性躯体理论”的又一个受害者，因此也是老年时的候选修补对象。Life Biosciences公司的研究人员声称发现了一种分子可以做到这一点，他们现在正处于测试它在抑制额颞叶痴呆、阿尔茨海默病和视网膜变性上的潜力的早期阶段。

与微自噬并存的还有巨自噬，这项功能的重要性足以使之被列为一个独立的衰老标志。与微自噬一样，巨自噬将需要分解的蛋白质传递给溶酶体。不同之处在于，它使用一种称为自噬体的垃圾车来运送，这种垃圾车足够大，不仅可以运输一堆蛋白质，甚至可以运输整个线粒体。自噬的基因抑制会加速实验动物的衰老。刺激它则可以延长健康年限和寿命。

刺激它的一种方法是使用一种叫做亚精胺的分子。这可使小鼠的寿命延长高达25%。二甲双胍是一种2型糖尿病药物，人们正在研究它是不是具有更广泛的抗衰老活性，它也能促进自噬。雷帕霉素也可能有这种作用。生物化学是一张错综复杂的网。所以也许不足为奇的是，根据可用能量来调节细胞行为的通路或许也可以参与处理多余的蛋白质。

其他刺激物则不太为人所知。由OpenAI的山姆·阿尔特曼（Sam Altman）资助的创业公司Retro Biosciences正在研究一种自噬增强剂用于治疗一种肌肉疾病。目前只知道这种增强剂被叫做RTR-242，该公司也拒绝透露是何种肌肉疾病。

洛佩斯-奥廷博士列出的最后一个衰老标志是慢性炎症，现在有点烦人的

流行说法是“炎性衰老”（inflammageing）。健康的炎症是对组织损伤、病原体或寄生虫的反应。白细胞听到受影响细胞发出的化学求救信号，猛扑过来清除受损细胞并反击入侵者。这样做的一个副作用是会引起肿胀，从而增加周围环境的压力。

出现基因组不稳定、衰老以及和微生物群通讯不良的细胞也会释放此类分子，在它们造成伤害的地方引发炎症反应。事实上，慢性炎症所带来的威胁是如此之大，以至于一种叫做IL-6的分子的高水平（炎症指标）可以预测人类的全因死亡率。

对于炎性衰老，没有灵丹妙药。健康生活就是答案。减肥（因为脂肪细胞是引发炎症的化学物质的来源）、锻炼、睡眠以及戒烟戒酒都是好主意。而在这方面做到极致，是一些想要尽可能长时间地逃避死亡的人已经走过的一条路。 ■



Give us the tools

Fighting ageing requires properly equipped cells

Keeping the right proteins in the right amounts

A CELL'S MACHINERY is made almost entirely of proteins, each of them a chain of amino acids that takes on a particular shape when folded up. The shapes of some of them are designed to recognise other molecules, and sometimes to bring two different molecules together in a way that catalyses a reaction between them. Others are designed to cut DNA, RNA or other protein molecules into chunks. Long thin ones fit together to create the rods and filaments which give the cell structure its cytoskeleton; others make pores in membranes. But whatever has to be done, the protein has to be folded into the correct shape to begin with.

To a large extent most proteins fold themselves. Some, though, need help from other proteins, known as chaperones and foldases. In both cases things can go awry. Mutations in the genome or mishandling of RNA can lead to a protein chain having the wrong amino acid in one or more positions and thus folding up badly. Alternatively, the chaperones and foldases may themselves make a mistake. Not only will these misfolded proteins not work properly, they risk, if produced in large quantities, overwhelming a cell's repair and removal mechanisms.

The process that keeps a cell supplied with the right proteins in the right proportions and in peak condition is proteostasis. Impaired control of this process is detrimental wherever it happens, sometimes terribly so. Accumulations of misfolded proteins underlie several of old age's nastiest illnesses, including Alzheimer's and Parkinson's diseases. Misfolded proteins also cause the cataracts which, though treatable, remain a leading cause of blindness throughout the world.

The possibility of dealing with such conditions explains why fixing proteostasis is the core activity of Altos's campus in Silicon Valley. This is run by Peter Walter, who was, before Altos recruited him, one of those responsible for identifying what is known as the integrated stress response (ISR) in cells.

As its name suggests, the ISR reacts to many forms of stress, including starvation, infection and too much reactive oxygen. One of its main jobs is to make sure that they don't mess with the cell's proteostasis. If things get out of whack the ISR slows the rate at which proteins are being made, which lightens the load on the chaperones and foldases. If things go really off the rails, it presses the self-destruct button which sets apoptosis in motion.

Altos's operational security makes it hard to say what if any progress Dr Walter and his colleagues are making. But the ISR is not the only approach to proteostasis. One alternative is microautophagy, a process which clears away damaged and superfluous proteins. Life Biosciences of Boston is dabbling in microautophagy alongside its work on epigenetic reprogramming.

Besides folding proteins up, chaperones also deliver their mistakes to bits of cellular machinery called lysosomes, which disassemble them so that their amino acids can be recycled. But this garbage-disposal system is yet another victim of disposable-soma theory, and thus another candidate for pepping up in later years. Researchers at Life Biosciences have found a molecule which, they claim, can do just that, and they are now in the early stages of testing its potential to curb frontotemporal dementia, Alzheimer's disease and retinal degeneration.

Alongside microautophagy sits macroautophagy, a big enough deal to have a hallmark of its own. Like microautophagy, the macro kind delivers proteins that need to be broken down to lysosomes. The difference is that it uses a

garbage truck called an autophagosome to get them there, one big enough to transport not just a bunch of proteins but even whole mitochondria. Genetic inhibition of autophagy accelerates ageing in laboratory animals. Its stimulation increases healthspan and lifespan.

One way to stimulate it is with a molecule called spermidine. This extends the lifespan of mice by up to 25%. Metformin, the type-2 diabetes drug being looked at for broader anti-ageing activity, also boosts autophagy. Rapamycin may do so, too. Biochemistry is a tangled web. It is perhaps not surprising that pathways which regulate what cells do according to the energy available might take an interest in the disposal of surplus proteins.

Other stimulants are less widely known. Retro Biosciences, the startup funded by Sam Altman of OpenAI, is looking at an autophagy booster known only as RTR-242 as a treatment for a disease of the muscles that it also declines to name.

The last of Dr López-Otín's hallmarks of ageing is chronic inflammation, now trendily and irritatingly often referred to as "inflammageing". Healthy inflammation is a response to tissue damage, pathogens or parasites. White blood cells heeding chemical cries for help from afflicted cells swoop in to clear out the damaged ones and fight back against the invaders. A side-effect of their doing this is that they cause swelling, thus increasing the pressure on their surroundings.

Cells experiencing genetic instability, senescence and poor communications with their microbiome also release such molecules, provoking inflammatory responses in places where they cause harm. Indeed, the threat posed by chronic inflammation is such that a high level of a molecule called IL-6, an indicator in inflammation, is predictive of all-cause mortality in humans.

For inflammageing, there is no magic pharmaceutical bullet. Healthy living is the answer. Weight loss (for fat cells are sources of inflammation-provoking chemicals), exercise, sleep and eschewal of smoking and alcohol are all good ideas. And that, taken to extremes, is a pathway beaten by some of those who would like to cheat death for as long as possible. ■



不可得兼

更老的基因组有更多不可靠的基因

进化的权衡可以避免吗？【专题《长命百岁》系列之六】

营养感知系统可以调校，衰老细胞可以定向清除，可以供应全新干细胞，也可以重整表观基因组。对于许多衰老标志来说，空气中弥漫着希望的气息。但它们中有些比另一些更难驾驭。也许最难攻克的是基因组不稳定——突变的持续累积。比如，英国剑桥附近的威廉桑格研究所（Wellcome Sanger Institute）的菲利普·琼斯（Philip Jones）领导的团队在2018年发表的研究显示，到了中年，人类每个食道内壁细胞将有平均20个基因已发生突变。

细胞具有监视和修复机制来纠正其DNA受到的损伤。然而突变仍会持续存在，这是因为进化使得这些机制只是足够好，而非完美。如果百分百修复突变，细胞付出的代价要比放任某些突变而致DNA受损更高。这解释了为什么人们会发现，当细胞被置于一个某种DNA损伤更为普遍的环境中，它们会放弃修复其他类型的损伤——这样的修复已不再值得。

最大的风险在于那些解放了细胞固有的不停歇或无目的自我繁殖能力的突变，它导致了癌症。身体有多种方式对这类突变做出反应：有一整套肿瘤抑制蛋白，其中最著名的是p53和p16；对于被突破了这类防御机制的细胞，免疫系统有多种方式向它们发动突击。而作为最后的防线，它还有海弗利克极限，也就是只给细胞有限的繁殖机会。

在这里，生命的权衡取舍再度上演。如果抗癌措施放松些，衰老问题可能就不那么严重了。p53的活性越低，衰老细胞的危害就越小，因为它们泄漏到环境中的p53和p16会削弱附近的任何干细胞。在有必要时让细胞更易恢复生长可能会抵消非致癌突变的缓慢侵蚀，减轻衰老细胞的死气沉沉，恢复其活力。但创造更适于生长和更新的组织的代价将是更多的癌症。

一些人认为代价是可以规避的。加州山景城的Rejuvenation Technologies

公司（和与本专题前文提到的名字相像的、位于加州拉霍亚市的 Rejuvenate Bio 公司一样，其资助者也包括了哈佛大学的丘奇博士）正计划帮助细胞延长其端粒并避免海弗利克极限。他们认为，如果细胞制造出更多端粒酶的一种重要子成分，那么端粒损耗就可以被抵消（洛佩斯-奥廷博士及其同事认为端粒损耗非常重要，足以成为一项独立的衰老标志）。为促成细胞这样做，他们将使用在一些新冠肺炎疫苗中使用的那种 mRNA 技术。

将 mRNA 注射到需要恢复活力的组织中，就可为细胞提供暂时制造这种端粒酶子成分的能力。多项研究已经表明，增强端粒酶活性可以延长小鼠的寿命和健康寿命，对胰岛素水平、神经功能和力量都有积极影响。 Rejuvenation Technologies 的初步针对目标将是两种形式的纤维化，然后是肝硬化。

在小鼠身上，这种方法还显现了一个意想不到的好处：它增强了细胞赖以产生三磷酸腺苷（ATP，蛋白质从这种分子中获取能量）的线粒体的活力。原因尚不清楚：尽管线粒体有自己的小基因组，它们没有端粒。但这是人们喜闻乐见的发现，因为衰老专家对线粒体感兴趣已有好几十年了。

后来得知，他们最初的兴趣投错了地方。它是基于这样的想法：线粒体利用氧从代谢物中获取能量的方式使它们暴露于高度活性的氧中，其浓度会损坏它们的基因。这种“氧化应激”造成的损害被认为是衰老的一个关键方面。

事实证明，这充其量只是部分正确。线粒体基因的损伤确实要紧，但它似乎是由于复制错误而非活性氧造成的。不过，那些氧自由基确实有可能引发炎症，而由于线粒体和我们许多人一样会在上年纪时变得稍微更易“渗漏”，这种可能性就会逐渐变成现实。而细胞清除老弱线粒体的系统也会随时间推移而变得更低效，使情况进一步变糟。

线粒体与衰老之间的另一个关联在护脑素（humanin），这是一种氨基酸短链，生物学家称之为肽。线粒体基因组似乎除了包含描述一些全长蛋白

质的基因除外，还包含许多可以描述肽的短DNA序列，其中一些肽现已被分离和研究。

随着人们年龄的增长，护脑素通常会变得不再那么普遍存在。但对百岁老人的研究表明，他们的护脑素水平仍然很高。这里发现的是相关性，而非因果关系，但足够有趣而值得展开一些实验。研究人员已经发现，经基因改造而具有高护脑素水平的线虫寿命更长。今年4月，意大利萨萨里大学的研究人员综述了护脑素的保护作用，指出它可能会在治疗阿尔茨海默病和帕金森氏症、糖尿病、肥胖症和炎症方面发挥作用。又一个美人胚子来到了舞会上。 ■



You can't have everything

Older genomes have more dodgy genes

Can evolution's trade-offs be avoided?

NUTRIENT-SENSING systems can be tuned up; senescent cells targeted for destruction; stem cells supplied afresh; epigenomes spruced up. For many of the hallmarks of ageing hope is in the air. But some are more refractory. Perhaps the toughest of all is genomic instability: the persistent accumulation of mutations. By middle age, to take an example published in 2018 by Philip Jones's group at the Wellcome Sanger Institute near Cambridge, England, the cells lining a human oesophagus will each have acquired mutations in an average of 20 genes.

Cells have surveillance and repair mechanisms to correct damage to their DNA. Mutations persist regardless, though, because evolution makes these mechanisms good enough, rather than perfect. The investment required to repair 100% of the mutations would cost the cell more than the damage it sustains to its DNA by letting some mutations slide. This explains the finding that when cells are placed in an environment where one sort of damage to DNA becomes more common, they give up on repairing other sorts; such repairs are no longer worth it.

The biggest risk comes from mutations which unleash the cell's innate capacity to reproduce without pause or purpose, thereby causing cancer. The body has various ways to react to such mutations; there is a whole set of tumour repressor proteins, of which the most well known are p53 and p16, and there are various ways for the immune system to swoop on the cells in which those safeguards are over-ridden. As a backstop, it also has the Hayflick limit, which gives cells only so many chances to reproduce.

Here again, life's trade-offs are at play. If anti-cancer measures were to be relaxed, ageing might be less of a problem. Less p53 activity would make senescent cells less damaging; the p53 and p16 they leak into the environment cripples any nearby stem cells. Making it easier for cells to resume growth if necessary might allow the slow erosion of non-cancer-causing mutations to be offset, with the dead weight of somewhat clapped-out cells lessened and vigour returned. But the price of creating tissues better suited to growth and rejuvenation would be more cancers.

Some think that price can be circumvented. Rejuvenation Technologies, of Mountain View, California (which like the similarly named and previously mentioned Rejuvenate Bio of La Jolla, California, counts Harvard's Dr Church among its backers), is planning to help cells extend their telomeres and avoid the Hayflick limit. They think telomere attrition (which Dr López-Otín and his colleagues see as important enough to qualify for a hallmark of its own) can be countered if cells make more of a vital sub-component of telomerase. To encourage them to do so they will use mRNA technology like that used in some SARS-CoV-2 vaccines.

Injected into tissues that need rejuvenation the mRNA would provide cells with a temporary ability to make this substance. Various studies have shown that pepping up telomerase increases both the lifespan and the healthspan of mice, with positive effects on insulin levels, neurological function and strength. The initial targets for Rejuvenation Technologies will be two forms of fibrosis, then cirrhosis of the liver.

In mice the approach also had an unlooked-for bonus: it perked up the mitochondria on which cells rely for the production of ATP, the molecule from which proteins get their energy. Why this might be is not clear; though mitochondria have small genomes of their own, they have no telomeres. But it is welcome, because mitochondria are something that ageing specialists have been interested in for decades.

Their initial interest was, it transpired, misplaced. It was based on the idea that the way in which mitochondria use oxygen to get energy out of metabolites exposed them to fearsomely reactive forms of oxygen at levels that damaged their genes. This damage due to “oxidative stress” was held to be a key aspect of ageing.

This turned out to be, at best, only partially true. Damage to mitochondrial genes does matter, but it seems to come about as a result of replication errors rather than reactive forms of oxygen. Those oxygen radicals do, though, have the potential to encourage inflammation—and because mitochondria, like many of us, get a bit more leaky as they age, over time that potential becomes reality. The cell’s systems for getting rid of clapped-out mitochondria also become less efficient over time, making matters yet worse.

Another link between mitochondria and ageing comes in the form of humanin, a short string of amino acids of the sort biologists call a peptide. It appears that as well as containing genes describing some full-size proteins, mitochondrial genomes also contain a lot of short DNA sequences that could describe peptides, and some of these peptides have now been isolated and studied.

Humanin normally becomes less prevalent as people age. But studies of centenarians show that their humanin levels stay high. Correlation, not causation; but interesting enough to justify some experiments. Those have found that nematode worms genetically engineered to have high humanin levels live longer. In April a review of humanin’s protective effects by researchers at the University of Sassari, in Italy, suggested that there could be a role for it in treating Alzheimer’s and Parkinson’s diseases, diabetes, obesity and inflammation. Another potential belle has come to the ball. ■



血液与肠道

年轻人能给老年人什么

肠道微生物和血液能成为青春的礼物吗？【专题《长命百岁》系列之五】

十九世纪法国先驱生理学家保罗·伯特（Paul Bert）在实验室实验中添加了一道可怕的新程序：把两只老鼠“嫁接”在一起，就像园艺工把树枝嫁接到另一棵树上那样。部分目的是要看看哪些特质可以从一只老鼠通过共享的血液转到另一只老鼠。在1950年代，这类“联体共生”实验带来了这样的提示：一个可转移的特质是青春。在被连接到年轻老鼠身上几周后，年长老鼠出现了返老还童的迹象。

这些实验少有人关注，直到本世纪头十年，人们对衰老科学产生的新兴趣使它们重见天日。自那时起，这种现象吸引了科学家以及一些或可被宽容地称为投机者的人们的新兴趣。年轻人给老年人输送的人血浆让富有的客户可以用拮据的学生的血液赌上一把。

年轻血液可能含有对老年人有帮助的物质，例如牛磺酸或护脑素（humanin）。然而，看起来很有可能的是，在老年老鼠身上看到的回春效果更多地要归因于垃圾的清除，而不是年轻精华物质的涌入。2020年，加州大学伯克利分校的伊琳娜·康博伊（Irina Conboy）和她的同事发现，仅用白蛋白这种血液蛋白加上盐水替换掉一只年老小鼠一半的血液，与使用年轻小鼠的血液来替换具有相同的回春效果。老龄血液需要的可能是过滤和稀释，而非补充。

有趣的是，血液并不是唯一一样在年老和年轻的动物间转移后会影响它们衰老进程的东西。肠道微生物也会。身体中的微生物不仅仅是寄居者，进化使得它们在宿主的健康状况中扮演角色。肠道细菌从食物中释放出难以获取的营养物质，并合成宿主自身无法合成的分子。

1950年代的一些联体共生实验旨在发现年轻的血液是否会让年老小鼠的微生物组减龄。（结果并没有。）但是，从年轻小鼠的消化道中取出粪便

(及其所含的微生物) 放入更年长小鼠的肠道中，似乎延长了经遗传工程改造的“早衰”小鼠的寿命和健康寿命。

西雅图的系统生物学研究所 (Institute for Systems Biology) 的一组研究人员对18岁至101岁的9000人的研究揭示了有关他们肠道中日益衰老的微生物组的三件事。

首先，到了中年，人与人之间的微生物组变得越来越不同。其次，随着年龄的增长，这种独特性增加的过程在健康人身上持续存在，但在不健康的人身上中止。第三，对于85岁或以上的人来说，缺乏这种独特性预示着更早死亡。

对于哪些微生物最为重要已有明显的线索。植物乳杆菌既延长了早衰小鼠的寿命，也减轻了其认知衰退。有趣的是，低热量饮食会增加植物乳杆菌的存在。相反，大量拟杆菌属细菌保留到老年是一个已知的死亡率预测指标。但该研究所的研究传达出的关键信息是，一个老龄友好的微生物组得要能很好地适应其所在的独特环境。或许我们首先必须对微生物组如何适应其宿主（反之亦然）有更为根本性的了解，方可建立一条由肠道通往不朽的道路。 ■



Blood and guts

What the young can give to the old

Can gut microbes and blood be gifts of youth?

PAUL BERT, a pioneering 19th-century French physiologist, added a gruesome new procedure to laboratory experimentation: grafting mice together rather as a gardener grafts branches onto a tree. Part of the idea was to discover what qualities could be passed from one mouse to the other through the blood they now shared. In the 1950s such “parabiosis” experiments led to the suggestion that one such thing was youth. Older rats, after several weeks grafted to younger rats, showed signs of rejuvenation.

The experiments were widely ignored until new interest in the science of ageing brought them to light in the 2000s. Since then the phenomenon has attracted new interest among both scientists and a number of people who might charitably be described as chancers. Young-to-old transfusions of human blood plasma allow wealthy clients to take a punt on the blood of hard-up students.

There may be substances in young blood that help the old, such as taurine or humanin. However it seems quite likely that the effect seen in older rats owes more to the removal of detritus than an influx of the essence of youth. In 2020 Irina Conboy of the University of California, Berkeley, and her colleagues found that replacing half of an old mouse’s blood with just albumin, a blood protein, and saline solution had the same rejuvenating effect as young-mouse blood. Old blood may need filtering and dilution, not supplementing.

Intriguingly, blood is not the only thing which, if transfused between old and young animals, has an effect on how they age. Gut microbes do so,

too. A body's microbial inhabitants are not mere hangers-on; evolution has built them a role in their host's well-being. Gut bacteria liberate inaccessible nutrients from food and synthesise molecules their host cannot.

Some of the parabiosis experiments in the 1950s were aimed at discovering whether the microbiome of the old mouse would be rejuvenated by young blood. (It was not.) But taking poo (and the microbes it contains) out of the digestive tract of a young mouse and putting it into the gut of an older one seems to enhance both lifespan and healthspan in "progeric" mice engineered for early ageing.

A study of 9,000 individuals aged between 18 and 101 by a team of investigators at the Institute for Systems Biology, in Seattle, revealed three things about the ageing microbiomes in their guts.

First, in middle age people's microbiomes become increasingly dissimilar from individual to individual. Second, this process of increasing distinctiveness continues in healthy people as they get older but stops in those who are unhealthy. Third, in those aged 85 or more, lack of such distinctiveness is a harbinger of earlier death.

There are broad hints as to which microbes are the ones that matter. *Lactobacillus plantarum* both extends lifespan and alleviates cognitive decline in progeric mice. Its presence is also, intriguingly, boosted by calorie-restricted diets. Conversely, retention into old age of lots of bacteria of the genus *Bacteroides* is a known predictor of mortality. But the key message of the institute's studies is that an old-age-friendly microbiome is one well adjusted to its unique circumstances. More fundamental insights into how the microbiome adapts to its host, and vice versa, may be necessary before a road to an enduring old age through the gut can be established. ■



弓头鲸和苏俄牧羊犬

实验室小鼠的替代品

研究人员正在考虑鲸鱼、麻雀和大型犬【专题《长命百岁》系列之四】

本系列读到这里，你完全有可能在暗自寻思，如果运气好或是先知先觉地投胎成了一只实验室小鼠，你的寿命就可轻松大大延长。毕竟，很多东西似乎都延长了它们的寿命。如果是这样，你应该学习一下阿拉巴马大学伯明翰分校的史蒂文·奥斯塔德（Steven Austad）的怀疑态度。

他认为，要了解没有经历数十年近亲繁殖，且生活环境比实验中人造的危险更为危险的动物的衰老，实验室小鼠的帮助微乎其微。在他看来，实验室小鼠不仅不能很好地指导动物衰老这一更为广阔的世界，而且已经几乎算不上是老鼠了。用他的一位同事的话说，它们只是“类似老鼠的物体”。

这种怀疑可能部分源自于奥斯塔德博士来到实验室前走过的异常漫长而迂回的路。他的第一个学位是英国文学。他尝试写一部伟大的美国小说但失败了，还做过出租车司机、报社记者和驯兽师。最后一份工作激发了他对动物学的兴趣，并最终引领他进入了学术界。

人类的最长寿命记录120岁出头，处于动物寿命的上限。但也有一些物种超越了人。弓头鲸估计有200年寿命，被认为是最长寿的哺乳动物。格陵兰鲨可以达到这个数字的两倍。众所周知巨龟能活几百岁。在无脊椎动物中，红海胆的寿命被认为可以达到100年，一种名为*Escarpi laminate*的管虫寿命可达300年，而圆蛤可以活500年。

要深入研究弓头鲸和格陵兰鲨显然存在困难。长寿的无脊椎动物可能不会像你可能会希望的那样对人的情况有太多的启发。而且研究真正的长寿动物，无论是否有脊椎，可能意味着要按照它们的时间表工作，这几乎没有帮助。

作为长寿和繁殖力之间的折衷方案，奥斯塔德博士建议采用麻雀。一般来

说，动物的寿命随着体型的增大而延长。但野生老鼠可以活三四个月，而体重相似的野生麻雀却可以活近20年。他认为，了解赋予这些鸟类如此长寿的生理差异可能会为延长人类的寿命和健康寿命带来有用的想法——尽管人类基本上是家养的，但他对这种物种很感兴趣。

另一种不走寻常路的方法是，不通过在野外寿命较长的动物的视角来看待衰老，而是通过在饲养环境中寿命较短的动物的视角。大型犬的寿命比小型犬短；为了培育它们的体型也导致它们的寿命短。这种情况发生的机制可能比衰老涉及的大多数机制更容易研究，因为选择性育种对狗的基因组的改变相对较小。将由此获得的理解转化为治疗方法，将让拥有大丹犬、纽芬兰犬等大型犬的人们献出大笔金钱和爱。

这正是旧金山创业公司Loyal的创始人席琳·哈利欧阿（Celine Halioua）想做的事情。她清楚自己想要瞄准哪条通路，其公司正在将一种药物（其详细信息未公开）投入试验。动物试验比人体试验更容易完成，兽医批准也比医学批准快得多。哈利欧阿博士希望，通过为大型犬开发这种延长寿命的补充剂，可以很快为Loyal提供可靠的收入来源。这样她就可以为自己的长期目标——延长人类寿命——提供资金。这应该有助于实现她的另一个英雄般的抱负——创建一家人们真正喜欢、甚至热爱的制药公司。什么样的第一步能比得上和最好的朋友一起度过更多年呢？■



Of bowheads and borzois

Alternatives to the laboratory mouse

Researchers are looking at whales, sparrows and large dogs

IT IS ENTIRELY possible that at this point you, the reader, are thinking that a greatly enhanced lifespan would be there for the taking had you only had the good luck or foresight to have been born a laboratory mouse. So many things, after all, seem to extend their life's lease. If so, you should learn from the scepticism of Steven Austad of the University of Alabama, Birmingham.

Laboratory mice are very little help, he thinks, in understanding ageing in animals that have not gone through decades of inbreeding and which live in environments that offer more danger than that inflicted in experiments. Lab mice, he feels, are not just a poor guide to the wider world of animal ageing; they are barely even mice any more. They are, in a phrase coined by one of his colleagues, just "mouse-like objects".

This scepticism may, in part, come from the fact that Dr Austad took an unusually long and circuitous route to the lab. His first degree was in English literature; as well as making an abortive attempt to write the great American novel he has enjoyed employment as a taxi driver, a newspaper reporter and an animal trainer. The last job provoked an interest in zoology that led to academia.

With a maximum recorded lifespan of just over 120 years, human beings are at the upper end of the animal longevity scale. But there are a few that outdo them. At an estimated 200 years, bowhead whales are thought to be the longest-living mammals. Greenland sharks can manage double that. Giant tortoises are well-known centenarians. Among invertebrates, red sea urchins are reckoned to be able to clock up 100 years, a type of tube worm

called Escarpia laminate, 300 years, and ocean quahog clams, 500 years.

In-depth studies of bowhead whales and Greenland sharks obviously pose difficulties. Long-lived invertebrates may not have as much to say about people as one might wish. And working with true methuselahs, backboned or not, might mean working on their timescales, which would hardly be helpful.

As a compromise between longevity and fecundity Dr Austad proposes the house sparrow. In general, animal lifespans increase with size. But whereas wild mice live three or four months wild sparrows, similar in weight, can live almost 20 years. Understanding the physiological differences that grant these birds such long lives might, he reckons, lead to useful ideas for increasing the lifespans and healthspans of people, a species in which he is interested despite its basically domesticated nature.

Another off-kilter approach is to look at ageing not through the lens of animals that lead long lives in the wild, but of animals which lead shorter lives in domesticity. Big breeds of dog live less long than small ones; breeding them for size bred them for short lives, too. The mechanism by which that happened may be more tractable to study than most of those involved in ageing; selective breeding has changed relatively little of the dogs' genome. And turning understanding thus gathered into a treatment would unleash a flood of dollars and love from people who own Great Danes, Newfoundlands and the like.

That is what Celine Halioua, the founder of Loyal, a San Francisco startup, wants to do. She knows which pathway she wants to target and the company is getting a drug (details of which are not public) into trials. Animal trials are more easily done than human ones, and veterinary approval is far faster than medical approval. Dr Halioua's hope is that by developing a life-lengthening supplement for big dogs she can provide Loyal with a reliable

revenue stream quite quickly. With that she can fund her long-term goal, the extension of human life. And it should help with her other heroic ambition—to found a drug company people actually like, even love. What better first step than extra years with a best friend? ■



不要贪吃

低热量饮食可以延缓衰老

而各种现有药物可能具有类似的功效【专题《长命百岁》系列之二】

1991年，八名志愿者将自己封闭在亚利桑那州图森附近沙漠中的一个巨大温室里。他们参与了一项实验，旨在探索精心挑选的一批植物和动物是否可以发展成为一个可以自我维续的生态系统：独立于“生物圈一号”（即外部世界）的“生物圈二号”。

就证明宏大的生态学真理而言，“生物圈二号”实验是失败的。作为一个当边缘科学遇到极端财富时会发生什么的例证，这些实验非常有趣。玻璃的两侧都发生了激烈的争吵。1994年，支付这一设施费用的石油大亨埃德·巴斯（Ed Bass）解雇了管理团队，把领导权移交给了史蒂夫·班农（Steve Bannon），后者后来成为唐纳德·特朗普的重要顾问。但与此同时，一些人认为其中取得了人类衰老科学的突破。

罗伊·沃尔福德（Roy Walford）是生物圈的八位居民之一，他是加州大学洛杉矶分校（UCLA）的病理学教授。沃尔福德和其他人的研究表明，限制动物的饮食范围可以显著延长其寿命。实验室方案为它们提供了含有矿物质、维生素等所有所需营养成分的饮食，但卡路里含量却比平常的惯例要少。线虫、果蝇、啮齿动物和狗的寿命可以由此延长多达50%。

生物圈二号让沃尔福德能够在没有办法偷偷溜走吃零食的人类身上测试这个理论。那些生物圈居民本来就很健康苗条，每天摄入1750至2100卡路里（7320至8790千焦）后全部都瘦下来了。但八个月后，他们的体重稳定下来。尽管瘦削，他们却精力旺盛。血液测试显示，他们的生理反应与那些被限制了热量而寿命延长了的啮齿动物的相当。

有些人据此认为应把限制卡路里纳入生活，正如沃尔福德所做的那样。但这种饮食方式很难维持下去，它远远超出了任何理智的人有志于付出的那种限制体重的努力。这引发了人们的兴趣，要去找到无需真正限制卡路里

摄入就能获得其益处的方法。

卡路里是细胞将食物分解为化学成分所获得的能量的量度。这种分解的确切性质，以及各种成分发生了什么，都受控于一系列信号通路，这些通路的作用是将细胞所做的事与生物体需要和可用的能量相匹配。这些营养信号通路的功能障碍是洛佩斯-奥廷博士及其同事列出的12个衰老标志之一。

如果在热量限制的成功背后有一个普遍真理的话，那就是当能量匮乏时，细胞中的营养信号传导通路会更加关注发生了什么，并使细胞保持更好的状态。如果要在不减少卡路里的情况下激发相同的通路，那么就有必要了解哪些其他信号可以产生相同的效果。

如果这些通路都具有独特的、清晰易懂的功能，那么研究就会更容易进行，也更容易理解。可惜事实并非如此。通路经常调节不止一种功能，功能也往往由不止一种通路调节，并且通路最远端很可能是模糊的。更难以理解的地方在于，参与这些通路的蛋白质的名称也极为难懂。

比如MTORC1通路。它的名字所指的这种蛋白质复合物首次引起人们的关注，是因为一种名为雷帕霉素的免疫抑制剂对其具有很强的作用：于是就有了“雷帕霉素复合物1的机械靶标”。然而，这并没有提供真正的线索来指明这样一个事实，即MTORC1所在的信号通路是一组复杂的控制和反馈，旨在调节代谢以对营养物质的多少（例如，提供能量的葡萄糖和用来制造蛋白质的氨基酸）以及使用它们的障碍（例如，氧含量低）做出响应。

这种调节能力所涉广泛；它影响细胞分解受损内部结构（“自噬”）的速度、蛋白质含量的平衡（“蛋白质稳态”）以及线粒体的繁殖（线粒体负责将接收到的卡路里转化为蛋白质可以使用的能量形式）。自噬、蛋白质稳态和线粒体繁殖是12个衰老标志中的另外三个。

更重要的是，雷帕霉素（MTORC1的名字来源于其效果）被证明可以延长实验动物的寿命，尽管它会抑制实验动物的免疫反应。这导致一些长寿爱

好者寻求标签外处方。但其副作用，包括贫血和对胰岛素不敏感，使得雷帕霉素不适合广泛使用。因此，人们正在寻找雷帕霉素类似物（rapalog），它可以带来调节MTORC1通路的益处，而无需付出这么多代价。

热量限制研究提出的另一条有希望的通路以一种名为AMPK的蛋白质命名（别问是什么）。它调节三磷酸腺苷（ATP）的产生，这是线粒体中产生的一种携带能量的小分子。当ATP水平下降时，AMPK通路会提高细胞对胰岛素的敏感度。

二甲双胍是一种用于治疗2型糖尿病的药物，通过激活AMPK通路来实现这一目的。与雷帕霉素一样，它可以延长健康小鼠的寿命。它对糖尿病人也有同样的作用。2014年发表的一项研究表明，接受二甲双胍治疗的糖尿病患者的死亡率不仅低于未接受治疗的患者，甚至低于未接受该药物的健康对照组。

毫不意外，二甲双胍也有标签外使用，可能比雷帕霉素更广泛。非营利组织美国老龄化研究联合会希望很快启动一项为期六年、有3000人参与的临床试验，以衡量其对65岁至79岁人群的影响。二甲双胍靶向衰老（TAME）试验将了解二甲双胍是否有助于预防心血管疾病、癌症和认知能力下降；它还将检验它降低全因死亡率的假设。

另一套用于治疗糖尿病但现在使用更广泛的药物是GLP-1受体激动剂。最著名的是索马鲁肽（商品名Wegovy），它已在多个地方获得特别许可，可用于没有糖尿病但需要减肥的人。这些人是否会比最终体重相同但不服用某种这类药物的人活得更久还是个悬而未决的问题。没有已发表的研究表明这些药物对实验动物的寿命有影响。

对实验动物有效的一种物质是牛磺酸，一种广泛用作膳食补充剂的氨基酸。根据加州诺瓦托市的巴克衰老研究所（Buck Institute for Research on Ageing）的帕尔敏德·辛格（Parminder Singh）及其同事最近发表的一篇论文，牛磺酸可使小鼠的寿命延长10%；其中一些似乎是由于营养信号传

导所致。但它也会对其他四五个衰老标志产生影响。牛磺酸水平在人类身上随着年龄的增长而下降，但在活到100岁以上的人中，牛磺酸仍保持在高得多的水平。

NAD⁺分子也可以增强营养敏感度。一些酶（催化化学反应的蛋白质）需要一个额外的小分子才能发挥作用。NAD⁺就是这样一种“辅酶”。超过300种酶需要它的存在才能为细胞发挥作用。如果你给老鼠更多这种物质，它们就会活得更久。

考虑到NAD⁺的贡献如此之大，我们很难确切地知道它所帮助的哪些酶带来了这种效果。但看起来特别有趣的是与一组称为sirtuin的蛋白质的联系。

二十年前，现任哈佛大学衰老生物学研究中心联合主任的大卫·辛克莱（David Sinclair）发现，刺激sirtuin的产生可以延长多种实验动物的寿命。sirtuin遂声名鹊起。刺激的一种形式是限制热量。但辛克莱博士发现了一种化学替代品：白藜芦醇，一种在红葡萄皮等地方发现的分子。

辛克莱博士完全不介意公众关注——他的发现引发了轩然大波。他创立了Sirtris公司，生产适合人体的白藜芦醇衍生物。这项工作有些虎头蛇尾。Sirtris被葛兰素史克收购后，于2013年不再作为独立实体存在。

这似乎是一个警示故事。但这也可以被视为希望的理由。Sirtuins受到了很多关注，因为已经有一阵子没有关于长寿的可信度类似的说法了。他们的故事为研究此类事情制定了蓝图：一种机制看起来很有趣，一种分子似乎很有前途，进行研究，得出结论。现在正在以同样的方式审查多得的机制和药物。一些怀疑是有道理的。但我们没有理由认为，仅仅因为迄今为止所做的少数研究尚未成功，它们中的任何一个都不会取得成果。■



Don't be greedy

Eating fewer calories can ward off ageing

And various existing medicines may offer similar benefits

IN 1991 EIGHT volunteers sealed themselves into a huge greenhouse in the desert near Tucson, Arizona. They were part of an experiment seeking to discover whether a carefully curated selection of plants and animals could develop into a self-sustaining ecosystem: a “Biosphere 2” independent of “Biosphere 1”, aka the outside world.

In terms of proving grand ecological truths the Biosphere 2 experiments were something of a bust. As an illustration of what can happen when somewhat fringe-y science meets extreme wealth they were fascinating. There were fierce fallings-out on both sides of the glass. In 1994 Ed Bass, an oil dynast who had paid for the facility, threw out the management team and handed the reins to Steve Bannon, later a key adviser to Donald Trump. At the same time, though, there was what some took to be a breakthrough in the science of human ageing.

One of the eight biospherians was Roy Walford, a professor of pathology at the University of California, Los Angeles (UCLA). Research by Walford and others had shown that restricting what animals ate could significantly lengthen their lives. The lifespans of nematode worms, fruit flies, rodents and dogs could be extended as much as 50% by laboratory protocols which gave them a diet with all the nutrients they needed in terms of minerals, vitamins and the like but fewer calories than were seen as normal.

Biosphere 2 allowed him to test the theory on humans in no position to sneak off for snacks. With a daily intake of 1,750-2,100 calories (7,320-8,790 kilojoules) the biospherians, trim to begin with, all slimmed down. But after

eight months their weight stabilised. Gaunt as they were, their energy levels remained high. Blood tests showed physiological responses which matched those of calorie-restricted rodents with extended lifespans.

Some people have taken this as a reason to incorporate calorie restriction into their lives, as Walford did. But such diets, which go well beyond the sort of weight-restricting efforts to which any sensible person might aspire, are hard to maintain. That has provoked an interest in finding ways to get the benefits of calorie restriction without having to engage in it.

Calories are a measure of the amount of energy that cells can get from breaking food into its component chemical parts. The precise nature of that breaking down, and what happens with all the parts, is under the control of a range of signalling pathways which have the job of matching what the cell is doing with how much energy the organism needs and has available. Dysfunction in these nutrient-signalling pathways is one of the 12 hallmarks of ageing listed by Dr López-Otín and his colleagues.

If there is a general truth behind the success of calorie restriction, it is that when energy is on the scarce side, the nutrient signalling pathways in cells pay greater attention to what is going on and keep the cell in better shape. What is necessary if the same pathways are to be recruited without the calorie reduction is an understanding of what other cues can have the same effect.

The research would be both easier to do and easier to understand if these pathways all had distinct, clearly understood functions. Alas, this is not the case. Pathways frequently regulate more than one function, functions are frequently regulated by more than one pathway and the farthest-flung parts of pathways are often obscure. To make things yet less comprehensible, the proteins involved in the pathways have incredibly opaque names.

Take the MTORC1 pathway. The complex of proteins which gives it its name first came to attention because an immune suppressant called rapamycin has a strong effect on it: hence “mechanistic target of rapamycin complex 1”. That gives no real clue, however, to the fact that the signalling pathway in which MTORC1 sits is a complex set of controls and feedbacks designed to regulate metabolism in response both to the availability of nutrients (for example, glucose, which provides energy, and amino acids, from which proteins are made) and impediments to their use (for example, low oxygen levels).

The ambit of this regulatory power is broad; it influences the rate at which cells break down damaged internal structures (“autophagy”), the balance of their protein content (“proteostasis”) and the reproduction of their mitochondria, components responsible for turning the calories it receives into a form of energy its proteins can use. Autophagy, proteostasis and mitochondrial reproduction are three more of the 12 hallmarks of ageing.

What is more, rapamycin, the effects of which give MTORC1 its name, turns out to lengthen the lives of lab animals even though it curbs their immune responses. This has led some longevity enthusiasts to seek off-label prescriptions for it. But its side-effects, including anaemia and an insensitivity to insulin, make rapamycin ill-suited for widespread use. There is thus a search for “rapalogs” which provide the benefits of a tuned-up MTORC1 pathway without so many costs.

Another pathway which calorie-restriction studies have marked out as promising is named after a protein called AMPK (don’t ask). This regulates the production of ATP, a small energy-carrying molecule produced in mitochondria. When ATP levels fall, the AMPK pathway increases a cell’s sensitivity to insulin.

Metformin, a drug used to treat type-2 diabetes, does so by activating the

AMPK pathway. Like rapamycin, it extends the lifespans of healthy mice. It does the same for diabetic humans. A study published in 2014 showed that diabetes patients treated with metformin enjoyed a decreased mortality rate, not just compared with patients who were not treated with it, but also with healthy controls who were not given the drug.

Not surprisingly, metformin is also used off-label, probably more widely than rapamycin. The American Federation for Ageing Research, a not-for-profit organisation, hopes soon to start a six-year, 3,000-person clinical trial to measure its effects in people from 65- to 79-years-old. The Targeting Ageing with Metformin (TAME) trial will see if metformin helps prevent cardiovascular disease, cancer and cognitive decline; it will also test the hypothesis that it reduces all-cause mortality.

A further set of medicines developed to treat diabetes but now used more widely are the GLP-1 receptor agonists. The best known, semaglutide (sold as Wegovy), has been specifically licensed in various places for use in people without diabetes who nevertheless need to lose weight. Whether they might live longer than someone of the same final weight who does not take one of the drugs is an open question. There are no published studies that show the drugs to have an effect on the lifespans of laboratory animals.

One thing that does do the job for lab animals is taurine, an amino acid widely used as a dietary supplement. According to a recent paper by Parminder Singh of the Buck Institute for Research on Ageing in Novato, California, and colleagues, in mice taurine increases lifespan by 10%; some of this seems to be due to nutrient signalling. But there are effects on four or five other hallmarks of ageing, too. Taurine levels drop with age in humans but, in those who live to be over 100, levels stay significantly higher.

Nutrient sensitivity may also be enhanced by a molecule called NAD+. Some enzymes—proteins which catalyse chemical reactions—require the

presence of a small extra molecule to do their thing. NAD⁺ is such a “co-enzyme”. More than 300 enzymes need it to be present if they are to do their bit for the cell. And if you give mice more of it, they live longer.

Considering that NAD⁺ is so generous with its favours it is difficult to know exactly which of the enzymes it helps are responsible for delivering this effect. But one connection which looks particularly interesting is that with a set of proteins called sirtuins.

Sirtuins came to prominence two decades ago when David Sinclair, who is now co-director of the Centre for Biology of Ageing Research at Harvard University, showed that stimulating their production prolongs life in a variety of laboratory animals. One form of stimulation is calorie restriction. But Dr Sinclair discovered a chemical alternative: resveratrol, a molecule found, among other places, in the skins of red grapes.

Dr Sinclair is by no means publicity-shy; his discovery saw a great deal of brouhaha. He founded a company, Sirtris, to produce resveratrol derivatives suited to the human body. The work did not amount to much. Sirtris, having been bought by GlaxoSmithKline, ceased to exist as a separate entity in 2013.

That might seem a cautionary tale. But it can also be seen as grounds for hope. Sirtuins got a lot of attention because there had been no similarly credible claims about longevity for some time. Their story set out a blueprint for looking into such things: a mechanism looked interesting, a molecule seemed promising, investigations were carried out, conclusions were drawn. Many more mechanisms and drugs are now being scrutinised in the same way. Some scepticism is warranted. But there is no reason to believe that none of them will get results just because the few looked at so far have not. ■



老旧不再

衰老的身体需要除去衰败的细胞

返老药和细胞再生可能是破解的关键【专题《长命百岁》系列之三】

1962年，当时在费城的威斯达研究所（Wistar Institute）工作（现已退休）的伦纳德·海弗利克（Leonard Hayflick）做出了长寿科学领域最著名的观察之一：在实验室中，非癌性哺乳动物细胞只能自我复制固定的次数，之后细胞就会停止分裂，进入一种“衰老”（senescence）状态。对于人类细胞而言，这一“海弗利克极限”为40到60次。

超出海弗利克极限并非通向细胞衰老的唯一路径；细胞衰老也可经由其他方式引发，包括作为一种应对DNA损伤的反应机制。身体通常用两种方式去除这些衰老细胞：激活称为细胞凋亡的一系列基因自毁程序，或派出免疫系统来清除它们。然而，随着年龄的增长，这两种形式的“房屋清扫”的效率都会降低，使得衰老细胞继续以一种类似僵尸的状态存在，给它们周围的健康细胞造成麻烦。

位于明尼苏达州罗彻斯特的梅奥诊所（Mayo Clinic）的詹姆斯·柯克兰（James Kirkland）列出了僵尸细胞聚积的组织中出现的令人生畏的一大堆问题。其中包括炎症、DNA损伤、一种称为纤维化的组织疤痕、蛋白聚集致功能失效，以及与本系列上一篇文章中讨论的MTORC1营养信号通路问题相关的两个衰老标志：蛋白稳态失衡和线粒体损伤。对小鼠的实验表明，衰老细胞与阿尔茨海默病有关。其他研究认为它们促成糖尿病、肺纤维化、骨关节炎、骨质疏松症和几种眼部疾病。

不过柯克兰博士并没有被吓退。正是他在2011年率先提出了一种解决细胞衰老问题的办法，如今研究这种方法的人越来越多。它尝试研发所谓的“返老药”来杀死衰老的僵尸细胞。

他的初步研究发现了四种已被表征的分子，看起来很有可能成为返老药：达沙替尼、非瑟酮、纳维托克和槲皮素。所有四种分子都会刺激细胞凋

亡，尽管机制不尽相同。它们都可以口服并延长实验动物的寿命。达沙替尼是一种抗白血病药物，自2006年起在美国和欧洲上市；纳维托克目前正被用于治疗骨髓纤维化（一种骨髓癌）的试验；槲皮素（在癌症治疗中常配合达沙替尼使用）和非瑟酮是可在水果中找到的天然物质。

柯克兰是转化老年科学网络（Translational Geroscience Network）的组织者之一。该组织在美国设有14个中心，正在对可能成为治疗年龄相关疾病的药物的化合物进行81项临床试验，试验方式的设计寻求增加对衰老的总体理解。其中大约30项在测试候选返老药，包括他最初罗列的上述四种中的三种。他说，总体思路是针对不同分子和不同目标疾病并行大量小型试验。尽管他认为成功发现一种返老药的几率只有25%左右，但他说自己刚开始这方面研究时会认为这个几率只有0.001%。

2020年，《自然》期刊对该领域的一项调查发现有二三十家创业公司在研究返老药。它们所用的方法不只是柯克兰最初确定的哪几种。毫无疑问，今天在这个课题上已经有了更多公司和更多方法。而且令人失望的结果也已显现。旧金山的联合生物技术（Unity Biotechnology）早年由杰夫·贝索斯和彼得·泰尔以及风险投资机构长寿基金（Longevity Fund）注资，于2018年上市，但两年后，它针对骨关节炎的一种返老药的早期试验结果令人失望，股价应声暴跌了三分之二。

在Unity等公司打造对抗细胞衰老的武器的同时，另一组公司正从另一面打量海弗利克极限。这些细胞再生公司并不寻找办法来杀死超出该极限的细胞，而是要把细胞维持在极限之下并帮助它们保持健康活力。其靶标不是需要清除的细胞，而是那些细胞无法正常更新的器官。这两种方法还有些其他的不同。返老疗法着眼于已有的药物和补充剂，尝试找到那些可以很快就帮上忙的。近期干细胞科学的进展则让细胞再生成为可能，这种方法更激进彻底。它需要且也在吸引财力更雄厚的参与者。

人体中有数百种不同类型的细胞，每种细胞的特性都适合担任某个特定类型的工作。这种分化是通过各种“表观遗传”修饰以在不同类型的细胞中打开和关闭各组基因来实现的。有些修饰是对储存着特定基因序列的DNA片

段的化学改变，有些是影响DNA所包裹的蛋白质，还有一些以更微妙的方式运作。这类表观遗传修饰至关重要。但驱动和维持它们的过程是生命运作机制中另一个随着年龄增长而变得不那么有效的部分。事实上，DNA甲基化（对DNA分子的遗传字母之一的一种特定化学改变）的模式可用于诊断细胞的年龄。

干细胞是可用于制造各种类型的新特化细胞的储备。当一个干细胞分裂时，两个子细胞中的一个会启动一条表观遗传特化途径，在几代后将产生一些特定类型的细胞。另一个子细胞将仍然是干细胞，准备在有需要时生成更多子细胞。例如，通过这种方式，骨髓中的造血干细胞产生的子细胞除了携氧的红血细胞外，还可从中衍生出所有不同种类的白血细胞。然而，若要终生继续这种生产，它们需要远超40到60次的分裂。

让干细胞能继续分裂是一种名为端粒酶的酶复合物的任务。一个细胞向海弗利克极限靠近的具体表现可在其染色体末端的结构（“端粒”）中找到。每次染色体被复制以让细胞分裂时，端粒就会变短；经过40到60次分裂后，它们已经短到令染色体无法再复制了。但在干细胞中，端粒酶在两次细胞分裂的间隙被用来重建染色体的端粒，从而重置时钟。但它做得并不完美。而且，随着时间推移，干细胞也会出现预期外的表观遗传标记。干细胞的数量或能力会降低，或两者同时降低。

那如果耗尽的干细胞可以重生或更换呢？2006年，京都大学的山中伸弥（Yamanaka Shinya）等人表明，通过管理一组特定的四个“转录因子”（即影响哪些基因被用作蛋白质蓝图的蛋白质），他们可以将细胞类型特异性的表观遗传标记从一个细胞的DNA中擦除，把它恢复到“多能”干细胞的状态。这开启了新的前景：如果用其他化学物质刺激，或被植入相关类型的组织中，这些诱导性多能干细胞（iPSC）可用于按需生成特定的细胞类型。较近期的研究表明，使用这四种蛋白质的子集提供了一种在较小程度上恢复细胞活力的方法：不是将它们直接剥离回干细胞状态，而是擦除一些随年龄增长变得明显过多的表观遗传标记。

细胞逆龄领域里的最大参与方是Altos Labs。这家公司创立于2022年，其

30亿美元的初始资本由多方提供，包括俄罗斯出生的亿万富翁尤里·米尔纳（Yuri Milner）。它有三个园区，两个设在美国加州，另一个位于英国剑桥南边。公司招募了一些该领域的名人进入园区，其中之一是史蒂文·霍瓦斯（Steven Horvath），他在加州大学洛杉矶分校时开发了一种根据某些DNA部分的甲基化程度来预测动物年龄的方法。这一“霍瓦斯时钟”可用来观察细胞的年龄是否与动物的年龄一致，是更年轻还是更老。换句话说，动物的衰老是慢是快。

Altos的研究对外保密，所以很难确切地说它在采用什么方法。但整个领域面临两种选择。一种是在实验室中制造新鲜干细胞并将它们移植入体内来对抗干细胞衰竭。另一种是把细胞中的霍瓦斯时钟稍微往回调一些，以尝试使组织和器官在原位恢复青春活力。

哈佛大学的丘奇博士喜欢后一种方法，它有时也称为瞬时或部分重编程。他有利益牵涉的Rejuvenate Bio公司的研究人员此前描述过用改良病毒将三种山因子的基因携带到细胞中以恢复活力。在小鼠中，这种重新编程赋予了旧组织新的自我修复能力：之后的损伤可以像在年轻小鼠身上那样被高效修补。这已经在骨骼肌、神经纤维、眼睛、皮肤、心脏、肝脏和胰腺上得到验证。它甚至可以减缓长期记忆丧失。但Rejuvenate的研究人员已经走得更远。他们的实验（诚然尚未经过同行评审）显示，OSK疗法（这个名字来自三种山因子蛋白质的首字母缩写）实际上可以延长实验室小鼠的寿命。

该试验发布在bioRxiv网站（该平台旨在方便此类未经同行评审的论文快速发布）。它报告称，接受治疗的老年小鼠的剩余预期寿命增加了一倍。它们本来只能再活9周不到，如今顽强坚持了超过18周（接受治疗时这些小鼠已经124周大，相当于人类70多近80岁的年龄）。

其他探索原位再生的公司包括波士顿的Life Biosciences，这是由去乙酰化酶sirtuin的倡导者戴维·辛克莱（David Sinclair）近期创办的一家企业。它的第一个项目是尝试使用部分重编程来修复青光眼对视神经的神经元造成的损伤。该公司的研究人员已经证明这种方法对小鼠有效。加州阿拉米达

的AgeX

Therapeutics公司则使用该公司创始人之一迈克尔·韦斯特（Michael West）发现的另一组能恢复细胞活力的转录因子。

据Retro Biosciences的老板乔·贝茨-拉克鲁瓦（Joe Betts-LaCroix）介绍，该公司的研究人员正在研究通过对干细胞重编程来恢复免疫系统的活力。这些干细胞分化为血细胞，其中一些是形成了免疫系统的一个分支的白细胞，还有一些则变成另一个分支中的T细胞。

不过，其他一些公司更喜欢干细胞移植的想法，这是“细胞疗法”领域的一个分支。山中因子的应用意味着如今干细胞有可能定制——包括使用来自患者自身的分化组织来定制，从而将使得移植的干细胞被免疫系统识别为友军而避免了排异问题。

这个领域里的先锋之一是拜耳的子公司BlueRock Therapeutics，总部位于麻省剑桥市。该公司表示，它已经开发了一种规模化制造多能人类干细胞的方法，然后用更多的转录因子调整它们，使它们走上各种不同的道路，最终通向神经细胞、心肌细胞、免疫系统细胞等。

它最初的目标是帕金森氏病，这种病症因大脑黑质区的神经细胞缺失引发。这种特异性和局部性使帕金森氏病成为细胞疗法一个具吸引力的靶点。该公司已启动一项12人参与的一期临床试验。如果这一阶段以及随后的更大规模试验取得成功，BlueRock希望能够将治疗扩展到其他目标疾病。

从拜耳的参与可以看出大型制药公司对这类方法抱有希望。加州卡尔斯巴德的Lineage Cell Therapeutics携手罗氏子公司基因泰克（Genentech）是另外一例，这两家公司要合作开发一种针对干性年龄相关性黄斑变性（导致失明的一个原因）的疗法。延长寿命和健康寿命这一外围领域和主流医学之间的界限变得模糊的地方不止于此：细胞疗法也是癌症治疗中即将出现的趋势，而阿斯利康等制药公司也在研究将细胞疗法用于组织修复。这些领域的成功可以促成抗老研究的成功，反之亦然。 ■



Out with the old

Ageing bodies need to get rid of decrepit cells

Senolytics and cellular rejuvenation could hold the key

IN 1962 LEONARD HAYFLICK, then at the Wistar Institute in Philadelphia, now retired, made one of the most famous observations in the science of longevity: in laboratories, non-cancerous mammalian cells can reproduce themselves for only a fixed number of times before cell division ceases and they enter a state called senescence. For human cells, this Hayflick limit is 40-60.

Exceeding the Hayflick limit is not the only route to senescence; it can arise in other ways, too, including as a response to DNA damage. The body normally gets rid of these senescent cells either by triggering a genetic self-destruct sequence called apoptosis or by sending the immune system in to dismantle them. Both forms of housekeeping, though, become less efficient with age, allowing senescent cells to persist in a sort of zombie state that makes things difficult for the healthy cells around them.

James Kirkland of the Mayo Clinic, in Rochester, Minnesota, offers a daunting list of the things that go wrong in tissue where zombie cells accumulate. It includes inflammation, DNA damage, a form of tissue scarring known as fibrosis, disabling aggregations of protein and two of the hallmarks of ageing associated with problems in the MTORC1 nutrient-signalling pathway discussed in the previous article: poor proteostasis and damage to mitochondria. Experiments on mice suggest that senescent cells are involved in Alzheimer's disease; other work suggests they play roles in diabetes, fibrosis of the lungs, osteoarthritis, osteoporosis and several diseases of the eye.

Dr Kirkland is, however, undaunted. For it was he who, in 2011, pioneered what has become an increasingly studied approach to the problem of cellular senescence. This is the development of drugs known as senolytics designed to kill senescent zombie cells.

His initial research discovered four already characterised molecules that looked promisingly senolytic: dasatinib, fisetin, navitoclax and quercetin. All four stimulate apoptosis, though not all by the same mechanism. They can all be taken orally and extend the lives of laboratory animals. Dasatinib is an anti-leukaemia drug available in America and Europe since 2006; navitoclax is currently in trials as a treatment for myelofibrosis, a bone-marrow cancer; quercetin (which is often added to dasatinib in cancer treatment) and fisetin, meanwhile, are natural substances that are found in fruits.

Dr Kirkland is one of the organisers of what is known as the Translational Geroscience Network. It has 14 centres across America and is running 81 clinical trials on compounds that could become drugs for age-related diseases, with the trials done in ways that seek to add to the understanding of ageing in general. About 30 of them are on potential senolytics, including three of the four on his original list. The idea, he says, is to conduct a lot of small trials in parallel, on different molecules and different target diseases. And, though he thinks there is only about a 25% chance of a successful senolytic drug emerging, he says that when he first started in the field he would have put the chances at 0.001%.

In 2020 a survey of the field by Nature, a journal, identified more than two dozen startups in the senolytic field. They use a broader range of approaches than those initially identified by Dr Kirkland. There are undoubtedly more companies, and more approaches, today. And there have already been disappointments. Unity Biotechnology of San Francisco, funded in early years by Jeff Bezos and Peter Thiel as well as the Longevity Fund, a venture-

capital operation, went public in 2018 only to see its share price collapse by two-thirds two years later when early trials of a senolytic aimed at osteoarthritis disappointed.

While Unity and other firms build weapons to fight senescence, another set of companies is looking at the Hayflick limit from the other side. Instead of searching for ways to kill cells that are over the limit, these cellular-rejuvenation companies are examining treatments aimed at keeping cells under it and helping them stay in fine fettle while they are there. Their targets are not cells that need to be removed, but organs the cells of which are failing to renew themselves as they should. The two approaches differ in other ways, too. The senolytic approach looks at drugs and supplements already available to try and find those that could help soon. Cellular rejuvenation, made plausible by recent developments in stem-cell science, is more radical and thoroughgoing; it needs, and attracts, those with deeper pockets.

The human body contains hundreds of different types of cell, each with the right properties for a particular sort of job. This differentiation is accomplished by having different sets of genes turned on and off in the different types of cell by means of various “epigenetic” modifications. Some are chemical alterations to the bits of DNA on which specific gene sequences are stored, others affect the proteins around which that DNA is wrapped, still others work in subtler ways. These sorts of epigenetic modification are vital. But the processes which drive and maintain them are another of those bits of life’s workings that get less effective with age. Indeed, the pattern of DNA methylation (a specific type of chemical change to one of the molecule’s genetic letters) can be used to diagnose the age of a cell.

Stem cells are reserves from which new specialised cells of various types can be made. When one divides, one of the two daughter cells sets off down a

route of epigenetic specialisation which, a few generations on, will produce a number of cells of specific types. The other daughter will remain a stem cell, ready to produce more daughters when required. In this way the hematopoietic stem cells in blood marrow, for example, can produce progeny from which all the different sorts of white blood cells are derived, as well as the oxygen-carrying red ones. To keep doing so for a lifetime, though, they need to divide a lot more than 40-60 times.

Allowing stem cells to keep going is the task of an enzyme complex called telomerase. The physical manifestation of a cell's progress, or descent, towards the Hayflick limit is found in structures at the end of its chromosomes called telomeres. Every time the chromosomes are copied to allow the cell to divide, the telomeres get shorter; after 40-60 divisions they are too short for the chromosome to be copied any more. In stem cells, though, telomerase is used between cell divisions to rebuild the chromosomes' telomeres, resetting the clock. But it does not do so perfectly. And, as time goes by, stem cells can pick up unwanted epigenetic markers, too. Stem cells diminish in number, in capacity, or both.

What if the exhausted cells could be pepped up, or replaced? In 2006 Yamanaka Shinya, of Kyoto University, and others showed that by administering a specific set of four "transcription factors", proteins that affect which genes are used as blueprints for proteins, they could strip the cell-type-specific epigenetic markers off the DNA in a cell and return it to the state of a "pluripotent" stem cell. That opened the prospect that these induced pluripotent stem cells, or iPSCs, if prodded with other chemicals or implanted in the relevant type of tissue, could be used to generate specific cell types on demand. More recently it has been shown that using a subset of those four proteins offers a way to rejuvenate cells to a lesser degree, not stripping them right back to the stem-cell state but nevertheless removing some of the apparently excessive epigenetic markings that come with age.

The biggest player in the cellular de-ageing business is a company called Altos Labs. It was founded in 2022 with \$3bn of initial capital from various sources, including Yuri Milner, a Russian-born billionaire. It has three campuses, two in California, the other in England, just south of Cambridge. To work in these the company has recruited some luminaries of the field. One such is Steven Horvath, who when at UCLA developed a way of predicting an animal's age based on the amount of methylation it has endured in parts of its DNA. Horvath's clock, as it is known, can be used to see if the age of cells is tracking the age of the animal they find themselves in, lagging it or leading it: in other words, whether the animal is ageing well or badly.

Altos plays its cards close to its chest; it is hard to say quite what approaches it is taking. But the field as a whole is faced with two options. One is to combat stem-cell exhaustion by making fresh stem cells in the lab and transplanting them in. The other is to try to rejuvenate tissues and organs *in situ*, by turning back the Horvath clocks in their cells a little way.

Dr Church at Harvard likes this latter approach, sometimes called transient or partial reprogramming. Researchers at Rejuvenate Bio, a firm in which he has an interest, have described using modified viruses to carry genes for three of the Yamanaka proteins into cells to be rejuvenated. In mice this reprogramming gives old tissues a fresh capacity for self-repair; subsequent damage is set right as efficiently as in young individuals. This has been shown to be true for skeletal muscle, nerve fibres, eyes, skin, hearts, livers and pancreases. It can even ameliorate loss of long-term memory. Rejuvenate's researchers have, however, gone further than that. Their experiment (admittedly not yet peer reviewed) showed that OSK treatment (so-called from the initials of the three Yamanaka proteins involved) can actually extend life in laboratory mice.

The trial in question, posted on a site called bioRxiv, which exists to

facilitate the early release of such un-peer-reviewed papers, reported a doubling of the remaining life expectancy of elderly mice given the treatment. Instead of living for less than nine further weeks they soldiered on for more than 18 (the mice were 124 weeks old when treated, an age equivalent to that of a human in their late 70s).

Others exploring in-situ rejuvenation include Life Biosciences, in Boston, a recent venture of David Sinclair, the prophet of sirtuins. Its first project is an attempt to use partial reprogramming as a way to repair the damage glaucoma does to the neurons of the optic nerve. The firm's researchers have shown that the approach works on mice. AgeX Therapeutics of Alameda, California, uses a different set of rejuvenating transcription factors, identified by Michael West, one of its founders.

According to Joe Betts-LaCroix, boss of Retro Biosciences, the firm's researchers are looking into rejuvenating the immune system by reprogramming the stem cells which differentiate into blood cells, including the white blood cells which form one branch of that system, and those that turn into the T-cells found in another branch of it.

Some other firms, though, prefer the idea of stem-cell transplants, a branch of a field known as cell therapy. Application of the Yamanaka factors means it is now possible to make stem cells to order—including from a patient's own differentiated tissue, which will thus be recognised as friendly by the immune system and avoid the problem of rejection.

One of the leaders in this field is BlueRock Therapeutics, a subsidiary of Bayer that is based in Cambridge, Massachusetts. It says it has developed a way of making pluripotent human stem cells at scale and then tweaking them with further transcription factors to set them off on various paths that lead, eventually, to nerve cells, cardiac cells, immune-system cells and so on.

Its initial target is Parkinson's disease, a condition caused by a loss of nerve cells in a region of the brain called the substantia nigra. This specificity and localisation makes Parkinson's an attractive target for cell therapy, and the firm has embarked on a phase-I clinical trial involving 12 people. If that and subsequent, larger trials work, BlueRock hopes the range of targets can be widened.

Bayer's involvement is a sign that big pharma has hopes for such approaches. So is a collaboration between Lineage Cell Therapeutics, of Carlsbad, California, and Genentech, a subsidiary of Roche, to develop a treatment for dry age-related macular degeneration, a cause of blindness. It is one of the places where the outsiderish field of lifespan and healthspan extension blurs with the medical mainstream; cell therapy is also a coming thing in cancer treatment, and pharma companies such as AstraZeneca are looking into it for tissue-restoration, too. Success in those fields could feed success in work on ageing—and vice versa. ■



追寻永恒

延缓人类衰老已成为一项严肃的研究课题

据本报道作者杰弗里·卡尔观察，其中一些项目正在取得进展【专题《长命百岁》系列之一】

“愿散千金换寸阴”据说是伊丽莎白一世的遗言。作为英国女王，她拥有的财产足以让她成为她那个时代最富有的女性之一。考虑到她出资支持炼金术士——这些人寻找的一个东西就是长生不老药——她的话可能真的可以按照字面来理解。但没有用。1603年3月，她迎来了生命的最后一刻，距离《圣经》中断言的“我们一生的年日是七十岁”只差几个月。

自这位“贤明女王贝丝”的统治以来，情况已有所改善。富裕国家的人们现在可以合理地认为自己的寿命将远远超过70岁。贫穷国家的人们正在迎头赶上（见图1）。自1950年以来，全球平均预期寿命每年都增加18周。

不过还是有两个问题。一是寿命增长似乎是有上限的。百岁老人的人数一直在增长，而且还会进一步增长。皮尤研究中心预测，到2050年，全球将有370万名百岁老人，人均百岁老人数量将是2015年的三倍。但其中只有千分之一的人能活过110岁，历史上也没有可靠的证据证明有人活过120岁。平均寿命在增加，而最高寿命的增长却微小得多（见图2）。另一个问题是“健康寿命”（即健康有活力的年数）并不会自动与寿命同步增长。

一些现代人的财富堪比伊丽莎白女王（如果地位还是比不上的话），他们也和她一样极度渴望获得更多的时间。为了获得更长、更健康的寿命，他们向当今的炼金术士、医学和生物技术奇才们支付大量资金，试图了解、延缓，最好还能逆转身体的衰老和随之而来的疾病。

贝宝（PayPal）的联合创始人彼得·蒂尔（Peter Thiel）、谷歌的联合创始人拉里·佩奇（Larry Page）和谢尔盖·布林（Sergey Brin），以及亚马逊的创始人杰夫·贝索斯（Jeff Bezos）都曾投资于试图延长寿命和健康寿命的公司，并经常在这些公司的创建过程中发挥重要作用。今年3月，OpenAI

的总裁萨姆·奥特曼（Sam Altman）透露，两年前他向Retro Biosciences投资了1.8亿美元，这家硅谷的公司创办的目标是要让人类的健康寿命增加十年。

在由科技皇族支持的公司林立的树冠下，有一层灌木是由传统方式资助的创业公司，它们正在研究可以延缓或阻止某些方面的衰老的药物。在更接近地面的地方，很多人在想办法利用现有的药片和药水来延长寿命和健康寿命，作为“饮食、运动和早睡早起”这套传统方法的补充（或替代）。一种DIY延长寿命的文化正在兴起，至少在那些拥有类似硅谷那种技术专长和科技狂妄情绪的富裕地区是这样。

许多主流科学和医学界人士对这一切将信将疑，这也可以理解。除了一些动机比较正派的人，这个领域也吸引着投机分子和招摇撞骗者，而其历史上有大量“突破”多少算得上是无疾而终。美国食品和药物管理局不承认“老年”是一种疾病状态，因此也不承认它是一种合适的治疗对象。然而，越来越多的证据表明，此类研究可能会有所收获。

至少对小鼠而言，一些已有的药物似乎确实能延长寿命。这既指向了它们也能在人身上发挥作用的可能性，也为了解其中的过程提供了一些线索。基因编辑越来越容易，这有助于此类研究，也有助于获取大量基因序列数据。生产可以永葆青春的个性化干细胞的能力开辟了新的治疗方案。现在，新的诊断工具为科学家提供了计算身体和器官的“生物年龄”并与实际日历年齡进行比较的手段。原则上，这使得长寿研究不需要观察参与者一生就能得出令人信服的结果。

衰老似乎很简单。身体是机器，机器会磨损。但与大多数机器不同的是，人体既能自我制造，也能自我修复。那么，为什么不能完美地做到这一点呢？

答案之一是，这台机器的设计者——进化论——感兴趣的是繁衍，而不是长寿。生命在于基因和环境，而环境会以意外、天敌和疾病的形式杀死大多数生物。如果一种基因只有在寿命比环境所允许的寿命更长时才显现出

益处，那除非它能带来其他益处，否则不可能有特别好的竞争力。那些能带来一个成功的且善于生育的青春的基因会是赢家。

事实上，进化甚至可能积极地谋害老年。如果一种基因有助于动物在年轻时繁殖，却会在动物年老时造成危害，这种基因就很有可能传播开来。有证据表明，与阿尔茨海默病有关的一种特殊基因的变体为年轻人提供了繁殖优势。

更泛泛而论，从相关基因的进化视角来看，个体只是制造更多基因拷贝的一种方式，而不是目的本身。让身体的修复机制保持最佳状态唯有当这么做能让更多的基因进入下一代时才是值得的。如果这些资源另有用途来更好地完成这个任务，那么修复就不是优选。在这种“一次性躯体”的思路中，个体只是达到目的的一种手段，当它不再适合目的时就会被抛弃。

这种观点解释了为什么有许多疾病，如阿尔茨海默病和帕金森氏症、视网膜退化、2型糖尿病和各种癌症在年轻时罕见，但在老年却相当常见。但这也显露出事情不是非得如此。虽然进化无意维持修复系统的永恒运转，这并不意味着它就不能被实现，只是可能需要我们想一些巧妙的办法。

大多数基因都有变体，即所谓的“等位基因”，它们都起作用，但效果可能有些不同。通过对实验室生物进行基因操作并研究百岁老人的基因，人们发现了一些特定基因的等位基因，它们在生物实验上证明可以延长寿命，又与百岁老人的长寿有关联性。这些研究有助于阐明身体衰老背后的过程。

比如，它们或许可以帮助人们理解为什么会出现这样的情况：伦敦国王学院的研究人员在2014年发表的一项研究显示，百岁老人死于癌症或心脏病的几率要低于80多岁的人。这意味着，真正长寿的人之所以长寿，可能是因为他们拥有某种相对罕见的保护，能够抵御那些夺去较年轻的老人生命的疾病。这也许是个大好消息。

但还是有一些东西会要了他们的命。国王学院的研究发现，百岁老人极易患上全身衰弱和“老人之友”肺炎。

面对进化论的冷酷无情，另一丝希望的曙光是衰老的生理细节正变得越来越清晰。特别是研究这个问题的人们已经能够把问题拆成小块，在某种程度上可以单独解决。这些小块（尽管往往仍然巨大）中的一些本身就是有吸引力的干预目标，例如慢性炎症或阿尔茨海默病中出现的异常蛋白质堆积。哈佛大学的乔治·丘奇（George Church）是一位不惧非正统的生物技术大师，他认为这种方法的潜力远不止于此：找出并分别处理每个要素，你可能会发现你已经从整体上解决了问题。

一些研究团队已经列出了这样的小块。西班牙奥维耶多大学的卡洛斯·洛佩斯-奥廷（Carlos López-Otín）和同事们设计的清单是被最广泛参考的清单之一。他们提出了12个衰老标志（见图），选择的依据是它们通常都会随着年龄的增长而恶化，如果受到刺激则会加速衰老，接受治疗则似乎会延缓衰老。处理好这“肮脏的一打”（丘奇博士会在这一打之外再加上癌症，使之成为13个，即“面包师的一打”），你也许就可以无限期地永葆健康。至少乐观主义者是这样认为的。

肿瘤学已经是一个发展成熟的研究领域。本报道不会直接讨论它，也不会在饮食、运动和良好的睡眠上赘言——除了赞美它们的价值。一如既往，它们仍然是必要的。

我们将把目光投向12个标志中的每一个所取得的进展。得出的图景并不像你可能希望的那样清晰明确。生理是一个错综复杂的网状机制，老龄化的许多标志相互重叠。有时，这意味着一项干预措施可能会在多个领域产生良好效果。有时则需要权衡利弊。但是，即使只处理清单中的一部分，也会给人们带来更好的生活。如果将它们全部清理，那会……谁知道呢？ ■



In search of forever

Slowing human ageing is now the subject of serious research

And some of it is making progress, writes Geoffrey Carr

“ALL MY POSSESSIONS for a moment of time.” Those, supposedly, were the last words of Elizabeth I, who as queen of England had enough possessions to be one of the richest women of her era. Given her patronage of alchemists—who searched, among other things, for an elixir of life—she may have meant it literally. But to no avail. She had her last moment of time in March 1603, a few months short of the three score years and ten asserted by the Bible to be “the days of our years”.

Things have improved since the reign of Good Queen Bess. People in the rich world can now reasonably assume that the days of their years will last well beyond 70. Those in poorer countries are catching up (see chart 1). In every year since 1950 average life expectancy around the world has risen by 18 weeks.

There are, however, two catches. One is that the increases seem to have a limit. The number of centenarians has been growing and will grow more. The Pew Research Centre predicts there will be 3.7m worldwide by 2050, three times as many per head of population as in 2015. But only one in 1,000 of them lives beyond 110, and no one in history is reliably attested to have got past 120. The average is going up; the maximum, much less so (see chart 2). The other catch is that “healthspan”, the number of healthy, vital years, does not automatically keep pace with lifespan.

Some of Elizabeth’s modern equivalents in wealth, if not majesty, are as desperate as she was for more moments than are currently on offer. In the hope of longer, healthier lives they are offering substantial down payments

to today's alchemists, the wizards of medicine and biotechnology trying to understand, decelerate and, ideally, reverse bodily ageing and its attendant ills.

Peter Thiel, a co-founder of PayPal, Larry Page and Sergey Brin, co-founders of Google, and Jeff Bezos, founder of Amazon, have all invested in, and often been instrumental in the creation of, firms trying to prolong lifespan and healthspan. In March Sam Altman, the head of OpenAI, revealed that two years ago he had invested \$180m in Retro Biosciences, a Silicon Valley firm founded with the goal of adding ten years to healthy human lifespans.

Beneath the forest canopy of firms backed by tech royalty an undergrowth of more conventionally financed startups is working on drugs that might slow or stall some aspects of ageing. Even closer to the ground, the idea is catching on of prolonging lifespan and healthspan using pills and potions that are already available, in addition to (and sometimes instead of) the conventional approach of diet, exercise and early-to-bed. A culture of do-it-yourself lifespan extension is emerging, at least in affluent places endowed with the sort of technical expertise and technological hubris identified with Silicon Valley.

Many in mainstream science and medicine look at all this slightly askance. That is understandable. It is an area which attracts chancers and charlatans as well as those with more decent motives, and its history is littered with "breakthroughs" that have led more or less nowhere. America's Food and Drug Administration does not recognise "old age" as a disease state, and thus as a suitable target for therapy. Nevertheless, evidence has been accumulating that such research might have something to offer.

Some established drugs really do seem to extend life, at least in mice. That offers both the possibility that they might do so in people and some insight into the processes involved. The ever-greater ease with which genes can be

edited helps such investigations, as does access to large amounts of gene-sequence data. The ability to produce personalised stem cells, which stay forever young, has opened up new therapeutic options. And new diagnostic tools are now offering scientists means to calculate the “biological ages” of bodies and organs and compare them with actual calendar ages. In principle this allows longevity studies to achieve convincing results in less than a lifetime.

Ageing seems quite simple. Bodies are machines, and machines wear out. But unlike most machines, bodies both make themselves and repair themselves. So why do they not do so perfectly?

One answer is that the machines’ designer, evolution, is interested in reproduction, not longevity. Life is a matter of genes and environment, and the environment, in the form of accidents, predators and diseases, is what kills most creatures. Genes with benefits that show up only over a longer lifespan than the environment allows are not likely to do particularly well unless they provide other benefits. Genes that offer a successful and fertile youth are onto a winner.

Indeed, evolution may be actively plotting against old age. If a gene helps an animal breed when young but endangers it when it is old, the odds are that it will spread. There is some evidence that one variant of a particular gene involved in Alzheimer’s disease provides reproductive advantages to young people.

More generally, looked at from the evolutionary point of view of the genes involved, an individual is simply a way to make further copies of those genes, rather than an end in itself. Keeping the body’s repair mechanisms in tip-top condition is worthwhile only if it gets more genes into the next generation. If other uses of those resources do the job better, then repair will lose out. In this “disposable soma” approach, the individual is a means to an

end abandoned when it is no longer fit for purpose.

This sort of perspective explains why there are many conditions, such as Alzheimer's and Parkinson's diseases, retinal degeneration, type-2 diabetes and various cancers which are rare in early life but quite common in old age. But it also suggests that this need not be the case. The fact that evolution has no interest in keeping the repair systems going does not mean it cannot be done, just that some cunning may be required.

Most genes have variants, known as alleles, which all work, but may have somewhat different effects. Genetic manipulation of laboratory organisms and studies of the genes of human centenarians have identified alleles of particular genes that, in the former, have been proved experimentally to increase lifespan and, in the latter, are associated with longer lives. Such work helps illuminate the processes behind bodily ageing.

It may, for example, lead to an understanding of why, as a study published in 2014 by researchers at King's College London showed, centenarians are less likely to die of cancer or heart disease than people in their 80s are. This suggests that people who live a really long time may do so because they have some comparatively rare form of protection against things that kill younger old people. That may be very good news.

Something does still kill them, though. The King's College study found centenarians disproportionately vulnerable to general frailty and "the old man's friend", pneumonia.

Another reason for hope in the face of evolution's callousness is that the physiological details of ageing are becoming clearer. In particular, those researching the question have been able to divide the problem into bite-sized chunks that can, to some extent, be tackled individually. Some of these smaller (if often still huge) problems are attractive targets for intervention

in their own right; chronic inflammation, for example, or the build-up of aberrant proteins seen in Alzheimer's disease. George Church of Harvard University, a biotech guru unafraid of the unorthodox, thinks the approach could offer more than that: identify and deal with each of the components separately and you may find you have solved the problem in its entirety.

Several groups have compiled lists of such chunks. One of the most widely consulted was devised by Carlos López-Otín of the University of Oviedo, in Spain, and his colleagues. They propose 12 hallmarks of ageing (see chart) chosen on the basis that they are all things which typically get worse with age, which accelerate ageing if stimulated and which seem to slow it down if treated. Deal with this dirty dozen (Dr Church would make it a baker's dozen by adding cancer to the roll) and you might prolong life indefinitely and healthily. That, at least, is how the optimists look at it.

Oncology is already a well-developed field of research. This report will not address it directly. Nor will it remark on diet, exercise and a good night's sleep, other than to extol their value. They remain as necessary as ever.

Instead, it will look at the progress being made with respect to each of the 12 hallmarks. The resulting picture is not as tidy as one might wish. Biology is a complex, networked affair and many of ageing's hallmarks overlap. Sometimes that means an intervention may do good in more than one area. At other times there may be trade-offs. But even dealing with part of the list will bring people better lives. Deal with all of it and, well, who knows? ■



经济学人视频

马斯克的驱动力是什么？（上）

马斯克的动力来源似乎是那些“需要他亲自出手拯救世界”的重大问题。



The Economist Film

What drives Elon Musk? - part 1

Musk seems to be motivated by big problems that require him personally to save the world.



加密货币密码学

解密人称“加密巨骗”的山姆·班克曼-弗里德

对于这个令人着迷又抓狂的主人公，迈克尔·刘易斯质疑人们的臆断【《走向无限》、《疯狂的虚拟货币》书评】

《走向无限》，迈克尔·刘易斯著。W.W.诺顿出版社；288页；27美元。艾伦莱恩出版社；25英镑。

《疯狂的虚拟货币》，齐克·福克斯。皇冠出版集团；304页；28.99美元。韦登费尔德和尼科尔森出版社；25英镑。

齐克·福克斯（Zeke Faux）在他关于加密货币的新书《疯狂的虚拟货币》（Number Go Up）中有一段对迈克尔·刘易斯（Michael Lewis）不大客气的描述。2022年4月，写过《大空头》（The Big Short）的刘易斯在巴哈马的一个大会讲台上采访了山姆·班克曼-弗里德（Sam Bankman-Fried），据传他当时正在写一本关于这位加密货币亿万富翁的书。“三年前，没人知道你，”刘易斯的赞美之情溢于言表，“而现在，你登上了杂志封面。你是超级富豪。你的公司可说是这个星球的历史上发展最快的企业之一。”这让当时坐在观众席上的彭博社撰稿人福克斯感到不适，因为“这位作者的提问太谄媚了”。他开始怀疑刘易斯是真的在写书还是在给班克曼-弗里德做托儿。

这本名为《走向无限》（Going Infinite）的传记现已面世，于班克曼-弗里德一案在纽约开庭受审的当天出版。他被控欺诈和挪用客户资金等多项罪名，但拒不认罪。在2022年至2023年初，刘易斯有无人能及的机会接触到他口中的“山姆”（其他人都管班克曼-弗里德叫SBF）。在此期间，班克曼-弗里德从30岁以下世界首富沦为加密货币时代最大诈骗案的嫌疑主脑。

过去，刘易斯一直专注书写闷头做大事的不知名人士。这次，他的主角却声名狼藉。可能有读者会像福克斯那样担心：刘易斯与班克曼-弗里德走

得太近，以致不再客观。

故事伊始，班克曼-弗里德就被描绘成一个令人捉摸不透但有着莫名魅力的人。他难以解读自己的童年。他的外表自带疏离感。（他得刻意学习微笑。）他讨厌时尚，爱穿工装短裤，头发蓬乱。一个令人捧腹的段落描写了他一边打着一款高难度的电子游戏一边和时尚杂志Vogue的主编安娜·温图尔（Anna Wintour）在Zoom上通话。

他的超理性几乎无人能及。他眼里的人不以好坏区分，而是围绕一个均值的“概率分布”。他运用人口统计来否定莎士比亚的作品。他认为，鉴于美国15万亿美元政府支出的巨大经济影响，政治献金并非太多而是太少了。他考虑给特朗普50亿美元，让他不要竞选总统。

班克曼-弗里德的理性使他走上两条道路。第一，他找到了自己的天职：在金融市场（尤其是加密货币）上发现统计异常并借此发财。第二，他在“有效利他主义”社区中找到了志同道合的怪才，这些人不仅关心其他人，还想拯救全人类。这使他们能够通过冷静计算来决定如何用自己的金钱带来最大的不同。这两条道路在他职业生涯的早期就汇聚到一起，带来耀眼而灾难性的后果。

刘易斯的叙事手法一如既往地精妙。书中的一个关键时刻是发生在2018年的一次名为“分裂”的事件，当时班克曼-弗里德刚刚着手创立加密货币对冲基金阿拉米达研究（Alameda Research）。公司的财务此时就已经很混乱了，大笔资金不翼而飞，他招募的一些“有效利他主义”员工公然造反，认为班克曼-弗里德不是不诚实、爱拿捏人就是好心但不善管理。他们愤然离职，离开前少不了为钱争吵一番。现在回过头去看，你也许会希望班克曼-弗里德周围的一切就此土崩瓦解，全世界就能省去许多麻烦。

在之前的书作中，刘易斯以任何人都看得懂的轻松语言解释金融创新的细节。这本书不一样，它没有揭示多少加密货币的内部运作，刘易斯说这些东西连班克曼-弗里德也懒得去弄明白。那些想要看到对加密货币内幕的劲爆（尽管尖酸）探讨的人应该去读福克斯的书。

《走向无限》着重展现事件中人的一面，包括班克曼-弗里德与阿拉米达研究的联席CEO卡罗琳·埃里森（Caroline Ellison）之间煎熬的关系。没有自由相爱：它是一厢情愿的、渴求关爱的。没有浪漫：两人互发信息都是冷冰冰公事公办的口吻。没有正派品格：刘易斯暗示班克曼-弗里德曾不公对待其高管团队中的部分女性。班克曼-弗里德还和赵长鹏相互较劲，后者经营名为币安（Binance）的加密货币市场（也是FTX的竞争对手）。班克曼-弗里德似乎乐于公开挑衅赵长鹏。这也解释了为什么在FTX崩塌前夕，赵长鹏就在背后拆台。

书中第三段耐人寻味的关系在刘易斯与约翰·雷三世（John Ray III）之间上演。约翰·雷三世是一位破产重组专家，被召来为债权人收拾FTX的烂摊子。刘易斯的写作风格在他隐身幕后时发挥得最酣畅淋漓，在本书大部分篇幅中他都是这么做的。但他却微妙地暗讽了约翰·雷三世，让人难免觉得他是在做班克曼-弗里德的传声筒（要是这位执行官真会洗耳恭听就好了）。

很明显，刘易斯对他的主角及其怪癖满怀敬畏，甚至更甚于沃尔特·艾萨克森（Walter Isaacson）对他刚为其作传的任性的科技巨头马斯克的崇敬。刘易斯笔下的班克曼-弗里德既令人着迷，又令人抓狂。结果在本书大部分篇幅中，班克曼-弗里德的声音淹没了其他所有声音。还有其他不足之处。刘易斯执着于FTX客户资金的去向（这些消失的资金在该公司的资产负债表上留下了近70亿美元的窟窿），以至忽略了背后的意图，而这将是庭审的重点。

一如他的其他作品，刘易斯对主角的鲜明刻画受到对其他人的扁平化处理的衬托。但在本案中，班克曼-弗里德周围的人，尤其是埃里森和其他已认罪的同事，很可能对他是否被定罪起着至关重要的作用。假如能对这些人做更复杂的描写，以及对主角的父母和哥哥在FTX事件中所扮演的角色做更多的探究，这本书应该会更丰富扎实。

尽管有这些不足，但越接近结尾，《走向无限》就越显得大胆。刘易斯对“超理性主义者无法像大多数人那样理解游戏规则”这个观点展现出包容，

借此含蓄地提请读者重新思考一下他们自以为的对班克曼-弗里德的了解。在公众舆论的法庭上，他已被定罪。单凭这一点，本书就值得一读。





Crypto cryptography

Decoding Sam Bankman-Fried, alleged titan of crypto conmen

Michael Lewis challenges assumptions about his mesmerising, maddening subject

Going Infinite. By Michael Lewis. W.W. Norton; 288 pages; \$27. Allen Lane; £25

Number Go Up. By Zeke Faux. Crown; 304 pages; \$28.99. Weidenfeld & Nicholson; £25

IN ZEKE FAUX'S new book on crypto, "Number Go Up", there is an unflattering portrait of Michael Lewis. The author of "The Big Short" took the stage in the Bahamas in April 2022 to interview Sam Bankman-Fried, a crypto billionaire about whom he was rumoured to be writing a book. "Three years ago, nobody knew who you were," Mr Lewis gushed. "And now you're sitting on the cover of magazines. And you're a gazillionaire. And your business is, like, one of the fastest-growing businesses in the history of the planet." It made Mr Faux, a writer for Bloomberg who was in the audience, uncomfortable, as "the author's questions were so fawning." He began to question whether Mr Lewis was writing the book or whether he was a shill for Mr Bankman-Fried.

That biography, "Going Infinite", is now out, published on the day that Mr Bankman-Fried's trial began in New York. He is charged with multiple counts of fraud and misappropriating clients' money; he has pleaded not guilty. Mr Lewis had unparalleled access to Sam, as he calls him—or SBF, as the rest of the world knows him—in 2022 and early 2023. In that time Mr Bankman-Fried went from the world's richest man under 30 to alleged mastermind of the biggest fraud of the crypto era.

In the past Mr Lewis has focused on little-known people doing

extraordinary things. This time his subject is notorious. Some readers may share Mr Faux's worry: that Mr Lewis has got so close to Mr Bankman-Fried that he ceases to be objective.

From the start, Mr Bankman-Fried is portrayed as a puzzling yet oddly magnetic personality. He struggles to make sense of his childhood. His appearance is alienating. (He has to teach himself how to smile.) He hates fashion, sporting cargo shorts and unkempt hair. A hilarious passage describes him playing a fiendish video game while speaking to Anna Wintour, the editor-in-chief of Vogue, on Zoom.

His hyper-rationality sets him apart from almost everyone. He views people not as good or bad, but as "probability distributions" around a mean. He uses population statistics to dismiss the work of Shakespeare. He argues that there is too little money in politics, rather than too much, given the enormous economic impact of America's \$15trn of government spending. He mulls paying Donald Trump \$5bn not to run for president.

Mr Bankman-Fried's rationality leads him down two paths. First, he finds a calling in spotting statistical anomalies in financial markets, especially cryptocurrencies, and exploiting them to make a fortune. Second, he discovers in the "Effective Altruism" (EA) community like-minded nerds who, more than having feelings for their fellow human beings, have feelings about saving humanity in general. That enables them to use dispassionate calculations to decide how to make the biggest difference with their money. Both paths intersect early in his career with dazzling, disastrous consequences.

Mr Lewis's storytelling is as good as ever. A key moment in the book tells of an incident called "The Schism" that took place in 2018, at the start of Mr Bankman-Fried's efforts to create Alameda Research, his crypto hedge fund. The firm's finances were already in chaos, a large pot of money had

gone missing and some of his EA recruits were in open revolt, believing Mr Bankman-Fried to be either dishonest and manipulative or well-intentioned but a terrible manager. They leave in a huff, though not before brawling over money. With the benefit of hindsight, you might wish everything had come crashing down around Mr Bankman-Fried's head at that point, saving the world a lot of trouble.

Unlike his previous books, which explain the minutiae of financial innovations in breezy language that anyone can grasp, this one reveals little about the inner workings of crypto, which Mr Lewis says even Mr Bankman-Fried barely bothered to understand. Those wanting a rollicking—albeit jaundiced—examination of crypto's underbelly should read Mr Faux's book.

“Going Infinite” focuses on the human dimensions of the story, including Mr Bankman-Fried’s excruciating relationship with Caroline Ellison, the co-CEO of Alameda Research. Forget free love: it is one-sided and desperate. Forget romance: the messages they send each other are coldly businesslike. Forget human decency: Mr Lewis suggests Mr Bankman-Fried treated some of the women in his senior management team unfairly. There is also the jealous rivalry between him and Changpeng Zhao, known as CZ, who runs a crypto marketplace (and rival to FTX) called Binance. Mr Bankman-Fried appears to revel in publicly provoking him. This helps explain why CZ pulled the rug from under FTX in the run-up to its collapse.

A third revealing relationship is that which plays out between Mr Lewis and John Ray III, the bankruptcy expert drafted in to rescue what is left of FTX for its creditors. Mr Lewis’s writing style works best when he stands in the background and, for most of the book, he does. But he subtly skewers Mr Ray, and it is hard to escape the feeling that he is channelling arguments that Mr Bankman-Fried would make—if only the bailiff would listen to him.

It is clear that Mr Lewis is awestruck by his subject and his oddities, even

more than Walter Isaacson was by Elon Musk, a capricious tech titan whose life he recently chronicled. Mr Bankman-Fried, as Mr Lewis portrays him, is both mesmerising and maddening. As a result, for most of the book, Mr Bankman-Fried's voice drowns out the rest. There are other shortcomings. Mr Lewis is so gripped by the question of what happened to FTX customers' money, which vanished leaving an almost \$7bn hole in the firm's balance-sheet, that he lets it overshadow the question of intent, around which the trial will revolve.

As in his other work, Mr Lewis's brilliant illumination of his central character is helped by his flattening of others. But in this case, those around Mr Bankman-Fried—especially Ms Ellison and other colleagues who have admitted guilt—are likely to have crucial roles in determining whether he is convicted or not. More complex portrayals of them, as well as more examination of the part his father, mother and brother played in the FTX saga, would have made this a richer book.

Despite its flaws, the closer you get to the end, the bolder “Going Infinite” appears. By tolerating the idea that hyper-rationalists cannot make sense of the rules of the game the way most people do, Mr Lewis implicitly asks readers to reconsider whatever they thought they knew about Mr Bankman-Fried. In the court of public opinion, he is already convicted. That's reason enough to give this book a read. ■



一拥而上

全球债券收益率飙升可能引发麻烦

投资者担心市场进入动荡期

一个判定40年趋势结束的投资者是勇敢的。但债券收益率大幅上升，而且在最近几周上升速度之快，令许多市场参与者现在认为低利率的时代终结了。自8月初以来，美国的十年期国债收益率已超过4%，这是从2008年到2021年间从未见过的水平。10月3日，该收益率在两周里上涨了0.5个百分点后，达到4.8%的16年高点。这一上涨外溢到了全球：在欧洲，这可能导致负债累累的意大利出现财政危机；在日本，当局正在费力维持极低利率（见图表1）。

发生了什么？先看看美国的一些金融机制。持有美国国债的投资者通常可以在货币市场上出借，货币市场隔夜利率由美联储设定。因此最短期美国国债的收益率会跟随美联储的政策而动。更长期国债的收益率反映出另外两个因素。一个是对美联储未来利率政策的预期。另一个是“期限溢价”，就是补偿投资者可能遭遇到的各种不测事件：对利率或通胀的预测可能错了，甚至美国政府违约了——这在理论上是可能的。

政策预期和期限溢价都推高了收益率。在今年春天美国的银行业动荡之后，投资者担心出现衰退，并预计美联储会在今年降息。然后银行业动荡结束，对衰退的担忧平息，对经济增长的预期加强。市场转而接受一个美联储自己信奉的观点：它会在更长时期内将利率保持在高位。同时，很多政策制定者和投资者略微上调了他们对长期利率水平的预计。投资者没有考虑更多通胀，对通胀的预期已经相当平稳。而预期实际利率飙升了（见图表2）。

最近几周情况发生了变化。纽约联储每日发布一个金融模型对十年期美债收益率期限溢价的估计。自8月以来，该指标已经上升了0.7个百分点，足以完全解释同期内美债收益率的上涨。

有些人把期限溢价大涨完全归因于供需关系。美国财政部一直在大举借贷。仅仅从1月到9月，它就从市场上募集了高达1.7万亿美元（占GDP的7.5%），比2022年同期增加了近80%，这在一定程度上是因为税收下滑。同时，美联储正在缩减其持有的长期美债组合，一些分析人士认为中国央行也在这么做。交易员谈到对价格不敏感的买家正在离场，留下来的是更习惯风险的。

其他人谈到了基本面。在美国以外，全球经济看起来摇摇欲坠。在经济低迷时期，投资者的风险偏好会降低。油价起伏不定，美国政府仍然可能要关门，众议院一片混乱。所有这些不确定影响推高了期限溢价。除了影响新美债的供应，美国的巨额财政赤字是一个长期现象。一篇文献综述得出的经验法则认为，如此大的赤字使得美联储稳定通胀所须设定的利率升高了近3个百分点。

实际上，美国公共财政的走势非常糟糕，最悲观的投资者甚至在讨论长期有“财政主导”的风险，也就是利率的设定到了最后是为了控制政府的偿债成本而非控制通胀。尽管市场定价还没有计入更严重的长期通胀，通胀风险的指标（影响期限溢价）在今年稍早时下落后又已反弹。

不论其成因为何，美国债券市场的这些走势为世界其他地方设定了基调。美国的高利率容易推高美元，促使他国央行采取紧缩政策，以避免受困于进口价格升高导致的通胀。而且由于资本的流动，全球的期限溢价是相互关联的。

欧元区的利率在近几周也已上升，反映了这些外溢效应，即便这里的经济形势有所不同。调查显示欧元区已经陷入衰退。欧元区整体的财政赤字减小，欧盟委员会正在辩论如何削减政府开支。

但由于各国管理自己的预算，考虑整体应对措施并不合理。利率上升让人们再度担忧起欧元区债务最严重的大经济体的公共财政可持续性。意大利的十年期国债收益率现在是4.9%，为2012年（欧债危机肆虐之时）以来最高。没有快速的经济增长或是财政紧缩，它的预算无法支撑太久。现在它

与德国十年期国债收益率之差已接近两个百分点。意大利国债的投资者担心他们可能要血本无归，或者有一天只能拿到里拉。

不过，国债收益率上升最明显的直接后果出现在日本。日本央行一直特立独行，在通胀上行时依然把利率维持在-0.1%。自7月时把十年期国债收益率上限从0.5%上调后，它也继续维持着1%的收益率上限。9月29日，该行宣布了一次计划外购债，购入3010亿日元（20亿美元）的债券以维持这一上限，因为收益率已逼近0.8%。10月4日，它再次出手购入1.9万亿日元的债券。10月3日日元兑美元汇率达到150，之后迅速回落到147，引发传言称日本当局可能出手干预了汇率——而这样的操作过去有过。去年10月，在日元兑美元汇率越过150关口后，日本当局24年来首次试图保卫日元汇率。如果长期的低利率时代真的终结了，未来几个月可能会有其他很多财政界限被冲破。■



All at once

A surge in global bond yields threatens trouble

Investors fear markets are in for a turbulent time

IT IS A brave investor who calls the end of a four-decade trend. But bond yields have risen so far and—in recent weeks—so fast that many market participants now believe the era of low interest rates to be over. Since early August America's ten-year Treasury yield has traded in excess of 4%, a level unseen from 2008 to 2021. On October 3rd it hit a 16-year high of 4.8%, having risen by half a percentage point in a fortnight. The moves have spilled over globally: to Europe, where they threaten to bring about a fiscal crisis in indebted Italy; and Japan, which is clinging on to rock-bottom interest rates by its fingertips (see chart 1).

What is going on? Start in America, with some financial mechanics. Investors who hold Treasuries typically have the option of lending in money markets, in which overnight interest rates are set by the Federal Reserve. The yield on the shortest-maturity Treasuries therefore tracks Fed policy. At longer maturities yields reflect two additional factors. One is expectations of how the Fed will change rates in future. The other is the “term premium”, which compensates investors for the chance of nasty surprises: that forecasts for interest rates or inflation turn out to be wrong—or even, in theory, that the government defaults.

Both policy expectations and the term premium have driven up yields. After America's banking turmoil in the spring, investors feared recession and expected the Fed to cut interest rates this year. Then the turmoil ended, the fears faded and forecasts for economic growth rose. Markets came around to the view espoused by the Fed itself: that it will hold rates higher for longer. At the same time, many policymakers and investors nudged up estimates

for where rates will settle in the long term. Investors were not pencilling in more inflation, expectations for which have been fairly stable. Instead, expected real interest rates soared (see chart 2).

In recent weeks things have changed. The New York Fed publishes a daily estimate of the term premium on the ten-year Treasury yield, derived from a financial model. Since August it has risen by 0.7 percentage points, enough to fully explain the rise in bond yields over that time.

Some attribute the surge in the term premium to simple supply and demand. The Treasury has been on a borrowing binge. From January to September alone it raised a whopping \$1.7trn (7.5% of GDP) from markets, up by almost 80% over the same period in 2022, in part because tax revenues have fallen. At the same time, the Fed has been shrinking its portfolio of long-dated Treasuries, and some analysts think China's central bank is doing the same. Traders talk of price-insensitive buyers leaving the market, and of those who remain being more attuned to risk.

Others point to fundamentals. Outside America, the global economy looks wobbly. In downturns, investors' appetite for risk falls. The oil price is volatile, America's government could yet shut down and the House of Representatives is in turmoil. The uncertain effects of all this push up the term premium. As well as affecting the supply of new Treasuries, America's gaping fiscal deficit is a long-term phenomenon. A rule of thumb from one literature review suggests it is large enough to be forcing up the interest rate the Fed must set to stabilise inflation by nearly three percentage points.

In fact, the trajectory of America's public finances is so dire that the most bearish investors talk of the long-term risk of "fiscal dominance"; that interest rates might eventually be set with the goal of controlling the government's debt-service costs, rather than inflation. Although markets have not priced in much more long-run inflation yet, measures of inflation

risk—which affects the term premium—have rebounded since falling earlier this year.

Regardless of their cause, movements in America's bond markets set the pace in the rest of the world. Higher rates in America tend to push up the dollar, encouraging other central banks to tighten in order to avoid suffering inflation from pricier imports. And term premia are correlated globally, owing to the mobility of capital.

Reflecting these spillovers, rates in the euro zone have risen in recent weeks, too, even though the economic picture is different. Surveys indicate the bloc is already in recession. Across the zone, fiscal deficits are smaller and the European Commission is debating how to cut state spending.

But dealing in aggregates does not make sense when each country runs its own budget. Rising rates have brought back worries about the sustainability of public finances in the euro zone's most indebted big economy. Italy's ten-year bond yield is now 4.9%, its highest since 2012, when the euro-zone's debt crisis was raging. It is more than its budget can bear for long without fast economic growth or austerity. The spread over German ten-year debt is now just below two percentage points. Investors in Italian debt fear that they might not get their money back—or that one day they may be repaid in lira.

Look to Japan, though, for the most dramatic immediate consequences of rising yields. The Bank of Japan has been an outlier, keeping interest rates at -0.1%, even as inflation has risen. It also continues to cap ten-year bond yields at 1%, a ceiling it lifted from 0.5% in July. On September 29th it announced an unscheduled purchase of ¥301bn (\$2bn) of bonds in defence of the cap, as yields neared 0.8%. On October 4th it returned to the market with a buy of ¥1.9trn. Rumours swirled that the authorities may have intervened to support the yen on October 3rd after it reached 150 to the

dollar only to snap back suddenly to 147. That would be in line with past practice. Last October the authorities tried to defend the currency for the first time in 24 years after it crossed the 150 mark. If the long era of low rates really is over, many other financial rubicons could be crossed in the months to come. ■



巴托比

办公室友谊

朋友让员工更敬业。但这不是公司插手的理由

研究幸福的学者发现，亲密的人际关系是美满生活的关键要素之一。盖洛普（Gallup）的研究表明，这个普遍适用的规律在职场里也同样有效。该民意调查机构发现，有一个“公司里最好的朋友”与种种美好结果密切相关，包括更高的员工敬业度、更高的留任率，以及更好的安全记录，等等。

在某种程度上，这不是什么惊人发现。和自己喜欢的人在一起会让大多数事情都变得更有吸引力，工作也不例外。如果一份工作相当单调乏味，同事之间的情谊也许就会成为上班的主要动力。朋友的支持也能鼓励人们尝试新鲜事物。杜克大学的埃里卡·菲尔德（Erica Field）及合著者在2015年的一项研究调查了对印度女性的商业培训带来的影响。与朋友一起参加培训的女性比单独参加的更有可能最终去申请贷款。

反之亦然。与同事的对立关系多半总会让工作变得痛苦。大峡谷州立大学（Grand Valley State University）的瓦莱丽·古德（Valerie Good）的一项研究发现，孤独感会对销售人员的业绩产生不利影响。别的不说，他们会开始花更多钱去招待客户吃喝。销售员一心想要赚你的钱已经很糟了，唯一比这更糟的是他们竟还想要你的陪伴。

所以朋友很重要。但是，若管理者一看到“员工敬业度变高”这几个字就马上得出结论，心想那可该想点办法营造工作友谊了，这时问题就来了。盖洛普在去年发表的报告中举了一个例子：一家公司（未透露名字）每周都会举行全体会议，每次聚焦一名员工在公司里最好的朋友。就是不知道在问答环节有没有人冒出来哭诉：“可我一直以为我才是你在公司里最好的朋友啊。”

创业公司也提供各种服务来促成工作友谊。一家公司监测不同团队中员工

之间的潜藏关联。它找到互不相识的员工之间的共同兴趣爱好（例如无麸质烘焙或职场监视），并安排他们见面。你以为生活很糟糕吗？至少你还不用和财务部的陌生人一起做煎饼。

管理者插手员工交友是个错误，这不仅仅是因为完全没有抓住重点。友谊的最大特点是它是自发的。员工都是成年人，不需要主管来安排玩伴。工作场所让人们聚在一起，往往是在充满考验的环境下：友谊自然会随之而来。

更大的问题是，职场友谊是一把双刃剑，其负面作用比其倡导者认为的更大。当权力关系发生变化时，友谊很快就会变得棘手。从朋友到老板，或从朋友到下属，这种转变本身就相当尴尬（“这是给你的最后警告。要不要去喝一杯？”）

而友谊也可能有任人唯亲的嫌疑。哈佛商学院的佐伊·卡伦（Zoe Cullen）和加州大学伯克利分校的里卡多·佩雷斯-特鲁利亚（Ricardo Perez-Truglia）进行的一项巧妙的研究发现，相较于其他员工，与主管有社交互动的员工更有可能提升自己的职业前景。

两位研究员考察了在东南亚一家大银行任职的吸烟者和不吸烟者的晋升情况，他们猜想吸烟的员工与也吸烟的上司在休息时一起吸烟可能有助晋升。结果确实如此。一个吸烟的员工从一个不吸烟的上司手下转到一个吸烟的上司手下的晋升速度要快过转到另一个不吸烟的上司手下。论文作者发现，社交互动不只是对吸烟者有帮助，男性经理和男性员工之间的社交也在很大程度上导致了男女薪酬差距根深蒂固。如果企业要插手建立友谊，就不能不警惕这么做的弊端。

公司应该促进员工之间的互动，在混合办公和远程工作的世界里尤其如此。社交聚会和伙伴制度是鼓励同事相互认识和培养企业文化的合理方式。但是，高质量的工作关系并不一定需要友谊。它需要的是对彼此能力的尊重、一定程度的信任，以及实现共同目标的愿望；它不需要生日贺卡和对手工拼布的共同兴趣。公司应该尽其所能鼓励这样的关系。如果员工

个人希望关系更进一步，那么这完全要看他们自己了。■



Bartleby

Friendships in the office

Friends make employees more engaged. That's no reason for companies to get involved

SCHOLARS OF HAPPINESS have found that close relationships are one of the critical ingredients of a contented life. What is true in general is also true of the workplace, according to research by Gallup. The pollster finds that having a “best friend at work” is closely associated with all manner of good things, from greater employee engagement to higher retention and better safety records.

At some level, that is unremarkable. Spending time with people you like makes most things more appealing, including work. If a job is sufficiently humdrum, camaraderie among colleagues can be the main draw. The support of friends can also encourage people to try new things. A study from 2015 by Erica Field of Duke University, and her co-authors, looked at the impact of business training given to Indian women. Women who attended the course with a friend were more likely to end up taking out loans than those who came alone.

The reverse also applies. Antagonistic relationships with co-workers are always likely to make working life miserable. A study conducted by Valerie Good of Grand Valley State University found that loneliness has an adverse effect on the performance of salespeople. Among other things, they start spending more on wining and dining their customers. The only thing worse than a salesperson who sees you as a way to make money is one who wants your company.

So friends matter. The problems come when managers see the words “higher employee engagement” and leap to the conclusion that they should

try to engineer work friendships. In a report published last year Gallup gave the example of an unnamed organisation which has a weekly companywide meeting that spotlights one employee's best friend at work. It's not known if, in the Q&A, others pop up to sob: "But I thought we were best friends at work."

Startups also offer services to encourage work friendships. One monitors the depth of connections between people in different teams. It identifies shared interests (gluten-free baking, say, or workplace surveillance) between employees who don't know each other and arranges meetings between them. You thought life was bad? At least you are not making crumpets with a stranger in finance.

It is a mistake for managers to wade into the business of friend-making, and not just because it royally misses the point. The defining characteristic of friendship is that it is voluntary. Employees are adults; they don't need their managers to arrange play-dates. And the workplace throws people together, often under testing conditions: friendships will naturally follow.

The bigger problem is that workplace friendships are more double-edged than their advocates allow. They can quickly become messy when power dynamics change. The transition from friend to boss, or from friend to underling, is an inherently awkward one ("This is your final warning. Fancy a pint?").

And friendships have the potential to look a lot like cronyism. A clever study by Zoe Cullen of Harvard Business School and Ricardo Perez-Truglia of University of California, Berkeley, found that employees' social interactions with their managers could give their career prospects a boost relative to others.

The researchers looked at promotions of smokers and non-smokers who

worked for a large bank in South-East Asia, hypothesising that sharing smoking breaks with managers who also indulged might give workers a leg up. And so it did. Smokers who moved from a non-smoking boss to a puffer were promoted more quickly than those who moved to another non-smoker. The authors found that social interactions did not just help smokers; socialising between male managers and male employees played a large role in perpetuating gender pay gaps. If firms are going to make friendship their business, they should worry about its downsides, too.

Companies should facilitate interactions between employees, particularly in a world of hybrid and remote working. Social gatherings and buddy systems are reasonable ways to encourage colleagues to meet each other and to foster a culture. But a high-quality work relationship does not require friendship. It requires respect for each other's competence, a level of trust and a desire to reach the same goal; it doesn't need birthday cards and a shared interest in quiltmaking. Firms should do what they can to encourage these kinds of relationships. If individuals want to take it further, it's entirely up to them. ■



聪明钱

OpenAI会成为下一个科技巨头吗？

从这家领跑的AI创业公司的业务看AI技术的未来【深度】

新市场的创建就像一场长跑的开局。参赛者争夺有利位置，观众们兴奋地呐喊助威。接着，就像在赛跑中那样，市场进入更平静的第二阶段。领先者与落后者之间逐渐拉开距离，观众也稀疏起来。

在寻求主导人工智能（AI）的未来的竞赛中，微软投资的OpenAI在去年11月推出ChatGPT，确立了领先优势。该应用很快就吸引到1亿用户，速度之快前所未见。对手蜂拥追赶。谷歌及其母公司Alphabet匆忙发布了它们的聊天机器人Bard。Anthropic这样的创业公司也是如此。2023年上半年，风投机构向AI公司注入了超过400亿美元，几乎占今年风投总额的四分之一。然后这股AI热潮就平息了下来。根据谷歌搜索的数据，公众对AI的兴趣在三四个月前触顶。ChatGPT网站的访问量从5月的2.1亿次下降到目前的1.8亿次（见图表1）。

OpenAI在新形成的市场秩序中保持技术上的领先。其最新的AI模型GPT-4在各种基准（例如解答阅读和数学问题的能力）上都击败了其他模型。在一一对较量中，它的表现领先当前的亚军Anthropic的Claude 2，两者之间的差距大概相当于世界第一国际象棋手与第二名之间的差距——尽管并非不可超越，但也不算太小。更重要的是，OpenAI已经开始真正赚钱了。据在线科技媒体The Information报道，该公司现在的年化收入为10亿美元，而在ChatGPT推出的前一年只有区区2800万美元。

OpenAI能否将其早期优势转化为持久优势，跻身科技巨头之列？要做到这一点，它必须避免重蹈网景（Netscape）和Myspace等昔日科技先驱的覆辙——这些公司被那些从它们早期的成功和挫折中汲取了经验教训的对手赶超。而由于OpenAI是先行者，它所做的决定也将很大程度上表明这个新兴行业的整体发展方向。

OpenAI是一家奇特的公司。它于2015年由包括现任老板山姆·阿尔特曼（Sam Altman）和特斯拉老板、科技狂人马斯克在内的一批企业家创立，当时的定位是一家非营利机构。其目标是构建能在所有类型的智力任务中达到或超过人类水平的通用人工智能（AGI）。在此之前要实现的一个目标是让AI能够掌握一款名为刀塔（Dota）的电子游戏。在研究如何攻克这个游戏的过程中，OpenAI的研究人员找到了一种简单的、但需要利用大量计算能力的方法，一位在这之后离职的早期员工表示。2017年，谷歌的研究人员发表了一篇论文，描述了一种革命性的机器学习方法，他们将其命名为“Transformer”。OpenAI的工程师意识到他们可以把互联网上抓取的海量数据与强大的处理能力相结合来扩大它的规模。最终产生了生成式预训练Transformer，简称GPT。

为了获得必要的资源，OpenAI也需要运用一些财务工程。2019年，它在其非营利架构内创建了一家“有限盈利公司”。首先，这个公司的投资者最多只能获得其初始投资本金100倍的投资回报。该公司不向投资者分配股权，而是分配不涉及所有权的未来利润分享（“利润参与单位”）。更重要的是，OpenAI表示可能会把所有利润用于再投资，直到董事会认为OpenAI的AGI目标已经实现。OpenAI强调这是一项“高风险投资”，应该被视为更类似于“捐赠”。“我们公司并不是谁都适合来投资的。”OpenAI首席运营官及财务主管布拉德·莱特凯普（Brad Lightcap）表示。

他也许没说错。马斯克于2018年退出了OpenAI。在OpenAI做最新一轮融资时，一些潜在投资者被其复杂的结构吓退了。但阿尔特曼和莱特凯普赢得了其他人的支持。为了提高投资吸引力，该公司已将利润上限放宽为基于年回报率的上限（尽管它不会确认最高年回报率是多少）。抛开关于AGI意义的学术争论不谈，“利润单位”本身是可以像普通股票一样在市场上出售的。OpenAI已经为早期员工提供了几次出售利润单位的机会。选择买入的投资者似乎相信，如果公司持续增长，他们就能获得风投级别的回报。

冒险成瘾的日本科技投资机构软银据信是最新一家有意大举下注OpenAI的投资方。OpenAI迄今已筹集了约140亿美元。其中大部分资金来自微

软，可能有约130亿美元。微软的云部门Azure也在为OpenAI提供其所需的计算能力。作为交换，这个软件巨头将获得OpenAI大部分的利润——如果未来它能转移利润的话。短期内，微软可以获得OpenAI技术的许可并提供给自己的客户——世界上最大的那些公司大部分都在其中。

幸好OpenAI还在吸引其他财力雄厚的投资者。毕竟这家公司需要巨量资金，才能获取持续创建愈加智能的模型所需的数据和计算能力。阿尔特曼表示，OpenAI很可能最终成为“硅谷历史上资本最密集的创业公司”。OpenAI的最新模型GPT-4的训练成本估计约为1亿美元，是GPT-3的几倍。

目前，投资者似乎很乐意向OpenAI投入更多资金。但最终他们还是期望能收到回报。至于OpenAI，它已经意识到如果要实现其使命，就必须像任何其他羽翼未丰的企业一样，认真考虑成本和收入的问题。

OpenAI在GPT-4上已展现出一定程度的成本意识。例如，研究公司SemiAnalysis的迪伦·帕特尔（Dylan Patel）指出，它被划分为16个部分，分别专门处理不同类型的任务。这比一个单一的整块式大模型的设计难度更大。但一旦模型完成训练，实际使用起来就更便宜，因为不需要所有这些专门部分都来回答问题。成本也是OpenAI没有训练其下一个大型模型GPT-5的重要原因。知情人士表示，OpenAI正在构建GPT-4.5，这个版本将具有与GPT-4“相似的质量”，但运行成本“要低得多”。

但OpenAI最大的转型是在业务创收方面，近来它在这方面也劲头最足。莱特凯普表示，在AGI大脑能像人类大脑一样全能之前很久，AI就可以创造出大量价值。OpenAI的模型是经过大量数据的训练的多面手，能够执行各种任务。ChatGPT热潮让OpenAI成为渴望采用该技术的消费者、开发者和企业的默认选择。根据投资了OpenAI的风投公司安德森霍洛维茨（Andreessen Horowitz）的一项研究，即便最近有所下降，ChatGPT仍吸引到前50大生成式AI网站访问量的60%（见图表2）。

但OpenAI已不再只是（甚至不是主要）发展ChatGPT了。它正日益成为一个B2B平台。它正在为包括投资银行摩根士丹利在内的大企业客户打造定

制产品。它还为开发人员提供使用其模型构建产品的工具。11月6日，预计OpenAI将在首届开发者大会上推出新的工具。

此外，OpenAI还有1.75亿美元可投资于小型创业公司，促成它们在其平台上构建应用。这既推广了OpenAI的模型，也让它有机会在这些应用开发者淘金成功时获取价值。为了进一步推广自身技术，它正在向Y Combinator的AI公司提供支持，阿尔特曼曾经执掌这家硅谷的创业公司孵化器。风投公司Founders Fund的约翰·卢蒂格（John Luttig）认为，这种广泛而多样化的推广可能比任何技术优势都更重要，该公司也持有OpenAI股份。

先发者地位无疑对OpenAI有利。类似GPT的模型固定成本高昂，这为竞争对手设置了巨大的准入壁垒。这反过来可能会让OpenAI更容易锁定企业客户。如果这些客户要共享公司内部数据以便根据自己的需求微调模型，许多客户可能只愿意共享一次，一方面是虑及网络安全问题，另一方面是在AI供应商之间迁移数据成本很高，就像在计算云之间已经可以看到的那样。教大模型学会思考还需要大量隐性工程知识，从识别高质量数据，到了解快速调试源代码的技巧等。阿尔特曼推测，在模型训练方面，全球只有不到50名真正的前沿专家。其中很多人都在为OpenAI工作。

这些确实都是真正的优势。但它们并不能保证OpenAI的统霸地位。一方面，以规模带来更大规模的网络效应曾帮助Alphabet、亚马逊和Meta分别成为搜索、电子商务和社交网络领域的准垄断企业，但在OpenAI上这种效应尚未显现。尽管GPT-4拥有大量用户，但现在的情况并不比六个月前好多少。尽管使用用户数据做进一步微调后它偏离轨道的几率降低，但整体性能却产生了不可预测的变化，在某些情况下甚至变差了。

成为模型构建的先发者也可能有不利之处。对于模型建构公司来说，最大的成本不是训练，而是实验。在有用的想法进入训练阶段之前，有很多想法都无果而终。这就是OpenAI去年估计损失了约5亿美元的原因，尽管GPT-4的训练成本是这个数字的五分之一。哪些想法不成功，往往会在整个AI领域迅速传开。这就帮助OpenAI的竞争对手绕开了代价高昂的死胡

同。

至于客户，许多人希望减少对OpenAI的依赖，担心会被它的产品锁定而受制于它。由从OpenAI出走的员工创立的Anthropic已经成为许多AI创业公司的热门次选项。很快它们可能还会有更多的尖端备选项。谷歌正在构建Gemini，外界认为它是一种比GPT-4更强大的模型。就连与OpenAI是合作关系的微软也仍是某种竞争对手。微软可以访问GPT-4的黑盒子，并拥有与全球最大一批企业IT部门联结深厚的庞大销售队伍。选择的多样性削弱了OpenAI的定价能力。这也迫使它必须不断训练更好的模型以保持领先。

OpenAI的模型是一个黑盒子的事实也降低了它对一些潜在用户的吸引力，包括关注数据隐私的大企业。它们可能更喜欢Meta的LLaMA 2这样的更透明的“开源”模型。另外，先进的软件公司可能希望构建自己的模型以便能完全掌控其行为。

还有一些公司放弃了能完成很多任务而不只是一项任务的通用性，去构建更便宜的模型，这些模型或是基于更窄的数据集训练出来，或是只能完成某种特定的任务。一家名为Replit的创业公司训练了一个专做计算机编程的模型。该模型基于AI云平台Databricks，平台投资者包括市值1万亿美元的专用AI芯片制造商英伟达（Nvidia）。Character AI设计了一个模型，让人们可以基于真实或想象的角色创建虚拟人物，可与其他用户对话。它是受欢迎度仅次于ChatGPT的AI应用。

风投家郭伟业（他没有投资OpenAI）在即将发表的一篇文章中指出，核心问题是模型的通用性能带来多大价值。如果价值不大，那么这个行业可能将由Replit或Character AI等一众专业公司主导。如果价值很大，那么OpenAI或谷歌等公司的大模型可能会占据主导。阿尔特曼仍然相信规模效应。“我们肯定会继续扩大规模，”他表示，即使许多收益“要寄希望于其他方面”。

风投公司Sutter Hill Ventures（也没有投资OpenAI）的麦克·斯皮瑟（Mike

Speiser) 倾向认为，市场最终将会包含为数不多的大型通用模型，以及大量面向特定任务的模型。这种寡头垄断可能会限制实现像谷歌那种规模的盈利的可能，但仍然可以为OpenAI带来可观的收入。而如果这家公司真的实现了其使命，创造出了超越人类的思考机器呢？那么一切都将难以预料了。 ■



Smart money

Could OpenAI be the next tech giant?

What the business of AI's leading startup says about the technology's future

THE CREATION of a new market is like the start of a long race. Competitors jockey for position as spectators excitedly clamour. Then, like races, markets enter a calmer second phase. The field orders itself into leaders and laggards. The crowds thin.

In the contest to dominate the future of artificial intelligence, OpenAI, a company backed by Microsoft, established an early lead by launching ChatGPT last November. The app reached 100m users faster than any before it. Rivals scrambled. Google and its corporate parent, Alphabet, rushed the release of their chatbot, Bard. So did startups like Anthropic. Venture capitalists poured over \$40bn into AI firms in the first half of 2023, nearly a quarter of all venture dollars this year. Then the frenzy died down. Public interest in AI peaked a couple of months ago, according to data from Google searches. The number of visitors to ChatGPT's website fell from 210m in May to 180m now (see chart 1).

The emerging order still sees OpenAI ahead technologically. Its latest AI model, GPT-4, is beating others on a variety of benchmarks (such as an ability to answer reading and maths questions). In head-to-head comparisons, it ranks roughly as far ahead of the current runner-up, Anthropic's Claude 2, as the world's top chess player does against his closest rival—a decent lead, even if not insurmountable. More important, OpenAI is beginning to make real money. According to the Information, an online technology publication, it is earning revenues at an annualised rate of \$1bn, compared with a trifling \$28m in the year before ChatGPT's launch.

Can OpenAI translate its early edge into an enduring advantage, and join the ranks of big tech? To do so it must avoid the fate of erstwhile tech pioneers, from Netscape to Myspace, which were overtaken by rivals that learnt from their early successes and stumbles. And as it is a first mover, the decisions it takes will also say much about the broader direction of a nascent industry.

OpenAI is a curious firm. It was founded in 2015 by a clutch of entrepreneurs including Sam Altman, its current boss, and Elon Musk, Tesla's technophilic chief executive, as a non-profit venture. Its aim was to build artificial general intelligence (AGI), which would equal or surpass human capacity in all types of intellectual tasks. An intermediate goal was an AI that could master a video game called "Dota". In working on that problem, OpenAI's boffins alighted on a simple approach that involved harnessing oodles of computing power, says an early employee who has since left. When in 2017 researchers at Google published a paper describing a revolutionary machine-learning technique they christened the "transformer", OpenAI's engineers realised they could scale it up by combining untold quantities of data scraped from the internet with processing oomph. The result was the generative pre-trained transformer, or GPT for short.

Obtaining the necessary resources required OpenAI to employ some engineering of the financial variety. In 2019 it created a "capped-profit company" within its non-profit structure. To begin with, investors in this business could make 100 times their initial investment—but no more. Rather than distribute equity, the firm distributes claims on a share of future profits that come without ownership rights ("profit-participation units"). What is more, OpenAI says it may reinvest all profits until the board decides that OpenAI's goal of achieving AGI has been reached. OpenAI stresses that it is a "high-risk investment" and should be viewed as more akin to a "donation". "We're not for everybody," says Brad Lightcap, OpenAI's chief operating officer and its financial guru.

Maybe not. Mr Musk pulled out in 2018. Some potential investors were scared away from OpenAI's most recent funding round by its complex structure. But Mr Altman and Mr Lightcap were able to win over others. To become more attractive the company has loosened its profit cap to one based on an annual rate of return (though it will not confirm what the maximum rate is). And academic debates about the meaning of AGI aside, the profit units themselves can be sold on the market just like standard equities. The firm has already offered several opportunities for early employees to sell their units. Investors who chose to buy in appear confident that they can achieve venture-scale returns if the firm keeps growing.

SoftBank, a risk-addled tech-investment house from Japan, is thought to be the latest investor keen to place a big bet on OpenAI. The startup has so far raised a total of around \$14bn. Most of it, perhaps \$13bn, has come from Microsoft, whose Azure cloud division is also furnishing OpenAI with the computing power it needs. In exchange, the software titan will receive the lion's share of OpenAI's profits—if these are ever handed over. In the short term, it gets to license OpenAI's technology and offer this to its own clients, which include most of the world's largest companies.

It is just as well that OpenAI is attracting deep-pocketed backers. For the firm needs an awful lot of capital to procure the data and computing power necessary to keep creating ever more intelligent models. Mr Altman has said that OpenAI could well end up being “the most capital-intensive startup in Silicon Valley history”. OpenAI's most recent model, GPT-4, is estimated to have cost around \$100m to train, several times more than GPT-3.

For the time being, investors appear happy to pour more money into the business. But they eventually expect a return. And for its part OpenAI has realised that, if it is to achieve its mission, it must become like any other fledgling business and think hard about its costs and its revenues.

GPT-4 already exhibits a degree of cost-consciousness. For example, notes Dylan Patel of SemiAnalysis, a research firm, it was divided into 16 parts that specialise in different types of tasks. That makes it trickier to design than a monolithic model. But it is then cheaper to actually use the model once it has been trained, because not all the specialists are required to answer questions. Cost is also a big reason why OpenAI is not training its next big model, GPT-5. Instead, say sources familiar with the firm, it is building GPT-4.5, which would have “similar quality” to GPT-4 but cost “a lot less to run”.

But it is on the revenue-generating side of business that OpenAI is most transformed, and where it has been most energetic of late. AI can create a lot of value long before AGI brains are as versatile as human ones, says Mr Lightcap. OpenAI’s models are generalist, trained on a vast amount of data and capable of doing a variety of tasks. The ChatGPT craze has made OpenAI the default option for consumers, developers and businesses keen to embrace the technology. Despite the recent dip, ChatGPT still receives 60% of traffic to the top 50 generative-AI websites, according to a study by Andreessen Horowitz, a venture-capital (VC) firm which has invested in OpenAI (see chart 2).

Yet OpenAI is no longer only—or even primarily—about ChatGPT. It is increasingly becoming a business-to-business platform. It is creating bespoke products of its own for big corporate customers, which include Morgan Stanley, an investment bank. It also offers tools for developers to build products using its models; on November 6th it is expected to unveil new ones at its first developer conference.

In addition, the firm has a \$175m pot to invest in smaller AI startups building applications on top of its platform, which at once promotes its models and allows it to capture value if the application-builders strike gold. To spread its technology further, it is handing out perks to AI firms at Y

Combinator, a Silicon Valley startup nursery that Mr Altman used to lead. John Luttig of Founders Fund, a VC firm which also has a stake in OpenAI, thinks that this vast and diverse distribution may be even more important than any technical advantage.

Being the first mover certainly plays in OpenAI's favour. GPT-like models' high fixed costs erect big barriers to entry for competitors. That in turn may make it easier for OpenAI to lock in corporate customers. If they are to share internal company data in order to fine-tune the model to their needs, many clients may prefer not to do so more than once—for cyber-security reasons, or simply because it is costly to move data from one AI provider to another, as it already is between computing clouds. Teaching big models to think also requires lots of tacit engineering know-how, from recognising high-quality data to knowing the tricks to quickly debug the source code. Mr Altman has speculated that fewer than 50 people in the world are at the true model-training frontier. A lot work for OpenAI.

These are all real advantages. But they do not guarantee OpenAI's dominance. For one thing, the sort of network effects where scale begets more scale, which have helped turn Alphabet, Amazon and Meta into quasi-monopolists in search, e-commerce and social networking respectively, have yet to show up. Despite its vast number of users, GPT-4 is hardly better today than six months ago. Although further tuning with user data has made it less likely to go off the rails, its overall performance has changed in unpredictable ways, in some cases for the worse.

Being a first mover in model-building may also bring some disadvantages. The biggest cost for modellers is not training but experimentation. Plenty of ideas went nowhere before the one that worked got to the training stage. That is why OpenAI is estimated to have lost some \$500m last year, even though GPT-4 cost one-fifth as much to train. News of ideas that do not pay off tends to spread quickly throughout AI world. This helps OpenAI's

competitors avoid going down costly blind alleys.

As for customers, many want to reduce their dependence on OpenAI, fearful of being locked into its products and thus at its mercy. Anthropic, which was founded by defectors from OpenAI, has already become a popular second choice for many AI startups. Soon they may have more cutting-edge alternatives. Google is building Gemini, a model believed to be more powerful than GPT-4. Despite its partnership with OpenAI, even Microsoft is something of a rival. It has access to GPT-4's black box, as well as a vast sales force with deep ties to the world's biggest corporate IT departments. This array of choices diminishes OpenAI's pricing power. It is also forcing Mr Altman's firm to keep training better models if it wants to stay ahead.

The fact that OpenAI's models are a black box also reduces its appeal to some potential users, including large businesses concerned about data privacy. They may prefer more transparent "open-source" models like Meta's LLaMA 2. Sophisticated software firms, meanwhile, may want to build their own model, in order to exercise full control over its behaviour.

Others are moving away from generality—the ability to do many things rather than just one thing—by building cheaper models that are trained on narrower sets of data, or to do a specific task. A startup called Replit has trained one just to write computer programs. It sits atop Databricks, an AI cloud platform which counts Nvidia, a \$1trn maker of specialist AI semiconductors, among its investors. Character AI has designed a model that lets people create virtual personalities based on real or imagined characters that can then converse with other users. It is the second-most popular AI app behind ChatGPT.

The core question, notes Kevin Kwok, a venture capitalist (who is not a backer of OpenAI), in a forthcoming essay, is how much value is derived from a model's generality. If not much, then the industry may be dominated

by many specialist firms, like Replit or Character AI. If a lot, then big models such as those of OpenAI or Google may come out on top. Mr Altman still believes in size. “We will keep scaling for sure,” he says, even if many of the gains “will hopefully come from other things”.

Mike Speiser of Sutter Hill Ventures (another non-OpenAI backer) suspects that the market will end up containing a handful of large generalist models, with a long tail of task-specific models. Such an oligopoly might limit the chance of an astronomical Google-like outcome, but could still earn OpenAI a pretty penny. And if the company really does achieve its mission of creating a thinking machine that surpasses humans? Then all bets are off. ■



导弹库存

大药厂囤不够的一类抗癌药

一连串的交易显现出对抗体药物偶联物的高期望

在世界各地，企业交易陷入了停滞。利率上升、地缘局势紧张和经济不确定性的综合作用阻碍了合资、合并与收购。一个例外是名字里带有人工智能（AI）的标的。另一个例外没那么显眼，首字母缩写也不像AI那么好记顺口：ADC。

ADC全称为抗体药物偶联物（antibody-drug conjugates），其生产商是全球最大制药公司中风头正劲的那些。辉瑞将斥资430亿美元收购Seagen，而后者刚刚与规模较小的生物技术公司Nurix Therapeutics合作开发这类药物。安进（Amgen）、阿斯利康和默克也在ADC上押注了数十亿美元。在过去五年里，围绕这类药物已签署了价值600亿美元的许可协议。交易的数量在此期间增加了两倍，达到26笔。今年到目前为止已经签署了18项协议，多于涉及其他新兴抗癌药物的类似协议。

ADC并不是什么新药。第一款ADC在2000年被批准用于治疗各类白血病。它们的作用就像生物制导导弹：携带有毒化疗药物的抗体能够直接找到癌细胞。因为它们绕过正常组织直接攻击目标，所以可以让患者接受更高剂量的治疗而不会造成太多附带伤害。

两方面的进展可以解释为何药厂近来疯狂囤积这类抗癌武器。一是临床信心增强。Enhertu是由阿斯利康和日本生物技术公司第一三共制药共同开发的ADC，于2019年首次在美国获批。但在2022年的另一组试验显示，与接受标准化疗的患者相比，该药让乳腺癌患者的寿命几乎延长了一倍且没有复发，该药的批准范围遂扩大到不同类型的乳腺癌和肺癌。监管机构已经批准了其他十几种ADC，它们现在被常规用于治疗一些最致命的癌症，包括白血病、淋巴瘤和乳腺癌。

目前有140多种新的ADC处于临床试验阶段。百时美施贵宝（Bristol Myers

Squibb) 和赛诺菲都有药物已进入后期试验。阿斯利康和默克各自与中国的生物技术公司成立了合资企业，以利用中国监管机构对早期试验更为宽松的规定，这有助于加速药物的开发。阿斯利康负责肿瘤研究和开发的苏珊·加尔布雷思 (Susan Galbraith) 说，在过去10年里，中国的药物试验时间已大大缩短。

临床的成功反过来又增强了商业信心。2022年，Enhertu的销售额超过12亿美元。去年，吉利德科学 (Gilead Sciences) 销售的一种被批准用于治疗晚期乳腺癌的类似药物Trodelvy的收入增长了79%，达到6.8亿美元。今年上半年，瑞士制药公司罗氏研发的Kadcyla为它带来了11亿美元的收入。医疗数据提供商Evaluate预测，到2028年，ADC的销售额可能达到近300亿美元，而去年约为75亿美元（见图表）。

其中有些押注可能是哑弹。目前尚不清楚这些药物与免疫疗法等其他药物联合使用的效果如何。它们生产起来也很复杂。如果中西方关系紧张加剧，任何涉及中国合作伙伴的交易都可能破裂。但就目前而言，ADC是一场值得欢呼的全球军备竞赛。 ■



Missile stockpiles

Big pharma can't get enough of one class of cancer drugs

A spate of dealmaking suggests high expectations for antibody-drug conjugates

AROUND THE world, dealmaking is in a rut. A combination of higher interest rates, geopolitical tensions and economic uncertainty has put a hold on joint ventures, mergers and acquisitions. One exception is targets with AI in their name. Another, less obvious one, involves a less catchy initialism: ADCs.

Makers of these antibody-drug conjugates, to give them their full name, are all the rage among the world's biggest drugmakers. Pfizer is paying \$43bn for Seagen, which in turn has just teamed up with Nurix Therapeutics, a smaller biotechnology firm, to work on this class of drugs. Amgen, AstraZeneca and Merck have also placed billion-dollar bets on ADCs. In the past five years licensing deals worth \$60bn have been signed for such therapies. The number of such deals tripled in that period, to 26. So far this year 18 have been signed, outpacing similar deals involving other emerging cancer drugs.

ADCs aren't new. The first was approved in 2000 for types of leukaemia. They act like guided biological missiles: a payload of toxic chemotherapy is carried by antibodies able to seek out cancer cells directly. Because they bypass normal tissue and go straight for their targets, they let patients receive higher doses that would otherwise cause too much collateral damage.

Two developments explain the frenzied stockpiling of these anti-cancer weapons of late. One is increased clinical confidence. Enhertu, an ADC developed by AstraZeneca and Daiichi Sankyo, a Japanese biotechnology

company, was first approved in America in 2019. But after another set of trials in 2022 showed that it allowed breast-cancer patients to live almost twice as long without relapse as those treated with standard chemotherapy, its approval was extended to different types of breast and lung cancer. Regulators have cleared a dozen other ADCs, which are now routinely used to treat some of the deadliest cancers, including leukaemia, lymphoma and breast cancer.

More than 140 new ADCs are currently in clinical trials. Bristol Myers Squibb and Sanofi all have therapies in late-stage tests. AstraZeneca and Merck have each formed a joint-venture with biotech firms in China, to take advantage of Chinese regulators' more relaxed rules for early-stage trials, which helps accelerate the drugs' development. Susan Galbraith, who oversees oncology research and development at AstraZeneca, says that the timeline for drug testing in China has been significantly reduced in the past decade.

Clinical success has, in turn, boosted commercial confidence. Sales of Enhertu exceeded \$1.2bn in 2022. Revenue from Trodelvy, a similar drug approved for advanced breast cancer and sold by Gilead Sciences, rose by 79% last year, to \$680m. Kadcyla brought in \$1.1bn for its Swiss developer, Roche, in the first half of this year. Evaluate, a provider of health-care data, forecasts that ADC sales could reach nearly \$30bn by 2028, up from around \$7.5bn last year (see chart).

Some of these wagers could misfire. It is unclear just how well the drugs will work in combination with others, such as immunotherapies. They are also complex to make. Any deals involving Chinese partners could unravel if Sino-Western tensions increase. For now, though, ADCs are a global arms race worth cheering. ■



样样都要

比起通缩，中国更怕汇率失控吗？

人行对人民币汇率的限制束缚了它自己的手脚

经济学家在评论汇率制度时都喜欢援引货币政策的“三元悖论”。一个国家可能想要汇率稳定、资本自由流动，以及货币政策独立——可因应本国经济的需要做调整，不论他国央行正在采取什么政策。然而，这些目标彼此之间存在着固有矛盾。因此，很遗憾，一个国家只能在这三个目标中择其二。

三元悖论在理论上非常明确简洁。然而在实践中，选择并非那么泾渭分明。没有哪个国家能够完全地三全其美。但有些国家却喜欢三样各来一点，比如中国。

例如，今年中国尝试在货币政策上自行其是。房地产滑坡、消费情绪低迷以及出口下滑拖累了疫情后重新开放的中国经济，造成通胀处于危险低位。为此，在美国和其他国家大幅加息之际，人民银行却放宽了货币政策。9月15日，中国今年第二次下调了银行存款准备金率。同时还两度降息。

可以想见，中国的经济放缓及其货币政策对人民币构成了压力。1月中旬，对中国重新开放的乐观情绪达到顶峰，而自那时起到9月8日，人民币兑美元汇率已经下跌了9%。从表面上看，这是好事。货币疲软应能促进出口，抵御通缩。据高盛称，如果人民币对中国贸易伙伴的汇率维持贬值10%，将为经济增长率额外贡献0.75个百分点，而中国今年正艰难争取实现5%的增长目标。从长远来看，这还会给目前几乎为零的消费价格通胀增加1个百分点。

然而，中国在保持货币政策独立性的同时也希望兼顾一点汇率稳定。中国担心人民币大幅走软会导致投资者进一步的贬值预期。2015年的人民币贬值引发了大量资本外流，中国至今仍心有余悸。因此，央行在行使货币自

主权时束手束脚。其降息幅度很小——每次仅将短期利率降低0.1个百分点。他们的行动也谨小慎微。渣打银行的刘洁指出，也许是为了避免与美联储的议息会议发生太明显的冲突，人行在6月比通常情况提前了两天下调七天期（逆回购）利率。

人行也试图支撑人民币。官员告诫投机者不要单边下注。他们降低了银行的外汇存款准备金率，向金融系统释放美元。人行收紧了离岸人民币流动性，使投机者更难借入并卖空人民币。人行自身的外汇储备在8月减少了440亿美元，而它持有资产的估值变化并不能完全解释这样的降幅。这可能是人行采取了小幅自我干预。

中国独特的汇率制度也让人行有机会以另一种方式干预。人民币的上下浮动幅度不得超过人行每天早上计算出的“中间价”的2%。中间价本应反映前一天的市场供求关系。但人行有时会在计算中引入所谓的“逆周期因子”（也就是一个调节系数）。因此可以将中间价设定在比前一天收盘价更高的水平。事实上，最近这些天的中间价调节比以往任何时候都多。

这些干预措施取得了一些成效。作为人民币汇率管理的基准，人民币兑一篮子贸易加权货币的汇率已经止跌（见图表）。人民币兑美元的汇率也略高于9月初的水平。

所有这些干预都是有代价的。它收紧了金融状况，使人行正在推行的部分货币宽松政策失效。虽然通过干预可以让人民币略微稳定下来，却会让货币刺激的力度打折扣。中国可以什么都不要一点。但哪一样都拿不到太多。





All at once

Does China's fear of floating exceed its fear of deflation?

The central bank is constrained by its own limits on the yuan

WHEN ECONOMISTS pass judgment on exchange-rate regimes, they like to invoke the monetary-policy “trilemma”. A country might want a stable currency, free capital flows and an independent monetary policy, which can respond to the needs of the domestic economy, regardless of what central banks elsewhere are doing. There are, however, intrinsic tensions between these objectives. And so, sad to say, a country can choose only two of the three.

The trilemma is a canonical bit of theory. In practice, however, the choice is not so stark. No country can have all three blessings in full. But some countries, such as China, like a little of each.

This year, for example, China has tried to go its own way in monetary policy. A property slump, low consumer morale and falling exports have marred the economy’s reopening from covid-19, contributing to dangerously low inflation. In response, China’s central bank has eased its monetary stance, even as interest rates have risen dramatically in America and elsewhere. It lowered reserve requirements for banks on September 15th for the second time this year. It has also twice cut interest rates.

China’s slowdown and its monetary response have, predictably, weighed on the yuan. From mid-January, when euphoria about China’s reopening peaked, to September 8th, the yuan fell by 9% against the dollar. On the face of it, this is a good thing. A weaker currency should boost exports and ward off deflation. According to Goldman Sachs, a bank, a sustained 10% drop in the yuan against China’s trade partners could add 0.75 percentage points

to China's growth, which is struggling to reach 5% this year. It could also increase consumer-price inflation, which is near zero, by one percentage points in the long term.

China, however, would also like a little currency stability to go with its monetary independence. It fears that sharp declines in the yuan can lead investors to expect further falls. It still bears the scars of 2015, when a devaluation triggered heavy capital outflows. The central bank thus feels inhibited in its exercise of monetary autonomy. Its rate cuts have been small—only 0.1 percentage points each time for the short-term rate. They have also been discreet. In June it cut this seven-day rate two days earlier than such moves are normally made, notes Becky Liu of Standard Chartered, another bank, perhaps to avoid too conspicuous a clash with the monetary-policy meeting of America's Federal Reserve.

China's central bank has also tried to prop up the yuan. Officials have told speculators not to take one-sided bets. They have cut foreign-exchange reserve requirements for banks, releasing dollars into the system. The central bank has tightened yuan liquidity offshore, making it harder for speculators to borrow yuan in order to sell it. The central bank's own foreign-exchange reserves fell by \$44bn in August, not all of which can be easily accounted for by changes in the valuation of assets it holds. This raises the possibility that the bank intervened modestly itself.

China's distinctive exchange-rate system also gives the central bank a chance to intervene in another way. The yuan is not allowed to float by more than 2% above or below a "fix", which the bank calculates each morning. The fix is supposed to reflect the previous day's market forces. But the bank sometimes introduces what it calls a "countercyclical factor" (ie, a fudge factor) into its calculations. This has allowed it to set the fix at a rate that is stronger than the previous day's close. Indeed, in recent days there has been more fudge in the fix than ever before.

These interventions have enjoyed some success. The yuan has stopped falling against the trade-weighted basket of currencies that the authorities use as a benchmark for managing its value (see chart). The currency is also a little stronger against the dollar than it was early in the month.

All this intervention comes at a cost. It tightens financial conditions, undoing some of the monetary easing the central bank is pursuing. Although a slightly more stable yuan can be engineered, it produces a somewhat less powerful monetary stimulus. China can have a little of everything. But not too much of anything. ■



新时代

亚洲正在重塑其经济模式

西方对亚洲未来的影响力将会减弱

七百年前，从日本海岸绵延到红海的海上贸易线上，大量阿拉伯三角帆船、中国戎克船和爪哇帆船在这一区域内来回运送陶瓷、贵金属和纺织品。在该地区的中心，一个叫作新加坡的贸易站蓬勃发展。直到崛起的欧洲各帝国的水手到来，以及亚洲商品开始输出到更远的市场，这个亚洲内部的庞大商业网络才被打乱。

今天，另一种重构正在推进中。上世纪末亚洲为欧美消费者生产产品的“亚洲工厂”模式惊人地推动了中国大陆、日本、韩国和台湾的繁荣。1990年，由于大量商品都流向了西方，亚洲的区域内贸易只占其总贸易量的46%。然而到2021年，这一比例已达到58%，向欧洲69%的水平靠近（见图表1）。区域内贸易的增长也带来了资本流动的增长，将各国连结得更加紧密。亚洲商业已经开启了一个新时代——它将重塑亚洲经济和政治的未来。

这一时代始于复杂供应链的发展，先是在上世纪90年代以日本为中心，后来也以中国大陆为中心。很快便有更多的中间产品（即最终会成为成品的组成部分的产品）开始跨境流动。然后是外国直接投资（FDI）。不计入香港和新加坡等金融中心，目前亚洲投资者对区域内部FDI存量的贡献达到59%，而2010年这一比例为48%。在印度、印尼、日本、马来西亚和韩国，来自亚洲内部的FDI份额上升了十个百分点以上，达到26%到61%不等。

在2007至2009年的全球金融危机之后，亚洲跨境银行业务也越发倚赖本地银行。危机爆发前，亚洲约三分之一的向海外发放贷款来自亚洲本地银行。而随着西方金融机构的离场，如今这一比例达到了一半以上。中国庞大的国有银行走在了前面。从2012年到去年，中国工商银行向海外的放贷

额翻了一番不止，达到2030亿美元。由于本国利润微薄，日本的大银行也在向海外扩张。同样这么做的还有新加坡的大华银行和华侨银行。

西方政府在亚洲的影响力也已减弱。新加坡的尤索夫伊萨东南亚研究所（ISEAS-Yusof Ishak Institute）不久前对东南亚的研究人员、商界人士和政策制定者的问调显示，约32%的受访者认为美国是在亚洲地区最具政治影响力的国家，但只有11%的受访者称之为在该地区最具经济影响力的国家。作为“一带一路”倡议的一部分，中国政府主导的对亚洲其他国家的投资引人瞩目，不过日本和韩国也加大了各自的官方援助和由政府推动的投资。

这些趋势很可能会加速。面对恶化的中美关系，亚洲一些依赖中国工厂的公司正考虑在印度和东南亚寻找替代工厂。与此同时，很少有老板预期自己会完全放弃中国。这就需要两条亚洲供应链，投资也差不多要增加一倍。各种贸易协定将加速这一进程。去年发布的一项研究报告表明，2020年签署的《区域全面经济伙伴关系协定》（RCEP，覆盖面广但不够深入）将增加在亚洲的投资。相比之下，由于美国在2017年退出了《跨太平洋伙伴关系协定》（TPP），亚洲的出口商几乎不可能获得更多进入美国市场的机会。

私人信贷公司ADM Capital的萨比塔·普拉卡什（Sabita Prakash）指出，由于需要建立新的供应链，运输和物流是另一个区域内部投资可能增长的领域。这类私人信贷公司的使命就是在寻求可靠回报的投资者和寻求融资的项目之间牵线搭桥。这在亚洲已是一个有利可图的副业，接下来应该会日益走向主流。从2020年到2022年年中，东南亚和印度的私人信贷市场规模增长了约50%，达到近800亿美元。其他大型投资机构也开始转向基础设施投资。管理着本国部分外汇储备的新加坡主权财富基金——新加坡政府投资公司（GIC）正在大举注资于新供应链所需设施。

亚洲储蓄和人口结构的变化也将加速经济一体化。中国大陆、香港、日本、新加坡、韩国和台湾的海外投资排名都有上升，跻身全球最大的海外投资者之列。亚洲这些更富裕也更年老的地区向区域内其他地区输出了天

量资本，资金沿着近些年建立的贸易关系流动。2011年，这些更富裕也更年老的经济体向孟加拉国、柬埔寨、印度、印尼、马来西亚、菲律宾和泰国等相对年轻和贫穷的经济体投资了3290亿美元（以现值计算）。十年后，这一数字攀升到了6980亿美元。

投资银行法国外贸银行（Natixis）的拉吉·纳拉因（Raghu Narain）表示，在印度和东南亚，“城市化仍在推进中，资本也在追随这些趋势”。城市扩建不仅需要更多的基础设施投资，还需要与城市生活更匹配的新公司。纳拉因表示，亚洲的跨境并购活动正在发生变化，变得更像欧洲和北美的。就在中国的内外部并购交易大幅放缓之际，其他地方的并购活动却开始变得更为普遍。由于本国利率低且经济增长缓慢，日本的银行尤其热衷于并购。过去一年，三井住友金融集团（Sumitomo Mitsui Financial Group）和三菱日联金融集团（Mitsubishi UFJ Financial Group）收购了印尼、菲律宾和越南的一些金融公司。

与此同时，亚洲不断增长的消费让区域内经济体成为更具吸引力的市场。在欧洲，70%左右的消费品都进口自区域内部，而亚洲这一比例只有44%。这种情况很可能会改变。研究公司世界数据实验室（World Data Lab）表示，预计明年将有1.13亿人进入全球消费者阶层（按2017年美元计每天消费超过12美元，经购买力平价调整），其中亚洲将会有约9100万人。中国的收入增长在经历了几十年的扩张后开始放缓，而其他国家却将加快步伐。预计在2023至2028年间，区域性集团东盟中的五个最大经济体——印尼、马来西亚、菲律宾、新加坡和泰国的进口额将以每年5.7%的速度增长，比任何区域都快（见图表3）。

这些区域贸易模式意味着贸易将回归一种更常规的状态。跨越全球的出口模式将第一世界的生活水平带到了亚洲大部分地区，并鼓励来自遥远地区的投资，然而它是特定历史环境的产物。从亚洲各个工业城市到美国的实际货运量远远大于根据它们各自进出口市场的相对规模以及两者间距离来预测的货运量。事实上，东盟和东亚经济研究所（Economic Research Institute for ASEAN and East Asia）的一份报告显示，2019年东北亚和东南亚对北美的机械出口额是根据上述两种因素所预测的出口额的两倍多。

更紧密的商贸联系将使亚洲各个经济体的商业周期更加牢固地捆绑在一起。尽管跨境交易一直使用美元，而且亚洲的投资者也一直青睐西方上市市场，但亚洲开发银行在2021年的一项研究推断，如今亚洲各个经济体更容易受到中国经济冲击的溢出效应的影响，而不是美国。这种情况在最近几个月得到了体现——随着中国大陆贸易的衰退，韩国和台湾的出口商也受到冲击。更多的贸易——不仅是中间产品，也包括消费制成品贸易——意味着亚洲的汇率和货币政策决策也会更多地同进退。

这会产生政治影响。美国将继续在安全方面保持对亚洲的影响力，但它在经济上的重要性将会下降。亚洲的商界人士和政策制定者会更关注、也更愿意迎合自己的邻居，而不是来自更遥远地方的客户和国家。鉴于亚洲还在建设工厂，消费也在持续增长，而亚洲日益年长的储蓄者积累的庞大储蓄急需投资项目，地区经济一体化的高峰尚未到来。亚洲商业的新时代将更关注本区域，而不是面向西方。亚洲本身也会如此。 ■



A new era

How Asia is reinventing its economic model

The continent's future will involve less Western influence

SEVEN HUNDRED years ago, maritime trade routes that stretched from the coast of Japan to the Red Sea were peppered with Arab dhows, Chinese junks and Javanese djongs, ferrying ceramics, precious metals and textiles across the region. At its centre, a trading post known as Singapura flourished. The enormous intra-Asian commercial network was disrupted only by the arrival of sailors from rising European empires and the emergence of farther-flung markets for Asian goods.

Today another reconfiguration is under way. The “Factory Asia” model of the late 20th century, in which the continent produced products for American and European consumers, provided an astonishing boost to the prosperity of China, Japan, South Korea and Taiwan. In 1990 just 46% of Asian trade took place within the continent, as vast quantities of goods flowed to the West. Yet by 2021 that figure had reached 58%, closer to European levels of 69% (see chart 1). More regional trade has led to an increase in capital flows, too, binding countries tighter still. A new era of Asian commerce has begun—one that will reshape the continent’s economic and political future.

Its emergence began with the growth of sophisticated supply chains centred first on Japan in the 1990s, and later on China as well. Intermediate goods—components that will eventually become part of finished products—soon started to move across borders in greater numbers. They were followed by foreign direct investment (FDI). Asian investors now own 59% of the stock of FDI in their own region, excluding the financial hubs of Hong Kong and Singapore, up from 48% in 2010. In India, Indonesia, Japan, Malaysia and South Korea the share of direct investment from Asia rose by

more than ten percentage points, to between 26% and 61%.

After the global financial crisis of 2007-09, cross-border banking also became more Asian. Before the crisis hit, local banks accounted for around a third of the region's overseas lending. They now account for more than half, having taken advantage of the retreat of Western financiers. China's huge state banks led the way. Overseas loans by the Industrial and Commercial Bank of China more than doubled from 2012 to last year, rising to \$203bn. Japan's megabanks have also spread, in order to escape narrow margins at home, as have Singapore's United Overseas Bank and Oversea-Chinese Banking Corporation.

The presence of Western governments has also diminished. In a recent survey of South-East Asian researchers, businessfolk and policymakers by the ISEAS-Yusof Ishak Institute in Singapore, some 32% of respondents said they thought America was the most influential political power in the region. Yet just 11% of respondents called it the most influential economic power. State-led investment from China to the rest of the continent under the Belt and Road Initiative has captured attention, but official assistance and government-facilitated investment from Japan and South Korea are also growing.

These trends are likely to accelerate. In the face of deteriorating relations between America and China, companies in the region that rely on Chinese factories are considering alternatives in India and South-East Asia. At the same time, few bosses expect to desert China entirely, meaning two Asian supply chains will be required, along with some doubling-up of investment. Trade deals will speed this along. A study published last year suggested that the Regional Comprehensive Economic Partnership, a broad but shallow pact signed in 2020, will increase investment in the region. By contrast, as a result of America's abandonment of the Trans-Pacific Partnership trade deal in 2017, there is little chance of Asian exporters gaining greater access to the

American market.

The need to establish new supply chains means that transport and logistics are another area where intra-Asian investment will probably increase, notes Sabita Prakash of ADM Capital, a private-credit firm. Matching investors searching for reliable income with projects looking for finance—the mission of such private-credit companies—has been a lucrative pastime in Asia, and is likely to become a more popular one. The size of the private-credit market in South-East Asia and India rose by around 50% between 2020 and mid-2022, to almost \$80bn. Other big investors are turning to infrastructure, too. GIC, Singapore's sovereign wealth fund, which manages a portion of the country's foreign reserves, is spending big on the building required for new supply chains.

Changes to Asian savings and demography will also speed up economic integration. China, Hong Kong, Japan, Singapore, South Korea and Taiwan have climbed the ranks of overseas investors, becoming some of the world's largest. These richer and older parts of the continent have exported striking volumes of capital into the rest of the region, with cash following recently established trade links. In 2011 richer and older countries in Asia had about \$329bn, in today's money, invested in the younger and poorer economies of Bangladesh, Cambodia, India, Indonesia, Malaysia, the Philippines and Thailand. A decade later that figure had climbed to \$698bn.

In India and South-East Asia, “you've still got urbanisation happening, and capital follows those trends,” says Raghu Narain of Natixis, an investment bank. Bigger cities require not only more infrastructure investment, but also new companies better suited to urban life. Asian cross-border merger-and-acquisitions (M&A) activity is changing, according to Mr Narain, becoming more like that found in Europe and North America. Even as deals into and out of China have slowed considerably, M&A activity has become more common elsewhere. Japanese banks, facing low interest rates and a slow-

growing economy at home, are ravenous for deals. Over the past year Sumitomo Mitsui Financial Group and Mitsubishi UFJ Financial Group have snapped up Indonesian, Philippine and Vietnamese financial firms.

Meanwhile, rising Asian consumption makes local economies more attractive as markets. Whereas in Europe 70% or so of consumption goods are imported from the local region, just 44% are in Asia. This is likely to change. Of the 113m people expected next year to enter the global consumer class (spending over \$12 a day in 2017 dollars, adjusted for purchasing power), some 91m will be in Asia, according to World Data Lab, a research firm. Even as Chinese income growth slows after decades of expansion, other countries will pick up the pace. The five largest economies in ASEAN, a regional bloc—namely, Indonesia, Malaysia, the Philippines, Singapore and Thailand—are expected to see imports grow by 5.7% a year between 2023 and 2028, the most rapid pace of any region (see chart 3).

These regional trading patterns would represent a return to a more normal state of affairs. The globe-spanning export model that delivered first-world living standards to large parts of Asia, and encouraged investment from far afield, was a product of unique historical circumstances. The amount of goods that travel from the continent's industrial cities to America is far higher than would be predicted by the relative size of their respective export and import markets, and the distance between them. Indeed, a paper by the Economic Research Institute for ASEAN and East Asia suggests that machinery exports from North-East and South-East Asia to North America in 2019 were more than twice as high as such factors would suggest.

Closer commercial links will bind the business cycles of Asian economies even more tightly together. Despite the enduring use of the dollar in cross-border transactions and Asian investors' continuing penchant for Western-listed markets, a study by the Asian Development Bank in 2021 concluded that Asian economies are now more exposed to spillovers from economic

shocks in China than in America. This has been on display in recent months, as China's faltering trade has hit exporters in South Korea and Taiwan. More trade, not just in intermediate parts but in finished goods for consumption, means the continent's currencies and monetary-policy decisions will increasingly move together.

This will have political ramifications. America will retain influence over Asian security, but its economic importance will decline. Local businessfolk and policymakers will be more interested in and receptive to their neighbours, rather than customers and countries farther afield. With local factories still being built, consumption growing and a deep pool of savings from Asia's increasingly elderly savers desperate for projects to finance, the high point for regional integration has yet to be reached. The new era of Asian commerce will be more locally focused and less Western-facing. So will the continent itself. ■



惊涛骇浪

一部单人航海史探讨人们为何甘愿冒险

《孤帆独航》充满了惊险旅程和不回头的狠角色【《孤帆独航》书评】

《孤帆独航》，理查德·金著。Particular Books出版社；512页；25英镑。

约书亚·史洛坎（Joshua Slocum）是一位不知疲倦的商人、创业者和航海家，1844年出生于加拿大新斯科舍省（Nova Scotia）的一个农场。作为船长，史洛坎的名声毁誉参半。他的船员常常叛乱——他曾开枪打死一人，而且他的很多艘船都遭遇了搁浅甚至更糟的命运。在1890年代，蒸汽轮船几乎完全取代了风帆货船，而他对蒸汽船的模样极为厌恶。对于一个“在吹拂的海风中出生”、“对大海的观察几乎无前人可比”的老航海家来说，还能做些什么呢？

他的答案是修复了朋友送给他的一艘残破的旧船，驾驶它成为第一个完成单人环球航行的人。在这艘37英尺（11米）长的“浪花号”上为时三年的冒险航行中，他靠向《波士顿环球报》（Boston Globe）寄送稿件来获得资金。他接下来撰写的《孤帆独航绕地球》（Sailing Alone Around the World）一书从未停印。

在一部引人入胜、文笔优美的单人航海史中，史洛坎的影响力和标杆作用一直依稀可见。作者理查德·金（Richard King）本人也是一名曾独自横渡大西洋的航海家。他想要弄明白，到底是什么驱使了越来越多的人坐上一艘小船，只身穿越世界的汪洋大海。

金考察了约50位孤身航海者的经历和情感。人们对单人航海的纯粹兴趣始于19世纪下半叶，那时有E.E.米德尔顿（E.E. Middleton）在1869年环绕英国海岸，阿尔弗雷德·约翰逊（Alfred Johnson）为纪念美国建国100周年在1876年横跨大西洋，以及伯纳德·吉尔博伊（Bernard Gilboy）在1882年从加利福尼亚几乎航行到澳大利亚。

人们为什么要踏上如此危险的旅途？对于这个问题的回答千差万别。单人航海者的动力往往源于渴望证明自己，但令人惊讶的是，相当多的航海者在计划（在某些情况下，甚至已经开始）他们的海上冒险之前，对船只或海洋知之甚少。安·戴维森（Ann Davison）于1952年成为第一位环球航行的女性，她的丈夫在一次航海事故中丧生，但她自己却是个航海新手。她选择航海“是因为它提供了自由、独立、旅行，还有一个家”。

“海上的探险家、嬉皮士兼诗人”伯纳德·摩特歇（Bernard Moitessier）与他看到的生物产生了深刻的共鸣，以至于觉得自己成了周围游弋生物世界的一部分。他相信自己的船是一个活生生、有呼吸的生命体。他形容“大岬角”有着“像孩子一样光滑、罪犯一样冷酷的灵魂”。在1968年的金球单人环球帆船赛中，摩特歇眼看就要第一个抵达终点了，但他越来越觉得这场比赛俗不可耐，毅然决定退出。他就那么一直航行下去——直到环绕了地球一圈半。

那些独自环球航行的人有着相似的观察和感受。海鸟是他们的朋友，尤其是上下翻飞的暴风海燕和慵懒滑翔的信天翁；还有那些顽皮嬉戏的海豚和顽强划水的海龟。几乎所有人都害怕鲨鱼，这种凶恶的生物静待着孤独的航海家犯错。所有人都睡眠不足（有些人还会产生幻觉）。他们只敢打一两个小时的盹，把命运交给自动操舵系统，心里明白可能会有巨浪向他们袭来，或者更糟糕的是，巨大的油轮或集装箱船可能在浑然不知的情况下把他们的小船撞翻。

作者讲述了自己在2007年独自驾驶一艘28英尺长的老式单桅帆船穿越北大西洋的故事。虽然不能与书中记录的那些非凡航海家的壮举相提并论，但这次经历也足够紧张刺激，让他能和自己笔下的人物同情共感。在航程即将结束时，一艘集装箱船差点撞上他的船。自动操舵的桨叶神奇地让小船改变了航向，躲过了一劫。

单人航海的早期先驱史洛坎就没那么幸运了。1909年11月，他从马萨诸塞州的葡萄园港（Vineyard Haven）启航后不久，就和浪花号一起失踪了。几乎可以肯定，他是被一艘自己痛恨的蒸汽轮船撞沉的。■



Rough waters

A history of solitary sailing asks why people seek out its danger

“Sailing Alone” is packed with ripping yarns and driven characters

Sailing Alone: A History. By Richard King. Particular Books; 512 pages; £25

JOSHUA SLOCUM, an indefatigable trader, entrepreneur and sailor, born in 1844 on a farm in Nova Scotia, had a patchy record as a ship's captain. Mutinies had a way of breaking out among his crews—he once shot a man dead—and too many of his ships had ended up grounded or worse. He loathed the look of steamships that by the 1890s had almost entirely replaced sail-powered freighters. What was there for an old sailor “born in the breezes”, who “had studied the sea as perhaps few men have studied it”, to do?

His solution was to restore a rotting hulk given to him by a friend and to become the first person to circumnavigate the world single-handedly. The three-year adventure aboard the 37-foot (11-metre) Spray would be funded by dispatches he would send to the Boston Globe. The book he went on to write, “Sailing Alone Around the World”, has never been out of print.

In an engaging, beautifully written history of single-handed sailing, Slocum's influence and example are never far from the horizon. Richard King, the author, is a solo trans-Atlantic sailor himself. He sets out to investigate what it is that possesses an ever-growing number of people to get into a small boat and sail on their own across the world's seas.

Mr King examines the experiences and emotions of some 50 lone sailors. Interest in solitary sailing for its own sake began in the second half of the 19th century, with voyages around the coast of Britain in 1869 (E.E. Middleton), across the Atlantic in 1876 (Alfred “Centennial” Johnson) and

from California nearly to Australia in 1882 (Bernard Gilboy).

The answer to the question of why people go on such dangerous journeys varies widely. A yearning for personal validation is often the wind at a solo sailor's back, but a surprising number of voyagers had little knowledge of boats or the sea before planning (or, in some cases, even beginning) their aquatic adventures. Ann Davison, who became the first woman to circumnavigate the globe in 1952, had been widowed by a sailing accident but was a novice sailor herself. She chose sailing "because it offered freedom, independence, travel and a home into the bargain".

The "explorer-hippy-poet of the sea" Bernard Moitessier so identified with the creatures he saw that he felt himself become part of the pelagic world around him. He believed his boat was a living, breathing being. He described the "great cape" as having a "soul as smooth as a child's, as hard as a criminal's". Moitessier was on the brink of securing the fastest time in the Golden Globe race of 1968 when he decided to leave what he increasingly felt was a vulgar competition. He just carried on sailing—one and a half times around the world.

Those who have undertaken solo, around-the-world sailing share similar observations and emotions. Seabirds, particularly busy storm-petrels and lazily gliding albatrosses, are friends, as are playful dolphins and doggedly paddling turtles. Nearly all are frightened of sharks, a sinister presence waiting for the lone sailor to make a mistake. All suffer sleep deprivation (and some, hallucinations). They doze an hour or two while trusting in their self-steering systems, conscious of the possibility of that rogue wave coming crashing down on them, or, even worse, being run down by a huge tanker or container ship oblivious to their tiny presence.

The author relates the story of his own solo North Atlantic passage in 2007, done in an elderly 28-foot sloop. Although not to be compared to the feats

of the extraordinary sailors he recounts in this book, his experiences are sufficiently intense for him to empathise deeply with them. Towards the end of his voyage, a container ship almost smashes into him. His self-steering vane somehow gybes his little boat away from disaster.

Slocum, the early pioneer of solo sailing, was not so lucky. Soon after setting sail from Vineyard Haven, Massachusetts, in November 1909, he and Spray disappeared. He was almost certainly run down by one of his hated steamships. ■



梧桐

为何钻石正在失去光彩

至少作为投资品，它们黯然失色了不少

镶嵌在戒指上，又或是串在项链上，钻石的魅力来自它闪耀的光芒。一颗钻石到底价值几何，要看它的切工、色泽、大小（也就是它的“克拉”）和是否有瑕疵。越干净、越重、越接近无色、切工越完美，钻石的价值就越高。

除了看起来漂亮，钻石对投资者另有一番吸引力：它以往带来了稳定的回报。由于市场不透明，售卖的宝石种类繁多，长期价格信息很稀缺。但是蒂尔堡大学（Tilburg University）的吕克·雷尼博格（Luc Renneboog）在2015年发布的一篇论文分析了从1999年到2012年间每年的数千次拍卖，发现钻石在此期间的平均回报堪比股票和房产。钻石持有者应能获得8%左右的年回报，相当不俗。

不过近来，稳定回报已经变成了剧烈的价格波动。据彭博社报道，长期垄断钻石供应的财团戴比尔斯（De Beers）已经将2到4克拉未经切割的原石的价格调低了40%。这个规格是原石的主流，因为它们可以切割成1到2克拉的钻石用于订婚戒指。9月13日，戴比尔斯宣布，为拉动需求，将重新打出其经典广告语“钻石恒久远，一颗永流传”。

过去的稳定回报一定程度上是由于有稳定的需求。正如另一种稀缺且高价的大宗商品黄金的投资依据一样，持有钻石的理由往往在经济不稳定的时期最有说服力。同时，钻石的主要用途是制作珠宝，这就意味着在经济繁荣时期其价格往往都保持得很不错。

但最重要的因素是垄断供应。一个多世纪以来，戴比尔斯成功主导了钻石生产。雷尼博格指出，这样的市场结构从两个方面促使价格稳步攀升。首先，通过限制供应，戴比尔斯制造了稀缺性。其次，它抑制投机，从而限制了投机造成的价格波动。在1980年代，戴比尔斯控制着全球约80%的钻

石供应，但自那以后它的份额已被其他竞争者蚕食，其中包括俄罗斯对手埃罗莎（Alrosa）。戴比尔斯现在只控制了三分之一的供应。

另一个问题出自实验室。人们在那里对碳加压来制造人造钻石，而不是从地里挖石头，而且人眼并不能区分人造和天然。人造钻石在1980年代就出现了，但是直到2018年才有了一点点市场——只有几个百分点。从那以后，更多的人造钻石进入了市场，市场份额上升到大约10%。

戴比尔斯可能在无意间加速了这种转变。它在2018年开始以极低的价格出售人造钻石，当时这种钻石的市场售价还是天然钻石的80%。它的目的是拉开这两种钻石的档次，让人造钻石丧失吸引力。纽约婚戒定制商Clear Cut采取了游击营销策略来达到同样的目的。它向购买了一万美元及以上婚戒的客户免费赠送一只人造仿版，可以在前往不安全地点时用作“旅行戒指”。现在，许多人造钻石的售价只有类似天然钻石的20%到30%。

戴比尔斯认为，随着人造钻石供应加速，它与天然钻石之间的价差将会继续扩大，导致人们没兴趣将这个新产品用于订婚。不过从近来的价格变动看，这种策略可能要事与愿违——毕竟天然钻石的价格正跟在人造钻石降价之后大幅下跌。

诚然，这可能不完全是市场结构性转变的结果。美国的情侣在订婚前要约会三年左右，由于新冠疫情的影响，2020年很少有人外出走动和未来的伴侣会面。今年准备订婚的人可能会异常地少。

但是，一个无所不能的钻石卡特尔本可以通过减少供应来平滑这种波动。而大幅降价只会是个清晰的信号，表明市场支配力减弱。对于打算求婚或是想要买件新首饰的人来说，这是个好消息。对于那些考虑投资钻石的人来说就相当扫兴了。 ■



Buttonwood

Why diamonds are losing their allure

As an investment category, at least

THE APPEAL of a diamond, for a ring on a finger or to string on a necklace, rests on its sparkle. Its precise value is determined by how well the stone is cut, its colour, its size (also called its “carat”) and whether it contains flaws. The clearer, heavier, closer to colourless and more perfectly cut the rock, the better.

The appeal of a diamond for an investor is that, in addition to being nice to look at, it has historically offered a steady return on investment. Given the opacity of the market, and the broad variety of gems that are available, long-run price data are scarce. But a paper by Luc Renneboog of Tilburg University, which was published in 2015, analysed thousands of auctions each year, finding that the average return between 1999 and 2012 rivalled those of stocks and property. Holders of diamonds would have earned a handsome 8% or so a year.

Recently, though, these steady returns have given way to enormous volatility. De Beers, a consortium that has long monopolised the supply of diamonds, has reduced the price of two-to-four carat uncut stones—a popular category because they can be made into one-to-two carat engagement rings—by 40%, according to Bloomberg, a news service. On September 13th the company announced that it would re-run its iconic “a diamond is forever” advertising campaign in an attempt to boost demand.

Stable returns in the past were partly brought about by steady demand. Just as with the investment case for gold, another rare and precious commodity, the logic for holding diamonds tends to be strongest during periods of

economic uncertainty. At the same time, the main use of diamonds is in jewellery, which means that prices have tended to do well during periods of prosperity, too.

But the most important factor was monopolistic supply. For more than a century De Beers managed to dominate the production of gems. This market structure facilitated steady price increases in two ways, as Mr Renneboog has noted. First, by stockpiling supplies De Beers created scarcity. Second, the firm curbed speculation, and the volatility it brings. Although De Beers controlled some 80% of the global supply of diamonds in the 1980s, since then its share has been eaten into by competitors, which include Alrosa, a Russian rival. The company now produces just a third of supply.

Another problem is emerging from laboratories. They are producing artificial gems, which are made by applying pressure to carbon, rather than digging stones from the ground, and are identical to the naked eye. Such stones have been available since the 1980s, but even as recently as 2018 made up a tiny fraction of the market, at just a few percentage points. In the years since, more lab-grown jewels have entered the market—and their market share has risen to around a tenth.

De Beers may have inadvertently hastened this transition. The company began to sell lab-grown diamonds at rock-bottom prices in 2018, when such stones fetched about 80% of the price of mined ones. The goal was to differentiate between the two types of gems, in order to diminish the appeal of lab-grown stones. The Clear Cut, a New York-based purveyor of engagement rings, has adopted guerrilla marketing tactics to make the same point. It offers customers who buy a ring worth \$10,000 or more a free lab-grown alternative, which can be used as a “travel ring” when visiting dubious places. Many lab-grown stones now fetch just 20-30% of the price of similar mined stones.

De Beers argues that, as the supply of lab-grown gems accelerates, the price gap between the two types of stone will continue to widen, making the newcomers unappealing for engagements. If recent price movements are anything to go by, though, the tactic appears likely to backfire—after all, mined prices are plunging in the wake of lab-grown ones.

Admittedly, this may not be entirely the result of a structural shift in the market. American couples date for about three years before getting engaged, and thanks to covid-19 very few people were out and about meeting potential husbands or wives in 2020. An unusually small number of people are probably getting engaged this year.

But this is the sort of fluctuation an all-powerful diamond cartel would have been able to smooth out by reducing supply. Slashing prices instead is a clear indication of diminished market power. That is good news for those looking to pop the question or acquire a new trinket. It is rather less appealing for those considering investing in the gems. ■



巴托比

谁是你公司里最重要的人？

只是想想这个问题就是一次有益的训练

问题通常比答案更有趣。如果要问你公司里谁最重要，会有一个显而易见的答案、一个老套且不真实的答案，和一个是错误但有用的答案。

显而易见的答案是“首席执行官”。这个头衔到顶了，公司里没有比这号人物更大的领导了。事关公司长期发展方向的最重要决策要由他们做出，最艰难的抉择摆在他们的案头，最高的薪水也是发到他们手里。董事会可能掌控着他们的命运，但没有人比他们的权力更大。对于创业公司来说尤其如此：在一家公司的前期阶段，创始人就是公司。

同样是这个问题，老套的回答是“客户”。TED演讲者会在一个恰到好处的、意味深长的停顿后吐出这个词。观众也会会意地点点头。哥伦比亚商学院的南迪尔·巴蒂亚（Nandil Bhatia）和史蒂芬·迈耶（Stephan Meier）分析了标准普尔500成分股公司的财报电话会议记录，发现高管们谈及客户的次数是谈及员工的十倍。

但这个回答也是不真实的。客户显然不是公司里的人。许多员工更关心是谁从公司茶水间拿走了他们的杯子。开会的时候，公司有时会找个人来扮演“客户维权者”的角色，这是有原因的。

第三类答案几乎肯定是错的，但得出答案的思维过程能令人获益良多。公司会经常性地甄别出各部门最有才华的人，并且为了留住这些人才而给他们发留任奖金。但它们通常不会问什么样的人可能够得上“公司最重要的人”这个头衔（先别管CEO）。

如果你认为客户高于一切，那么可以先看看与客户打交道最多的人。在某些行业，这些人地位很高，例如投行大咖。但在许多其他行业里，一线员工工资低、工作满意度低，倦怠感高。这可能会产生非常有害的影响，尤

其在公共部门。例如，美国儿童福利工作者的流动率持续居高不下，而这与更差的儿童保育成果相关联。

你搜寻的目光可能来到最前沿——某个正在开发你公司最有前景的新产品的高管、程序员或研究员。你也可能追溯到过去。那个最重要的人可能是某个看得懂梵文的牛人。2021年发布的一份报告发现，英国政府近一半的科技支出都用在维护过时的IT系统上。已有60年历史的编程语言COBOL至今仍在许多银行广泛使用。据路透社报道，COBOL程序员的平均年龄在45岁到55岁之间。

你公司的产品的特色可能要归功于某一个人，例如为一款豪华汽车设计出独特曲线的设计师。或者，如果你认为公司的成功秘诀是像企业文化这类无形的东西，你的目光可能就会停留在能够体现这种文化的人身上。亚马逊任命了一支特殊的面试官队伍，称为“门槛提升者”，他们以类似文化战士的身份参与到招聘流程中。其工作是确保成功的候选人拥护该公司的“领导力原则”。

你可能会想到最重要的人是公司里影响力最大的人，这可能与头衔大小无关，但这个人确实拥有最多的隐性知识和社会资本。在重要问题上老板会认真听取他们的意见，他们洞悉公司里的一切人和事——知道与谁共事是一场噩梦；知道为什么公司和那个供应商断绝了关系；还知道谁能帮你订一部新的笔记本电脑。他们是公司里的巴拿马运河——没他们也能完成工作，但要花多得多的时间。

至此这道思考题已经达到了它的目的。公司里的部门就像身体的器官一样，唯有大多数部门运转良好，整个公司才能蓬勃发展。你可能不太关心你的脾脏，但如果它突然消失，你就会想念它。你公司里的合规主管也是这样的存在。显而易见的那个答案几乎肯定是正确的——CEO确实比其他任何人都更重要。

但问一问这个问题可能会促使你调整对这个人的奖金发放，或记录一下那一处的运转如何。这可能会让你发现有哪些创造了价值的地方没有得到充

分认可。只是不用告诉每个人他们的排名。 ■



Bartleby

Who is the most important person in your company?

Just thinking about this question can be a useful exercise

QUESTIONS ARE usually more interesting than answers. If you had to identify the most important person in your organisation, there is an obvious answer, a trite-and-untrue answer and a wrong-but-useful answer.

The obvious answer is “the chief executive”. No cheese is bigger, no dog is more top. The most important decisions about the long-term direction of a company lie with the CEO; the hardest calls land on their desk; and the biggest pay cheques head their way. A board of directors might control their fate but no one wields more power. That is especially true of a startup: up to a certain point in its history, founders are the company.

The trite answer to the same question is “the customer”. This is the kind of thing someone delivering a TED talk would say, after a suitably meaningful pause. It is the kind of thing that people in the audience would nod wisely at. An analysis of earnings-call transcripts of S&P 500 firms by Nandil Bhatia and Stephan Meier of Columbia Business School finds that executives talk about customers ten times more than they do about employees.

But it is also untrue. The customer is patently not in your organisation. Many employees care more about who took their mug from the kitchen than anything else. There is a reason why firms sometimes have someone play the role of “customer advocate” in meetings.

The third category of answer will almost certainly be wrong but it will be the product of an instructive thought process. Firms routinely identify their most talented people across departments, and offer retention bonuses to get them to stay. But they don’t usually ask what might qualify someone for the

title of most important person in an organisation (setting the CEO to one side).

If you think customers trump everything, then you might start by looking at the people who interact most with them. In some industries—rainmakers at investment banks, for instance—these folk have lots of status. But in many others, front-line employees suffer from low wages, job dissatisfaction and burnout. The effects can be pernicious, particularly in the public sector: turnover among child-welfare workers in America is persistently high, to take one example, and associated with worse outcomes for kids.

Your search might lead you to the cutting edge: an executive, programmer or researcher working on your most promising new product. It might also take you back in time. The vital employee might be someone who knows the technology equivalent of Sanskrit. A report published in 2021 found that almost half of the British government's tech spending was devoted to maintaining outdated IT systems. A 60-year-old programming language called COBOL is still in widespread use in many banks; according to Reuters, the average COBOL programmer is between 45 and 55 years old.

Your products might owe their character to one person in particular: the designer who makes the curves of a luxury car distinctive, say. Or, if you think the secret sauce of your company lies in something amorphous like its culture, you might alight on people who embody it. Amazon anoints a special cadre of interviewers known as “bar raisers”, whose purpose is to participate in hiring processes as a kind of culture warrior. Their job is to ensure that successful candidates embrace the firm’s code of leadership principles.

You might think of importance in terms of influence within the company—the person who may not have the longest title but does have the most tacit knowledge and social capital. They have the ear of the boss

on important issues, but they also know everyone and everything: who is a nightmare to work with, why the firm cut ties with that supplier and who can help you order a new laptop. They are the Panama Canal of the organisation. Things can get done without them, but it takes a lot more time.

This thought exercise is no more than that. As with organs in the body, the fact is that most departments have to run well for the whole company to thrive. You may not think much about your spleen but you would miss it if it suddenly disappeared; the same goes for your head of compliance. And the obvious answer is almost certainly correct: the CEO does matter more than anyone else.

But asking the question might lead you to adjust a bonus here or document how things work there. It might lead you to spot a gap between where value is created and where it is being recognised. Just don't tell everyone where they rank. ■



梧桐

如何避免一个常见的投资错误

少想想要买什么，多想想该买多少

如果你听到一位职业投资者讲到有一笔交易让他教训深刻，竖起耳朵好好听。通常情况下，这实际上就是在说“那一次我狠狠亏了一大笔钱”，而且你会听到关于金融市场运作的第一手精彩故事。

在这个前沿阵地上，维克多·哈冈尼（Victor Haghani）的故事就值得一听。1990年代中期，他是华尔街最炙手可热的对冲基金的合伙人和超级明星级债券交易员。在成立的头四年里，长期资本管理公司（LTCM）给它的第一批投资人带来了超过30%的年均回报，而且从来没有连续两个月亏过钱。此外，它的合伙人曾在投资银行所罗门兄弟（Salomon Brothers）负责债券交易，在此前20年里取得了类似的业绩。但在1998年，他们突如其来地翻车了。LTCM一下子损失了90%的资本。尽管它的一群交易对手提供了36亿美元的救助，这家基金还是被清算，其合伙人的个人投资血本无归。哈冈尼写道，他“亏掉了9位数”。

现在，哈冈尼和他今天的同事詹姆斯·怀特（James White）合写了一本书，希望帮助其他投资者规避他犯过的错误。幸运的是，《失踪的亿万富翁》（The Missing Billionaires）并不是讨论LTCM债券套利交易的细枝末节。本书探讨的是，作者认为有一个问题远比挑选正确的投资标的重要，但却被忽视了——关键不是投资“什么”，而是投资“多少”。

人们对这个问题的回答往往很糟糕。为了说明这一点，本书描述了一个实验，给61个年轻人（财经专业的学生，还有一些年轻的金融从业者）25美元，要求他们对一枚受操控的硬币下注，押中后可以获得和下注金额相等的奖励。他们被告知，每次抛硬币时都有60%的几率正面向上。他们有时间抛大约300次硬币，可以选择每次下注的多少，最多可以赢得250美元。这是一个极好的交易：只要每次拿出手头资金的10%下注，就要94%的机

会拿到最高回报，不会有人输光。然而参与者的平均回报只有91美元，只有五分之一的人拿到了最高回报，有28%的人亏掉了所有钱。

这些抛硬币的人犯过的错看起来就像是一本揭示股市投资禁忌的寓言故事集。他们没有选择一项策略并坚持执行下去，而是胡乱下注。近三分之一的人在某一次抛硬币时压上了所有的钱，令人吃惊的是，有些人是赌那40%背面朝上的几率。很多人按亏损的双倍下注，尽管这样会妥妥地让小亏变大亏。另一些人按固定金额小额下注，虽然避免了亏本，但也放弃了获得最多回报的机会。很少人想到获利最多的最优策略，那就是把固定比例的本金投入到有吸引力的机上。

这本书接下来对这些让财富流失的人类本能提出了纠正方法。最重要的是设计支出、储蓄和配置投资的规则，按占总财富的比例显示。然后必须要坚守它们，避免忍不住去追逐热门资产或是在面对损失时投入过多。

作者重大的成功是为做到这些提供了一个一致且清晰的框架。其核心理念是“预期效用”，也就是源自一定财富水平的快乐。这解释了为何大多数人不愿意拿大部分资金去冒险。一个会让人快乐的结果是确定投资多少以使预期效用最大化——而非财富最大化，这可以大大减少你遭遇无法承受的亏损的机会，同时又承担了足够的风险去争取不错的回报。

从实用性来讲，这本书的最大成绩是它对“莫顿比例”的解释。这是一个确定资产配置的经验法则，认为资产配置应随预期回报上升按比例提升，随投资者的风险厌恶上升按比例下降，随波动性上升按大比例下降（准确点说，按它的平方）。

这并不是说这本书读来轻松。作者列出的计算方式只有最顽强的投资者才会有兴趣，而且最好还要有彭博终端在手。大多数人看完会认为需要一家财富管理公司来帮自己——这好办，哈冈尼和怀特就经营着这么一家公司。不过，对于那些投资于自己的公司或者就是一家炙手可热的对冲基金的人来说，单凭一点本书就值得一读：哈冈尼反思了自己多年前应该向LTCM投入多少钱。剧透警告：那是大大少于他实际投进去的钱。 ■



Buttonwood

How to avoid a common investment mistake

Think less about what to buy, and more about how much

IF YOU EVER hear a professional investor talk about a trade that taught them a lot, prick up your ears. Usually, this is code for “a time I lost an absolutely colossal amount of money”, and you are in for one of the better stories about how finance works at the coalface.

On this front, Victor Haghani is a man to whom it is worth listening. He spent the mid-1990s as a partner and superstar bond trader at the hottest hedge fund on Wall Street. In its first four years, Long-Term Capital Management (LTCM) made its initial backers average returns of more than 30% a year and never lost money two months in a row. Moreover, its partners had been trading the capital of Salomon Brothers, an investment bank, for the preceding 20 years, with similar results. But in 1998 the wheels came off in spectacular fashion. LTCM lost 90% of its capital at a stroke. Despite a \$3.6bn bail-out from a group of its trading counterparties, the fund was liquidated and its partners’ personal investments wiped out. Mr Haghani writes that he took “a nine-figure hit”.

Now, along with his present-day colleague James White, he has written a book that aims to spare other investors his mistakes. Fortunately, “The Missing Billionaires” is not a discussion of the minutiae of LTCM’s bond-arbitrage trades. Instead, it examines what its authors argue is a much more important—and neglected—question than picking the right investments to buy or sell: not “what” but “how much”.

People tend to answer this question badly. To show this, the book describes an experiment in which 61 youngsters (college students of finance and

economics, plus some young professional financiers) were given \$25 and asked to bet on a rigged coin at even odds. Each flip, they were told, had a 60% chance of coming up heads. They had time for about 300 tosses, could choose each bet's size and would keep their winnings up to a cap of \$250. This was an exceptionally good deal: simply betting 10% of the remaining pot on each toss had a 94% chance of yielding the maximum payout and none of going bust. Yet the players' average payout was just \$91, only a fifth of them hit the cap and 28% managed to lose everything.

A list of the coin-flippers' mistakes reads like a parable of how not to invest in the stockmarket. Rather than picking a strategy and sticking to it, subjects bet erratically. Nearly a third wagered their entire pot on a single flip and, amazingly, some did so on the 40% chance of getting tails. Many doubled down on losses, even though doing so is a reliable way of making mild ones catastrophic. Others made small bets fixed in dollar amounts, avoiding ruin but also giving up the lion's share of their potential returns. Few considered the optimal, lucrative strategy of betting a constant fraction of their wealth on an attractive opportunity.

The rest of the book offers a corrective to these wealth-sapping instincts. Most important is to devise rules for spending, saving and allocating investments, expressed as fractions of your total wealth. Then you must stick to them, avoiding the temptation to chase hot assets or spend too much in the face of losses.

The authors' great success is in offering a consistent and explicit framework within which to do all this. At its core is the concept of "expected utility", or the pleasure derived from a given level of wealth. This accounts for the fact that most people are averse to risking large chunks of their capital. A happy consequence is that sizing investments to maximise expected utility, rather than wealth, can sharply reduce your chances of intolerable losses while keeping enough risk for a shot at decent returns.

In practical terms, the book's crowning achievement is its explanation of the "Merton share". This is a simple rule of thumb for determining asset allocation, which says that allocations should rise in proportion to expected returns, fall in proportion to the investor's risk aversion and fall a lot in proportion to volatility (specifically, to its square).

This is not to suggest the book makes for light reading. The authors prescribe calculations that will appeal to only the most dogged investors, ideally with access to a Bloomberg terminal. Most will conclude that they need a wealth-management firm to help them; conveniently enough, Messrs Haghani and White run one. Yet for those investing in their own business—or, indeed, a hotshot hedge fund—it is worth reading simply for Mr Haghani's reflection on how much he ought to have ploughed into LTCM all those years ago. Spoiler alert: it was rather less than he did. ■



生存指南

打败科技巨头的勇敢企业

佳明、Dropbox和美卡多表明，开辟利润丰厚的利基市场是可能的

科技巨头不断壮大。今年到目前为止，美国五大数据巨头（Alphabet、亚马逊、苹果、Meta 和微软）的总市值飙升了一半，达到约9万亿美元。这几乎是囊括美国最大的那些公司的标准普尔500指数总市值的四分之一

（该指数在此期间仅上涨了17%）。在指数内的所有科技公司中，这五家公司的销售额、利润和研发支出几乎占到了60%。人们普遍预计，它们将成为人工智能（AI）革命的主要赢家。

这种主导地位让各国政府愈发忌惮。9月12日，美国司法部与谷歌及其母公司Alphabet就二十年来最大的反垄断案展开法庭对决，谷歌被指控滥用其互联网搜索垄断地位。上月，一项欧盟法律将五巨头称为数字“守门人”，禁止它们捆绑某些服务并在其平台上歧视第三方商家等。全球的反托拉斯检察官认为，这些巨头已经发展得太过庞大，吸干了科技生态系统中的氧气，将挑战者逼入濒临灭绝之境，或者至少让其他人都难以繁荣发展。不信你问问Snap、Spotify或Zoom。

但是，就和自然生态系统一样，商业生态系统也会为新进入者提供机会。为了保持投资者所期望的高速增长，五巨头最关注的是那些给其收入带来实质差异的大市场，去年其总收入达到了15亿美元。这意味着它们忽略了某些规模较小但仍可能有利可图的领域。那些能够发现这些利基市场并加以利用的有创意的公司不会只是勉强维生，而会在巨头的阴影下茁壮成长。

先说说佳明（Garmin）吧。该公司成立于1989年，是全球定位系统（GPS）导航商业应用的先驱。到2008年，它已经占据了便携式导航设备市场近三分之一的份额，其中大部分是安装在汽车仪表盘上的设备，约占公司销售额的72%。随后，谷歌发布了谷歌地图应用，先是于2008年推出

了安卓智能手机版，四年后又推出了iPhone版。驾车者只需使用手机就能找路，而无需花钱购买专用设备。到2014年，佳明的汽车业务收入比六年前下降了一半，至12亿美元。

一年后，科技巨头又给了它一次重击。苹果公司推出了首款智能手表，这有可能破坏佳明正在增长中的面向健身和户外运动爱好者的设备销售业务。然而，这一次，这家较小的公司顶住了攻击（见图1）。它专注于高端手表和健身追踪器，其中一些产品的售价是顶配Apple Watch的好几倍。为此，它建立了一个由登山者、跑步者和其他各类健身狂热者组成的忠实用户群；4月，Meta的运动狂老板马克·扎克伯格发布了一张他的佳明手表的照片，照片上的他不疾不徐地跑完了5公里。

投资公司Upslope Capital的乔治·利瓦达斯（George Livadas）认为，佳明是少数几家在有苹果产品的市场上创建了高端品牌的公司之一。如今，它的年收入总额接近50亿美元，大约是第一代Apple Watch上市时的两倍。智能手表和健身追踪器占该公司销售额的近60%（其余大部分来自船舶和飞机的专业导航系统，见图2）。

Dropbox是另一家在开发不足的技术利基市场上成功开拓的公司。苹果公司联合创始人史蒂夫·乔布斯曾将这家位于旧金山的云存储公司斥为“功能而非产品”。Dropbox成立于2008年，在整个生命周期中与苹果、谷歌和微软（一度还有亚马逊）展开了激烈的竞争。其较大的竞争对手都将云存储与其他服务捆绑在一起；例如，注册谷歌Gmail的用户可以获得一些免费的在线存储服务。但这些服务虽然通常都是免费的，却缺乏Dropbox的功能性。

加拿大皇家银行的里希·贾卢里亚（Rishi Jaluria）称，Dropbox很早就意识到，许多用户需要的不仅仅是一个存放文件的地方。例如，摄影师和其他创意型用户希望存储高分辨率文件而不必担心文件大小。这些用户往往愿意为这种便利付费。通过开发对他们有吸引力的功能，例如最近推出的可以查找和总结文档的人工智能搜索工具，Dropbox不断吸引到新订户。

一个可开发的利基市场也可以是地域性的。阿根廷电子商务公司美卡多（MercadoLibre）就是一个很好的例子。当亚马逊分别于2012年和2013年进入美卡多最大的市场巴西和墨西哥时，它剩下的日子似乎已经屈指可数了。但事实并非如此。十年后，美卡多占到拉丁美洲所有电子商务贸易的四分之一。亚马逊对这个地区购物巨头造成最大威胁的市场是墨西哥，但即使在那里，其市场份额也只有竞争对手的一半。

美卡多通往成功的窍门是根据当地情况调整商业模式。该公司很快就发现，基础设施薄弱是阻碍其发展的一个因素，这增加了卖家的成本，降低了购物者的购买体验。该公司投资建设了自己的物流网络，90%的包裹经由该网络运输。其支付服务MercadoPago在欺诈猖獗的地区很受欢迎。提供免费送货积分等小创新帮助它赢得了对价格敏感的拉美人的青睐。该公司也拿自己的本地背景做文章来赢得客户。公司商务主管阿里尔·萨夫斯泰金（Ariel Szarfsztejn）称公司是“由拉美人打造的”。今年4月，正当亚马逊在全球裁员之际，MercadoLibre宣布计划招聘1.3万人。

找到一个利基市场并不足以保证成功。佳明、Dropbox和美卡多还有其他优势。这三家公司都至少有一位创始人仍在高管的位子上。要在与科技巨头的竞争中获胜，就必须执着于产品开发，并有长期投资的魄力。有长期经验的不受季度目标左右的掌舵人很有帮助。

最重要的是，这三家公司还能赚钱——在利率不断上升的今天，这对投资者来说是一大卖点，因为利率上升使得科技公司未来盈利的承诺不如此刻的收益更有吸引力。2022年，佳明、Dropbox和美卡多的净收入分别为9.74亿美元、5.53亿美元和4.8亿美元。这与Alphabet的600亿美元或苹果的1000亿美元相比不值一提，但三家公司的智能手表、云计算和电子商务业务的营业利润率看起来都很健康。2015年以来，佳明的市值增长了两倍，超过200亿美元。美卡多的市值增长了五倍，达到700亿美元。Dropbox的市值为100亿美元，与它在疫情期间数字化热潮时达到的巅峰相差无几。谁说会有灭顶之灾？■



Survival guide

The plucky firms that are beating big tech

Garmin, Dropbox and MercadoLibre show carving out a lucrative niche is possible

BIG TECH keeps getting bigger. So far this year the combined market value of America's five digital behemoths—Alphabet, Amazon, Apple, Meta and Microsoft—has soared by half, to around \$9trn. That is almost a quarter of the total for the S&P 500, an index of America's largest companies (which has risen by just 17% in the period). The five account for almost 60% of sales, profits and spending on research and development of all the technology firms in the index. They are widely expected to be the main winners from the artificial-intelligence (AI) revolution.

Governments view this dominance with increasing trepidation. On September 12th America's Department of Justice began a courtroom showdown with Google and its corporate parent, Alphabet, in the biggest antitrust case in two decades, accusing it of abusing its internet-search monopoly. An EU law last month labelled the big five as digital "gatekeepers", which bars them from bundling some services and discriminating against third parties on their platforms, among other things. The giants have grown so gigantic, the world's trustbusters argue, that they suck all the oxygen out of the tech ecosystem, driving challengers to extinction or, at best, making it hard for anyone else to prosper. Just ask Snap, Spotify or Zoom.

Like natural ecosystems, though, commercial ones present opportunities for newcomers. To keep growing at the blistering rates their investors expect, the big five pay most attention to markets vast enough to make a meaningful difference to their revenues, which collectively touched \$1.5trn last year. That means they ignore certain areas that are smaller but

potentially still lucrative. The ingenious companies that identify such niches and are able to exploit them don't just get by, but thrive in the shadow of the giants.

Take Garmin. Founded in 1989, it pioneered the commercial use of GPS-navigation systems. By 2008 it had nabbed almost a third of the market for portable navigation devices, mostly dashboard-mounted units for cars, which were some 72% of the company's sales. Then Google released its Google Maps app, first, in 2008, for Android smartphones and then, four years later, for the iPhone. Motorists could simply use their phones to find their way, rather than forking out for a dedicated device. By 2014 Garmin's revenues from its automotive segment had slumped by half compared with six years earlier, to \$1.2bn.

A year later big tech delivered another blow. Apple launched its first smartwatch, which risked undermining Garmin's growing business of selling devices for fitness and outdoor enthusiasts. This time, however, the smaller company withstood the assault (see chart 1). It focused on high-end watches and fitness trackers, some of which sell for several times the price of the top-end Apple Watch. In doing so it has built a loyal user base of mountaineers, runners and other assorted fitness fanatics; in April Mark Zuckerberg, Meta's exercise-fanatical boss, posted a photo of his Garmin watch after finishing a 5km run in good time.

George Livadas of Upslope Capital, an investment firm, believes that Garmin is one of the few companies that has created a premium brand in a market with an available Apple alternative. Today its total annual revenues of almost \$5bn are roughly twice what they were when the first Apple Watch hit the shelves. Smartwatches and fitness trackers contribute almost 60% of the firm's sales (with most of the rest coming from professional navigation systems for ships and aircraft, see chart 2).

Another company to successfully exploit an underserved tech niche is Dropbox. Steve Jobs, Apple's co-founder, once dismissed the San Francisco-based cloud-storage firm as a "feature, not a product". Founded in 2008, it has battled Apple, Google and Microsoft (and for a while, Amazon) throughout its life. Its bigger rivals all bundle cloud storage with other services; customers who sign up for Google's Gmail, for instance, receive some free online storage. But those offerings, though often free, lack Dropbox's functionality.

According to Rishi Jaluria of the Royal Bank of Canada, early on Dropbox recognised that many users needed more than just a place to stash files. Photographers and other creative types want to store high-resolution files without worrying about file size, for example. These users are often ready to pay for the convenience. By developing features that appeal to them, most recently an AI-powered search tool to find and summarise documents, Dropbox has continued to attract new subscribers.

An exploitable niche can also be geographic. MercadoLibre, an Argentine e-commerce firm, is a case in point. Its days might have seemed numbered when Amazon entered Brazil and Mexico, its biggest markets, in 2012 and 2013, respectively. Not so. A decade later MercadoLibre accounts for a quarter of all e-commerce trade in Latin America. The closest Amazon has come to challenging the regional shopping giant is in Mexico, but even there its market share is half that of its rival.

MercadoLibre has succeeded by adapting its business model to local conditions. It quickly identified poor infrastructure, which raised costs for sellers and degraded the buying experience for shoppers, as a hindrance to growth. The firm has invested in its own logistics network, which transports 90% of its parcels. Its payments service, MercadoPago, is a popular option in a region with rampant fraud. Small innovations like offering points towards free delivery have helped it win over price-conscious Latin Americans. The

company also plays up its local roots to win over customers. Ariel Szarfesztejn, its head of commerce, describes it as “built by Latin Americans”. In April, as Amazon was slashing its workforce worldwide, MercadoLibre announced plans to hire 13,000 people.

Finding a niche is not enough to guarantee success. Garmin, Dropbox and MercadoLibre have other things going for them. All three still have at least one of their founders in executive roles. Winning against big tech requires an obsessive focus on product development and the stomach for long-term investments. It helps to have experienced operators at the helm who aren’t swayed solely by quarterly targets.

Crucially, the three companies also make money—a big selling point for investors at a time of rising interest rates, which make the promise of tech hopefuls’ future profits less attractive than earnings in the here and now. In 2022 Garmin, Dropbox and MercadoLibre raked in \$974m, \$553m and \$480m, respectively, in net income. That is peanuts next to Alphabet’s \$60bn or Apple’s \$100bn. But the trio’s operating margins look healthy for smartwatch, cloud and e-commerce businesses. The market capitalisation of Garmin has tripled since 2015, to over \$20bn. MercadoLibre’s has quintupled, to \$70bn. Dropbox is worth \$10bn, not too far off its peak amid the pandemic-era mania for all things digital. Who said anything about extinction? ■



Tok秀

TikTok正在改变推荐和销售图书的方式

这对读者、作者和出版商来说都是一种深刻转变

首先，镜头扫过八本书——书页间贴着少说得有数百个便签贴，彰显这些书有被认真阅读和仔细标注。接着，屏幕上滑过一句话：“我第一次愿意出卖灵魂换得再读一遍的书。”音乐声渐强，一只纤纤玉手随着节奏揭开了书的封面，向观众展示西蒙娜·德·波伏娃（Simone de Beauvoir）、埃莱娜·费兰特（Elena Ferrante）和莎莉·鲁尼（Sally Rooney）等作者的名字。

这位名叫“buryme.withmybooks”（“拿我的书给我陪葬”）的用户没有解释她为什么喜欢这些书，但这并不重要。在TikTok这类社交媒体上，要的就是夸张。大约有930万人观看了这段视频，近40万人将其收藏以备日后参考。

如今，拥有逾10亿活跃用户的TikTok正在出版界留下重要印记。这主要得益于供用户评论书籍的社群BookTok。它是TikTok上最大的社群之一，目前带有BookTok标签的视频播放量已经达到1790亿次，是BeautyTok（美妆爱好者也细化为不同的群体）的两倍多。再加上带有#reading、#books和#literature等标签的视频，总播放量超过2400亿次。那些曾宣称“书籍已死”的人是不怎么刷TikTok，也不大逛书店的——如今书店用整块显示屏来推介“TikTok同款”书。

去年，英国有四分之一的购书者使用了TikTok。但能直接归功于TikTok的销量仍然很小。根据研究公司尼尔森（Nielsen）的数据，2022年，英国由TikTok和YouTube等视频平台带动的图书销量仅占总销量的3%左右。但TikTok的影响力显著，而且还在不断增长。54岁及以下的女性是最大的购书群体，她们使用TikTok的可能性比同龄男性更大。TikTok的推荐影响了她们的购买行为，其结果是造就了一些文学新星，也让一些老作家出人意料地流行起来。

TikTok并不是第一个改变出版业格局的在线平台。成立于2006年的自助出版公司Wattpad帮助作者在网上发表作品并获得读者。多年来，Facebook、Instagram和推特（现在叫X）让作者能够与读者建立联系——有时候一上平台就能达成出版协议。

不过，TikTok的运作略有不同。我们可以把BookTok视为互联网时代的书友会。奥普拉·温弗瑞和巴拉克·奥巴马等明星人物只要更新一下自己的推荐书目，就能让书店书架上的书被一抢而空，BookTok做的也是类似的事情。不过在这里，引领潮流的通常不是名人，而是正在进行“阅读挑战”（#readingchallenges）的“爱书萌妹”（#bookgirlyies），并且往往是在灯光很有氛围感的卧室里读书。（不过温弗瑞现在也在TikTok开了读书会。）

从许多方面来说，BookTok本身已经成为一种新的艺术类型——在这里，感情夸张地谈论书中人物和故事情节受到推崇，甚至必不可少。（不像那些严肃内敛的专业文学评论家，他们往往并不会写一本书如何把自己看哭了。）

一些守旧的爱书人可能会质疑，与其说BookTok是在讨论书，不如说人们是通过在BookTok上“安利”书籍来寻求关注。但BookTok用户已经开始影响畅销书排行。和在电子书兴起等之前的技术变迁中发生的一样，“言情”类小说受到的提携最大。2022年初，科琳·胡佛（Colleen Hoover）的《莉莉的选择》（It Ends With Us）在TikTok上走红，迄今在英国售出了100多万本平装书。去年的美国十大畅销书中有六本都出自她手。它们的主题也很类似，比如女人渴望自己遥不可及的男人以及“创伤性联结”等，这些题材在BookTok上很受欢迎。

但在BookTok上最走红的往往是些更早期的作品。其中一些，包括胡佛最畅销的书，创作于TikTok问世之前。例如，一种美化拥有哥特式建筑的大学、粗花呢和古典文学的所谓“暗黑学院风”的审美观，就引发了人们对唐娜·塔特（Donna Tartt）于1992年出版的544页的小说《校园秘史》（The Secret History）的关注。

服装绚丽、内容空洞的奈飞热门剧《布里奇顿》（Bridgerton）造就了一大批言情年代剧的新粉丝，转而又激发了年轻读者重新发现《傲慢与偏见》等经典作品。今年8月，简·奥斯汀的小说在TikTok首届图书奖上获得了“最佳起死回生奖”（Best BookTok Revival）。（奥斯汀对这一荣誉会作何感想就另当别论了。）

由于TikTok的视觉特性突出，它对纸质书的销售影响更大。毕竟电子书提供不了这么有吸引力的视觉道具。尼尔森的一项调查显示，80%的14岁至25岁的英国人更喜欢纸质书。BookTok用户骄傲地展示批注，翻阅书页。他们拍摄自己在一天内就读完了一本书，身后的书架上还摆放着成百上千本——这些都是表演的一部分，而如果这本书看起来很厚，就会让观众格外印象深刻。

许多作者对这个平台仍然摸不着头绪。胡佛没有TikTok账号，和她一样的许多畅销书作者也没有。出版商为销量增长高兴，但也有一些不明所以，因为相比之下，他们自己的官方TikTok账号并没什么人气。挑战在于如何保持下去。这可不是找些作者来写出更多催泪的、揪心的或让人战栗的书，然后希望有人会拍摄下自己这些情绪那么简单。尽管有些编辑也这么做做了。

一些勇于开拓的出版商会留意平台上的人们又在倾情赞美什么新书，然后先人一步抢下其他地区的版权。还有一些出版商则在充分利用BookTok的势头。当Orion的前高管莎拉·本顿（Sarah Benton）听闻自家两年前出版的惊悚小说《沉默的病人》（The Silent Patient）出人意料地在BookTok获得关注时，Orion便调整了营销策略，并告诉书商要强调它在BookTok上的成功。这类招术正迅速成为常态。

出版商可能会发现，TikTok不仅带来了新的读者，也带来了更多竞争。TikTok的中国母公司字节跳动计划推出自己的图书出版社，据说正在洽谈签约言情小说作者。一家中国公司拥有西方年轻人自由表达的最重要平台之一，同时也控制了推介书籍这一自由思想的落于页面上的象征物的重要途径——这样的现实堪比小说里的情节反转。出版自家图书将把字节跳动

与文学（如果它的书能被称为文学的话）的关系提升到一个新的水平。■



Tok of the town

TikTok is changing the way books are recommended and sold

This represents a profound shift for readers, authors and publishers

FIRST THE camera pans across eight books arrayed with hundreds of sticky tabs, flaunting that they have been closely read and meticulously annotated. Next a description runs across the screen: “Books I would sell my soul to read again for the first time”. The music crescendoes, and a manicured hand reveals the books’ covers in time with the beat, featuring authors including Simone de Beauvoir, Elena Ferrante and Sally Rooney.

The user, who is called “buryme.withmybooks”, does not say why she likes them, but that does not matter. On TikTok hyperbole is the name of the social-media game. Around 9.3m people have watched the video and almost 400,000 people have saved it for future reference.

TikTok, which has more than 1bn regular users, is making a mark on the world of publishing. Much of this is done through BookTok, the app’s community of users who comment on books. It is among the largest communities on the app; videos with this tag have been viewed 179bn times, more than twice as many as BeautyTok (beauty enthusiasts splinter into various groups). Adding #reading, #books and #literature pushes views to more than 240bn. Whoever said books are dead has not spent much time on TikTok, nor in bookstores, which now have whole displays touting titles “as seen on TikTok”.

Last year in Britain one in four book buyers used TikTok. The slice of sales directly attributable to the app is still small. Video platforms like TikTok and YouTube drove only around 3% of sales in 2022 in Britain, according to Nielsen, a research firm. But TikTok’s influence is significant and growing.

The largest group of book buyers—women aged 54 and younger—are more likely to use the app than their male peers. TikTok recommendations influence their purchases, creating new literary stars and unearthing unlikely past ones, too.

TikTok is not the first online platform to alter the publishing landscape. Wattpad, a self-publishing firm founded in 2006, helped writers publish stories and reach readers online. For years Facebook, Instagram and Twitter (now X) have allowed authors to connect with readers—and sometimes score a book deal in the first place.

However, TikTok functions slightly differently. One way to think about BookTok is as a book club for the internet age. Just as stars like Oprah Winfrey and Barack Obama can cause copies to fly off bookstore shelves by updating their lists of recommended reads, BookTok does something similar. However, the tastemakers are not usually celebrities but attractive #bookgirlyies doing #readingchallenges, often in artfully lit bedrooms. (Although Ms Winfrey's book club is now on TikTok, too.)

In many ways BookTok has become a new artistic genre, where emoting about characters and plots is glorified, even required. (Unlike those buttoned-up professional literary critics, who do not tend to write about how books make them cry.)

Some old-fashioned bibliophiles may suspect that BookTok is less about books than about people seeking attention by promoting them. But BookTokers are already swaying bestseller lists. Novels categorised as “romance” have enjoyed the biggest boost, as happened with previous technological shifts, including the rise of e-books. Colleen Hoover’s “It Ends With Us” went viral on TikTok in early 2022 and has sold over 1m paperback copies in Britain. Six of the ten bestselling titles in America last year were written by her, too. They pick up similar themes, such as women lusting

after hard-to-get men and “trauma bonding”, subjects that fare well on the video-sharing app.

But BookTok favourites are often older releases, with some, including Ms Hoover’s most popular, written before the app was invented. For example, an aesthetic known as “dark academia”, which glamorises gothic-style universities, tweed and classic literature, has brought attention to a 544-page novel published in 1992 called “The Secret History” by Donna Tartt.

The popular Netflix show “Bridgerton”—big on colourful costumes, light on substance—created new fans of period romance and, in turn, inspired young readers to rediscover classic books such as “Pride and Prejudice”. In August Jane Austen’s novel won “Best BookTok Revival” at TikTok’s inaugural book awards. (How Austen would have felt about this honour is another question.)

Because TikTok is so visual, the app has an outsize impact on sales of physical books in particular. E-books do not make such attractive visual props. According to a survey by Nielsen, 80% of Brits aged 14-25 prefer print. BookTokers show off annotations and flick through pages. Filming themselves finishing a book in a single day against a backdrop of hundreds of them on shelves is all part of the performance, and viewers will be extra impressed if the book looks thick.

Many authors remain puzzled by the app. Ms Hoover does not have a TikTok account, and neither do many of her other bestselling peers. Publishers, happy for new sales, are also a bit perplexed; their official TikTok accounts are unpopular by comparison. The challenge is how to keep up. It is not as simple as commissioning more books that make people cry, squirm or shudder and then hoping that people film themselves doing so. Although some editors are doing that anyway.

Some enterprising publishers keep an eye out for gushing videos about forthcoming books and then snap up the rights in other territories. Others are making the most of momentum on BookTok. When Sarah Benton, a former executive at Orion, heard that “The Silent Patient”, a two-year-old thriller that the firm had published, was unexpectedly gaining traction, Orion tweaked its marketing and told booksellers to emphasise success on BookTok. Such tricks are rapidly becoming the norm.

Publishers may find that TikTok means not only new readers but also more competition. ByteDance, the Chinese company that owns the app, has plans to launch its own book publisher and is said to be in discussions to sign romance writers. The fact that a Chinese company owns one of the most important platforms for young people’s free expression in the West—and a critical route for recommendations of books, paginated symbols of free thinking—is a plot twist fit for fiction. Publishing its own books will bring ByteDance’s relationship with literature (if its books can be called that) to a new level. ■



大救星？麻烦精？或者都是？

冲动和自毁：一本新书所刻画的马斯克

这位亿万富翁对人类有着崇高的愿景，并有非同寻常的决心要去实现它【《埃隆·马斯克传》书评】

《埃隆·马斯克传》。沃尔特·艾萨克森著。西蒙与舒斯特出版社；688页；35美元/28英镑。

马斯克到底在搞什么名堂？爱琢磨这个问题的曾经只有科技迷。但鉴于他在航空发射服务、卫星互联网接入、电动汽车和社交媒体方面是如此举足轻重，这位世界首富令人难以捉摸的行为现在带有全球性后果。他掌控着特朗普的推特使用权限、乌克兰武装部队的互联网连接以及美国把人送入太空的能力。他改变了多个行业的发展轨迹。他还有一种识别什么在未来能成大气候的本领（因此他在大脑芯片和类人机器人上的附加赌注可能值得关注）。难怪现在有这么多人想知道马斯克的所作所为背后的缘由。

沃尔特·艾萨克森（Walter Isaacson）试图在这本不乏私人秘辛的传记中回答这个问题。曾是史蒂夫·乔布斯的传记作者的他跟随马斯克两年，接触了他的家人和至交密友，为他刻画出一幅精细的心理肖像。

马斯克出生于1971年，在南非度过了一个动荡的童年。他先后在一个苦苦挣扎的单身母亲和一个虐待成性的父亲的抚养下长大。在学校遭受暴力霸凌后，马斯克躲进了白日梦和科幻小说的世界中。到了青年时期，他移居国外，先是加拿大，接着到了美国。他在上世纪90年代末的互联网热潮中赚到了他的第一个一百万美元：先是与人共同创建了一个在线商户名录；接着是一家在线银行，和另一家公司合并后成了PayPal。再后来，他为自己设定了一个“小目标”，要把智人变成一个能够在地球灭绝后存活下来的“多行星物种”。

很难想象还有哪个人在这么多不同的领域带来了如此惊人的变化，尤其是他的火箭公司SpaceX和电动汽车制造商特斯拉。然而，由于他的政治言

论、他对“觉醒思维病毒”（woke mind virus）的讨伐，以及他对推特（出于某种原因，他将其更名为X）一波三折的管理，他有多受人钦佩，就有多遭人嫌恶。艾萨克森描绘了一个对人类有着崇高愿景的人，但他冲动、好斗、自毁。

在艾萨克森看来，马斯克的动力源自他深信人类正迅速走向灾难。因此，他抱持超人式的工作理念（他几乎不睡觉），并能容忍风险（他曾数次险些败光全副身家，并经常说服他的工程师们在精密盘算后放手一搏）。也因此，他惯于狠狠训斥那些他认为不称职或不够敬业的员工，甚至让他们立马走人。

马斯克对自己的智慧深信不疑。在人工智能这个问题上，他相信除了他，没有人足够可靠，可以被委以保护人类免受恶毒机器伤害的重任。他还卷入了地缘关系中。正如本刊去年10月报道的那样，艾萨克森记述了马斯克如何拒绝让乌克兰利用他的卫星互联网服务“星链”（Starlink）攻击占领克里米亚的俄罗斯军队，担心对这个半岛发起攻击可能会引发核报复。（乌克兰后来还是攻击了克里米亚，但没有引发这样的结果。）

浮现在读者眼前的便是这样一幅画面：一个有冲劲、有才华的企业家已变得越发反复无常和心胸狭隘，而与此同时他对全球事务的影响力却与日俱增。毫无疑问，其他商业领袖也擅长不可预测的行为——一下子就能想到乔布斯（作者也支持将二人作比较）——但他们并没有在推特上实时分享自己的想法。被誉为乔布斯接班人的马斯克而今被拿来与另一位善变的亿万富翁作比较，后者激发了狂热的忠诚，言行却像个气鼓鼓的学步稚子。

是财富和影响力的增长让他越发感到不受约束，于是现出了真面目，还是他对推特的使用加剧了他的所作所为？也许两者都有一点。艾萨克森承认，他的主人公有时表现得很愚蠢。马斯克对社交媒体的沉迷引发了不必要的口水战。他先前指控泰国的一名救援潜水员是“恋童的家伙”，引发了一场诽谤诉讼（马斯克赢了）。他宣称自己“已获得资金”将特斯拉私有化，事实上他并没有，结果不得不与美国证券交易委员会（SEC）达成数百万美元的和解。正如马斯克承认的那样：“我经常搬起石头砸自己的

脚，我应该买几双扛砸的鞋才是。”

近年来，他在推特上炮轰关于性别认同等问题的左翼立场，跟右翼阴谋论眉来眼去。艾萨克森表示，这种向右倾的转变一定程度上跟马斯克与变性女儿詹娜（Jenna）失和有关，詹娜的马克思主义世界观促使她与父亲决裂。马斯克决定收购推特有一个重要因素，那就是他相信推特已经染上了觉醒习气并且在审查所有其他观点。艾萨克森还推测，这笔交易给了因童年受欺凌而留下创伤的马斯克一个“拥有游乐场”的机会。

这一切现在都有可能令马斯克的积极贡献失色。一些特斯拉司机在保险杠上明晃晃地贴着一句，“我买这车的时候，埃隆是个王八蛋还不是尽人皆知呢”。更令人担忧的是，他在地缘方面似乎力有不逮。这本大部头扣人心弦地讲述了马斯克非同寻常的生涯。但你总有一种感觉，马斯克的故事只讲了一半。 ■



Messiah, menace or both?

Impulsive and self-destructive: Elon Musk as depicted in a new book

The billionaire has a lofty vision for humanity—and is unusually determined to see it through

Elon Musk. By Walter Isaacson. Simon & Schuster; 688 pages; \$35 and £28

WHAT EXACTLY is going on with Elon Musk? This question once preoccupied only techie types. But Mr Musk's prominence in space-launch services, satellite-internet access, electric cars and social media means that the unpredictable behaviour of the world's richest man now has global consequences. He controls Donald Trump's access to Twitter, internet connectivity for Ukraine's armed forces and America's ability to send people into space. He has altered the course of multiple industries. And he has a knack for spotting what will be important in the future (so his side bets on brain chips and humanoid robots are probably worth watching). It is no surprise so many people now want to know what makes Mr Musk tick.

Walter Isaacson sets out to answer that question in this intimate biography. Previously a biographer of Steve Jobs, he shadowed Mr Musk for two years, gaining access to his family and closest confidants, to produce a detailed psychological portrait.

Born in 1971, Mr Musk had a tumultuous childhood in South Africa. He was brought up partly by a struggling single mother and partly by an abusive father. Violently bullied at school, Mr Musk escaped into daydreams and science-fiction novels. As a young man he emigrated, first to Canada, then America. He made his first millions during the dotcom fever of the late 1990s, co-founding an online business directory and then an online bank that, after a merger, became PayPal. He then set himself the modest goal of turning Homo sapiens into a "multi-planetary species" that could survive

extinction on Earth.

It is hard to think of anyone else who has wrought such astounding change in so many different fields of endeavour, notably with SpaceX, his rocket company, and Tesla, a maker of electric cars. Yet Mr Musk is as widely loathed as he is admired, thanks to his pronouncements on politics, his crusade against the “woke mind virus” and his rocky stewardship of Twitter (which for some reason he has renamed X). Mr Isaacson describes a man with a lofty vision for humankind, but who is impulsive, pugnacious and self-destructive.

In Mr Isaacson’s view, Mr Musk is propelled by a conviction that humanity is hurtling towards calamity. Hence his superhuman work ethic (the man barely sleeps) and his tolerance for risk (he has endangered his fortune a number of times and often pushes his engineers to take calculated gambles). Hence, too, his habit of furiously reprimanding or even summarily firing employees whom he deems incompetent or insufficiently committed.

Mr Musk has faith in his own wisdom. When it comes to artificial intelligence, he believes no one but he can be trusted to protect humans from malevolent machines. He is being drawn into geopolitics, too. Mr Isaacson recounts how, as *The Economist* reported last October, Mr Musk refused to let Starlink, his satellite-internet service, be used by Ukraine to attack Russian forces occupying Crimea, for fear that an assault on the peninsula might provoke nuclear retaliation. (Ukraine attacked it later, triggering no such response.)

What transpires is a picture of a driven, talented entrepreneur who has become increasingly unstable and petty even as his influence over global affairs has grown. No doubt other business leaders are capable of unpredictable behaviour—Jobs comes to mind (a comparison the author

encourages)—but they have not provided a live feed of their thoughts on Twitter. Lauded as Jobs's successor, Mr Musk now draws comparisons with a different mercurial billionaire who inspires cult-like loyalty while acting like an aggrieved toddler.

Has the true Mr Musk emerged, feeling increasingly unconstrained as his wealth and power have grown, or has this behaviour been exacerbated by his use of Twitter? It is probably a bit of both. Mr Isaacson concedes that his subject sometimes behaves foolishly. Mr Musk's addiction to social media has caused unnecessary spats. He accused a rescue diver in Thailand of being a "pedo guy", provoking a defamation suit (which Mr Musk won). He declared he had "funding secured" to take Tesla private, when he did not, and had to make a multimillion-dollar settlement with the US Securities and Exchange Commission. As Mr Musk admits: "I've shot myself in the foot so often I ought to buy some Kevlar boots."

In recent years his tweets have lambasted left-wing positions on issues such as gender identity, and flirted with right-wing conspiracy theories. This rightward shift can be explained in part, Mr Isaacson says, by a falling-out between Mr Musk and his transgender daughter Jenna, whose Marxist worldview led her to sever ties with her father. Mr Musk's belief that Twitter had become infected with wokery and was censoring alternative viewpoints was a big factor in his decision to buy it. Mr Isaacson also speculates that the deal gave Mr Musk, scarred by his childhood bullying, a chance to "own the playground".

All this now risks overshadowing Mr Musk's positive contributions. Some Tesla drivers tout bumper stickers that read "I bought this car before we all knew Elon was a jerk". More worryingly, he seems out of his depth in geopolitics. This doorstep-sized book provides a gripping account of Mr Musk's extraordinary life. But it is hard to escape the feeling that the story of Elon Musk is still only half told. ■



AI科学

科学家正在如何运用人工智能

它已经在提升科研的速度、质量和成效【深度】

二〇一九年，麻省理工学院（MIT）的科学家们取得了现代医学的一个非凡成果——他们发现了一种新的抗生素halicin。今年5月，另一个研究小组发现了另一种抗生素abacinc。这两种化合物之所以与众不同，不仅是因为它们可能被用来对抗已知最危险的耐药菌中的两种，还因为发现它们的方式。

在这两次发现中，研究人员都使用了人工智能（AI）模型在数百万候选化合物中搜索，以确定哪些化合物在针对两种“超级细菌”的其一时最有效。在训练该模型时使用了几千种已知抗生素的化学结构，以及它们在实验室中对抗这两种细菌的效果。在训练过程中，该模型找到了抗生素的化学结构与其杀灭细菌效果之间的联系。一旦AI给出经过初步筛选的化合物清单，科学家们就会在实验室里测试它们，并找出有效的抗生素。麻省理工学院的计算机科学家雷吉娜·巴尔齐莱（Regina Barzilay）协助发现了halicin和abacinc。她说，如果说发现新药好比大海捞针，那么AI就像是金属探测器。候选药物从实验室走到临床需要经过多年的医学试验。但毫无疑问，AI缩短了这一过程中最初阶段的反复试错。它改变了可能性的边界，巴尔齐莱表示。有了AI，“我们将要问的，与我们今天正在问的，会是迥然不同的问题”。

药物研发并不是AI可以施展潜力的唯一领域。如今，研究人员在解决许多世界上最复杂和重要的问题时都在寻求AI的帮助，让前进的步伐迈得更大或更快，这些问题包括预测天气、寻找电池和太阳能电池板所需的新材料，以及控制核聚变反应等等。

这种潜力是巨大的。“AI可能开创一轮新的发现复兴，”位于伦敦的AI实验室谷歌DeepMind的联合创始人戴米斯·哈萨比斯（Demis Hassabis）表

示，“它相当于人类智慧的倍增器。”他把AI比作望远镜——有了这项关键技术，科学家可以比仅凭肉眼看得更远、了解更多。

尽管自上世纪60年代以来，AI就已经被加入到了科学工具包中，但在大部分时间里，其应用一直局限于粒子物理学、数学等科学家早已精通计算机代码的学科中。然而，根据澳大利亚联邦科学与工业研究组织（CSIRO）的数据（见图表），随着深度学习的兴起，到2023年，99%以上的研究领域都出现了与AI相关的成果。位于伦敦的阿兰·图灵研究所（Alan Turing Institute）的首席科学家马克·吉罗拉米（Mark Girolami）表示：“大众化是AI大爆发的原因。”过去一些需要计算机科学学位和一系列晦涩难懂的编程语言才能完成的工作，现在使用易于使用的AI工具就能搞定——往往问一下OpenAI的聊天机器人ChatGPT就能让它们开始工作了。因此，科学家们可以很方便地使用AI工具——它实质上就是一个锲而不舍、超人般的研究助理，可以解方程和不知疲倦地翻查海量数据，以寻找其中存在的任何规律或相关性。

例如，在材料科学中会遇到与药物研发类似的问题——可能的候选化合物数不胜数。利物浦大学的研究人员在寻找制造更优质电池所需的具备某些具体特性的材料时，使用了一种被称为“自动编码器”的AI模型，在无机晶体结构数据库（Inorganic Crystal Structure Database，是世界上最大的此类数据库）中所有20万种已知的稳定晶体化合物中搜索。这个AI此前已经掌握了新电池材料需要具备的最重要的物理和化学性质，现在它把这些条件应用于搜索。它成功地把供科学家在实验室测试的候选材料从数千种减少到只有五种，节省了时间和资金。

最终胜出的是一种由锂、锡、硫和氯组成的新型材料，尽管目前判断它能否投入商用还为时过早。但研究人员正在使用这种AI方法来发现其他新型材料。

AI还可用于预测。蛋白质在细胞中合成后扭曲而成的各种形状对它们发挥功能至关重要。到目前为止，科学家还不知道蛋白质是如何折叠的。但在2021年，谷歌DeepMind开发了AlphaFold模型，该模型通过自主学习，只

需根据氨基酸序列就能预测蛋白质的结构。AlphaFold自发布以来已经预测了超过两亿个蛋白质结构，并据此建立了一个数据库。如今已有120多万研究人员使用了该数据库。例如，牛津大学的生物化学家马修·希金斯（Matthew Higgins）使用AlphaFold破解了蚊子体内一种蛋白质的形状，这种形状对常由蚊子携带的疟原虫很重要。之后，他结合AlphaFold的预测，找出了这种蛋白质的哪些部分最容易成为药物的靶点。另一个团队使用AlphaFold在短短30天内便发现了对一种肝癌的扩散产生影响的蛋白质结构，从而为设计新的靶向疗法开启了大门。

AlphaFold还协助人们增进了对生物学其他问题的了解。例如，细胞核有一些通道可以让物质进入并生成蛋白质。几年前，科学家们就知道这些通道的存在，但对其结构知之甚少。科学家们利用AlphaFold预测出了它们的结构，并加深了对细胞内部机制的理解。“事实上，我们并不完全知道[这个AI]是如何成功预测这种结构的，”AlphaFold的发明者之一、现任谷歌DeepMind的“AI for Science”团队负责人的普什米特·科利（Pushmeet Kohli）表示，“但是一旦它破解了这个结构，实际上就奠定了一个基础，现在整个科学界都可以在它上面添砖加瓦。”

事实证明，AI还能帮助加快复杂的计算机模拟。例如，天气模型的基础是描述特定时间地球大气状态的数学方程。然而，用来预测天气的超级计算机造价昂贵、耗电惊人，并且运算耗时长久。模型还必须不间断反复运行，才能跟得上从世界各地气象站不断涌入的数据。

因此，为了加快计算机模拟过程，气候科学家和私营公司开始部署机器学习。由中国公司华为开发的盘古气象AI模型可以提前一周预测天气，速度比目前的标准快数千倍，成本也更低，而且在准确度上完全没有实质性的下降。美国芯片公司英伟达（Nvidia）开发的FourCastNet模型可以在两秒钟之内做出类似的预测，FourCastNet是第一个以高空间分辨率准确预测降雨的AI模型，而这种高分辨率数据是预测突发性洪水等自然灾害的重要信息。这两种AI模型都经过训练，可以通过学习观测数据或超级计算机模拟的输出来预测天气。而这还仅仅只是开始——英伟达已经宣布计划创建一个地球的数字孪生体，名为“Earth-2”，英伟达希望这个计算机模型将

能够提前几十年预测更具体地域内的气候变化。

与此同时，试图掌控核聚变的物理学家已在使用AI控制各种复杂的装置。一种核聚变研究使用一个叫作托卡马克装置的环形容器，在其内部产生氢等离子体（等离子体是一种温度极高的带电气体）。当温度加到足够高——大约一亿摄氏度时，等离子体中的粒子开始融合并释放能量。但是如果等离子体接触到托卡马克装置的内壁，就会冷却并停止工作，所以物理学家把等离子体约束在一个磁笼里。找到正确的磁场配置极其困难（一位物理学家打比方说“有点像用毛线去拴住一块果冻”），人工控制磁场需要设计一些数学方程来预测等离子体的行为，再对十来个不同的磁线圈进行每秒数千次的微调。而谷歌DeepMind和瑞士洛桑联邦理工学院（EPFL）的科学家创建了一个AI控制系统，让科学家可以在计算机模拟中测试不同形状的磁线圈——之后由AI找出实现所需形状的最佳途径。

另一个兴趣点是让物理实验和实验室工作自动化并加快进展。“自动驾驶实验室”可以筹划实验，使用机械臂来做实验，然后分析结果。在发现新化合物、或者找到更好的方法制造现有化合物方面，自动化可以把速度提高最多一千倍。

2022年，随着ChatGPT的到来，生成式AI迅速引起了公众的注意，但科学家早就在尝试这种工具了。生成式AI有两个主要的科学用途。首先，它可以用来生成数据。“超分辨率”AI模型可以将低成本的低分辨率电子显微镜创建的图像增强为高分辨率图像。如果要直接获得高分辨率电镜图像，成本会非常昂贵。用高、低两种分辨率的电子显微镜分别记录一种材料或生物样本的同一小片区域，然后用AI比较所得图像。超分辨率AI模型学习掌握了两种分辨率图像的差异后，便可以在两者间进行转换。

正如大语言模型（LLM）可以逐个预测下一个最合适的单词来生成流畅的句子一样，分子生成模型能够一个原子接一个原子、一个化学键接一个化学键地构建分子。LLM将自主习得的统计数据与从互联网上精选的数万亿单词的训练文本结合起来，写出仿佛出自人手的文字。经过囊括了各种已知药物及其特性的庞大数据库的训练，“全新分子设计”模型可以算出哪种

分子结构最有可能起什么作用，并生成相应的分子。加州制药公司Verseon已经用这种方法研制出了一些候选药物，其中有几种正在进行动物试验，还有一种精准抗凝血药正在进行第一期临床试验。就像AI发现的新抗生素和电池材料一样，由算法设计的化学药物也需要在现实世界中接受常规试验，才能评估其有效性。

滑铁卢大学的心理学家伊戈尔·格罗斯曼（Igor Grossmann）想到的一种LLM用途更具有未来色彩。如果LLM能够在真实（或虚构）的故事背景提示下准确说出人类参与者可能会说的话，那么从理论上讲，LLM就可以取代焦点小组，或者在经济学研究中充当代理。LLM可以接受各种角色训练，然后其行为可以被用在模拟实验中，如果得出的实验结果很有趣，稍后可再请来人类受试者验证。

科学家自己也已经在使用LLM来提高效率了。GitHub表示，使用其开发的“Copilot”之类的工具可以帮助程序员将软件编写速度提高55%。对所有科学家来说，在开始一个项目前，阅读相关领域的背景研究资料可能是项艰巨的任务——现代科学文献浩如烟海，根本读不过来。通过使用LLM，美国非营利研究实验室Ought开发的免费在线AI工具Elicit可以帮助人们搜索海量研究文献并总结重要的文献，速度要比人类快得多。很多学生和年轻科学家已经开始使用Elicit，他们中的许多人发现，在面对海量文本时，它能帮助自己找到要引用的论文或者明确研究方向。LLM甚至可以帮助人们从数百万份文件中提取结构化信息，比如使用某种药物所做的所有实验。

使用AI还可以拓宽学科内部的知识分享。位于日内瓦的欧洲核子研究组织（CERN）的大型强子对撞机（Large Hadron Collider）上的每个探测器都需要配备专门的操作和分析团队。如果负责各个探测器的物理学家不聚在一起分享各自的专业知识，就无法整合和比较数据。对于那些想要快速验证新想法的理论物理学家来说，这种方式并不总是可行。为此，加州大学河滨分校（UCR）的物理学家米格尔·阿拉蒂亚（Miguel Arratia）提议，使用AI来整合多种基础物理实验（甚至宇宙学观测）的测量结果，这样理论物理学家就可以快速地在自己的工作中探索、整合并再利用这些数据。

AI模型已经展示了它们可以处理数据，让计算和一些实验室工作实现自动化（见列表）。但吉罗拉米警告说，尽管AI可能帮助科学家弥补知识空白，但这些模型仍然难以突破已知的知识边界。AI系统擅长内推——连点成线；但不擅长外推——设想下个点可能的走向。

还有一些难题是当今最成功的AI系统也还没能解开的。例如，AlphaFold并不总能准确预测所有的蛋白质结构。加州拉荷亚市（La Jolla）斯克里普斯研究所（Scripps Research Institute）的结构生物学家简·戴森（Jane Dyson）表示，对于他重点研究的“无序”蛋白质，这个AI的预测基本上是垃圾。“这场变革并不会让我们所有科学家都失业。”而且，AlphaFold还没有解释为什么蛋白质会以现有的方式折叠。不过，或许它对此是“有一个理论的，只不过我们还没能领会它”，科利表示。

尽管存在这些局限性，结构生物学家仍然认为AlphaFold已经帮助提高了他们的工作效率。包含大量由AlphaFold预测的蛋白质结构的数据库让科学家能够在几秒钟内就算出某种蛋白质可能的结构，而不用AI工具可能要花费好几年和几万美元。根据谷歌DeepMind的数据，使用AlphaFold的科学家发表的论文比同领域不使用它的科学家多20%左右。

在加快科研和发现的步伐、最大限度地提高效率方面，AI还大有可为。富国俱乐部经合组织（OECD）在不久前发布的一份关于AI科研应用的报告中表示：“虽然AI正在渗入科学的各个领域和阶段，但还远没有充分发挥其潜力。”报告认为它可能带来极大的回报：“在AI的所有用途中，提高科研效率可能最具经济和社会价值。”

如果AI工具设法提高了科研效率，那么毫无疑问，世界将获得哈萨比斯所预言的“人类智慧的倍增器”。但AI还有更大的潜力：正如望远镜和显微镜拓宽了科学家的视野一样，AI中使用的概率模型和数据驱动模型将日益帮助科学家更好地模拟和理解各种复杂系统。在气候科学和结构生物学等领域，科学家们已经知道复杂的过程在发生中。但到目前为止，研究人员主要还是通过自上而下的定律、方程和模拟来尝试理解这些课题。而AI可以帮助科学家自下而上地解决问题——首先测量大量数据，随后再使用算法

得出定律、模式、方程和科学理解。

如果说过去几年科学家们只涉足了AI的浅水区，那么未来十年乃至更长的时间内，他们将不得不潜入AI的深水区，并向更远的海角天边遨游。■



AI Science

How scientists are using artificial intelligence

It is already making research faster, better, and more productive

IN 2019, scientists at the Massachusetts Institute of Technology (MIT) did something unusual in modern medicine—they found a new antibiotic, halicin. In May this year another team found a second antibiotic, abaucin. What marked these two compounds out was not only their potential for use against two of the most dangerous known antibiotic-resistant bacteria, but also how they were identified.

In both cases, the researchers had used an artificial-intelligence (AI) model to search through millions of candidate compounds to identify those that would work best against each “superbug”. The model had been trained on the chemical structures of a few thousand known antibiotics and how well (or not) they had worked against the bugs in the lab. During this training the model had worked out links between chemical structures and success at damaging bacteria. Once the AI spat out its shortlist, the scientists tested them in the lab and identified their antibiotics. If discovering new drugs is like searching for a needle in a haystack, says Regina Barzilay, a computer scientist at MIT who helped to find abaucin and halicin, AI acts like a metal detector. To get the candidate drugs from lab to clinic will take many years of medical trials. But there is no doubt that AI accelerated the initial trial-and-error part of the process. It changes what is possible, says Dr Barzilay. With AI, “the type of questions that we will be asking will be very different from what we’re asking today.”

Drug discovery is not alone in being jolted by the potential of AI. Researchers tackling many of the world’s most complicated and important problems—from forecasting weather to searching for new materials for

batteries and solar panels and controlling nuclear-fusion reactions—are all turning to AI in order to augment or accelerate their progress.

The potential is enormous. “AI could usher in a new renaissance of discovery,” argues Demis Hassabis, co-founder of Google DeepMind, an AI lab based in London, “acting as a multiplier for human ingenuity.” He has compared AI to the telescope, an essential technology that will let scientists see farther and understand more than with the naked eye alone.

Though it has been part of the scientific toolkit since the 1960s, for most of its life AI has been stuck within disciplines where scientists were already well-versed in computer code—particle physics, for example, or mathematics. By 2023, however, with the rise of deep learning, more than 99% of research fields were producing AI-related results, according to CSIRO, Australia’s science agency (see chart). “Democratisation is the thing that is causing this explosion,” says Mark Girolami, chief scientist at the Alan Turing Institute in London. What used to require a computer-science degree and lines of arcane programming languages can now be done with user-friendly AI tools, often made to work after a query to ChatGPT, OpenAI’s chatbot. Thus scientists have easy access to what is essentially a dogged, superhuman research assistant that will solve equations and tirelessly sift through enormous piles of data to look for any patterns or correlations within.

In materials science, for example, the problem is similar to that in drug discovery—there are an unfathomable number of possible compounds. When researchers at the University of Liverpool were looking for materials that would have the very specific properties required to build better batteries, they used an AI model known as an “autoencoder” to search through all 200,000 of the known, stable crystalline compounds in the Inorganic Crystal Structure Database, the world’s largest such repository. The AI had previously learned the most important physical and chemical

properties required for the new battery material to achieve its goals and applied those conditions to the search. It successfully reduced the pool of candidates for scientists to test in the lab from thousands to just five, saving time and money.

The final candidate—a material combining lithium, tin, sulphur and chlorine—was novel, though it is too soon to tell whether or not it will work commercially. The AI method, however, is being used by researchers to discover other sorts of new materials.

AI can also be used to predict. The shapes into which proteins twist themselves after they are made in a cell are vital to making them work. Scientists do not yet know how proteins fold. But in 2021, Google DeepMind developed AlphaFold, a model that had taught itself to predict the structure of a protein from its amino-acid sequence alone. Since it was released, AlphaFold has produced a database of more than 200m predicted protein structures, which has already been used by over 1.2m researchers. For example, Matthew Higgins, a biochemist at the University of Oxford, used AlphaFold to figure out the shape of a protein in mosquitoes that is important for the malaria parasite that the insects often carry. He was then able to combine the predictions from AlphaFold to work out which parts of the protein would be the easiest to target with a drug. Another team used AlphaFold to find—in just 30 days—the structure of a protein that influences how a type of liver cancer proliferates, thereby opening the door to designing a new targeted treatment.

AlphaFold has also contributed to the understanding of other bits of biology. The nucleus of a cell, for example, has gates to bring in material to produce proteins. A few years ago, scientists knew the gates existed, but knew little about their structure. Using AlphaFold, scientists predicted the structure and contributed to understanding about the internal mechanisms of the cell. “We don’t really completely understand how [the AI] came up with

that structure,” says Pushmeet Kohli, one of AlphaFold’s inventors who now heads Google DeepMind’s “AI for Science” team. “But once it has made the structure, it is actually a foundation that now, the whole scientific community can build on top of.”

AI is also proving useful in speeding up complex computer simulations. Weather models, for example, are based on mathematical equations that describe the state of Earth’s atmosphere at any given time. The supercomputers that forecast weather, however, are expensive, consume a lot of power and take a lot of time to carry out their calculations. And models must be run again and again to keep up with the constant inflow of data from weather stations around the world.

Climate scientists, and private companies, are therefore beginning to deploy machine learning to speed things up. Pangu-Weather, an AI built by Huawei, a Chinese company, can make predictions about weather a week in advance thousands of times faster and cheaper than the current standard, without any meaningful dip in accuracy. FourCastNet, a model built by Nvidia, an American chipmaker, can generate such forecasts in less than two seconds, and is the first AI model to accurately predict rain at a high spatial resolution, which is important information for predicting natural disasters such as flash floods. Both these AI models are trained to predict the weather by learning from observational data, or the outputs of supercomputer simulations. And they are just the start—Nvidia has already announced plans to build a digital twin of Earth, called “Earth-2”, a computer model that the company hopes will be able to predict climate change at a more regional level, several decades in advance.

Physicists trying to harness the power of nuclear fusion, meanwhile, have been using AI to control complex bits of kit. One approach to fusion research involves creating a plasma (a superheated, electrically charged gas) of hydrogen inside a doughnut-shaped vessel called a tokamak. When hot

enough, around 100m°C, particles in the plasma start to fuse and release energy. But if the plasma touches the walls of the tokamak, it will cool down and stop working, so physicists contain the gas within a magnetic cage. Finding the right configuration of magnetic fields is fiendishly difficult (“a bit like trying to hold a lump of jelly with knitting wool”, according to one physicist) and controlling it manually requires devising mathematical equations to predict what the plasma will do and then making thousands of small adjustments every second to around ten different magnetic coils. By contrast, an AI control system built by scientists at Google DeepMind and EPFL in Lausanne, Switzerland, allowed scientists to try out different shapes for the plasma in a computer simulation—and the AI then worked out how best to get there.

Automating and speeding up physical experiments and laboratory work is another area of interest. “Self-driving laboratories” can plan an experiment, execute it using a robotic arm, and then analyse the results. Automation can make discovering new compounds, or finding better ways of making old compounds, up to a thousand times faster.

Generative AI, which exploded into public consciousness with the arrival of ChatGPT in 2022 but which scientists have been playing with for much longer, has two main scientific uses. First, it can be used to generate data. “Super-resolution” AI models can enhance cheap, low-resolution electron-microscope images into high-resolution ones that would otherwise have been too expensive to record. The AI compares a small area of a material or a biological sample in high resolution with the same thing recorded at a lower resolution. The model learns the difference between the two resolutions and can then translate between them.

And just as a large language model (LLM) can generate fluent sentences by predicting the next best word in a sequence, generative molecular models are able to build molecules, atom by atom, bond by bond. LLMs use a mix

of self-taught statistics and trillions of words of training text culled from the internet to write in ways that plausibly mimic a human. Trained on vast databases of known drugs and their properties, models for “de novo molecular design” can figure out which molecular structures are most likely to do which things, and they build accordingly. Verseon, a pharmaceutical company based in California, has created drug candidates in this way, several of which are now being tested on animals, and one—a precision anticoagulant—that is in the first phase of clinical trials. Like the new antibiotics and battery materials identified by AI, chemicals designed by algorithms will also need to undergo the usual trials in the real world before their effectiveness can be assessed.

A more futuristic use for LLMs comes from Igor Grossmann, a psychologist at the University of Waterloo. If an LLM could be prompted with real (or fabricated) back stories so as to mirror accurately what human participants might say, they could theoretically replace focus groups, or be used as agents in economics research. LLMs could be trained with various different personas, and their behaviour could then be used to simulate experiments, whose results, if interesting, could later be confirmed with human subjects.

LLMs are already making scientists themselves more efficient. According to GitHub, using tools like its “Copilot” can help coders write software 55% faster. For all scientists, reading the background research in a field before embarking on a project can be a daunting task—the sheer scale of the modern scientific literature is too vast for a person to manage. Elicit, a free online AI tool created by Ought, an American non-profit research lab, can help by using an LLM to comb through the mountains of research literature and summarise the important ones much faster than any human could. It is already used by students and younger scientists, many of whom find it useful to find papers to cite or to define a research direction in the face of a mountain of text. LLMs can even help to extract structured information—such as every experiment done using a specific drug—from

millions of documents.

Widening access to knowledge within disciplines could also be achieved with AI. Each detector at the Large Hadron Collider at CERN in Geneva requires its own specialised teams of operators and analysts. Combining and comparing data from them is impossible without physicists from each detector coming together to share their expertise. This is not always feasible for theoretical physicists who want to quickly test new ideas. Miguel Arratia, a physicist at the University of California, Riverside, has therefore proposed using AI to integrate measurements from multiple fundamental physics experiments (and even cosmological observations) so that theoretical physicists can quickly explore, combine and re-use the data in their own work.

AI models have demonstrated that they can process data, and automate calculations and some lab work (see table). But Dr Girolami warns that whereas AI might be useful to help scientists fill in gaps in knowledge, the models still struggle to push beyond the edges of what is already known. These systems are good at interpolation—connecting the dots—but less so at extrapolation, imagining where the next dot might go.

And there are some hard problems that even the most successful of today's AI systems cannot yet handle. AlphaFold, for example, does not get all proteins right all the time. Jane Dyson, a structural biologist at the Scripps Research Institute in La Jolla, California, says that for "disordered" proteins, which are particularly relevant to her research, the AI's predictions are mostly garbage. "It's not a revolution that puts all of our scientists out of business." And AlphaFold does not yet explain why proteins fold in the ways they do. Though perhaps the AI "has a theory we just have not been able to grasp yet," says Dr Kohli.

Despite those limitations, structural biologists still reckon that AlphaFold

has made their work more efficient. The database filled with AlphaFold's protein predictions allows scientists to work out the likely structure of a protein in a few seconds, as opposed to the years and tens of thousands of dollars it might have taken otherwise. According to Google DeepMind, scientists who use AlphaFold publish around 20% more papers than those in the same field who do not.

And speeding up the pace of scientific research and discovery, making efficiencies wherever possible, holds plenty of promise. In a recent report on AI in science the OECD, a club of rich countries, said that "while AI is penetrating all domains and stages of science, its full potential is far from realised." The prize, it concluded, could be enormous: "Accelerating the productivity of research could be the most economically and socially valuable of all the uses of artificial intelligence."

If AI tools manage to boost the productivity of research, the world would no doubt get the "multiplier for human ingenuity" predicted by Dr Hassabis. But AI holds more potential still: just like telescopes and microscopes let scientists see more of the world, the probabilistic, data-driven models used in AI will increasingly allow scientists to better model and understand complex systems. Fields like climate science and structural biology are already at the point where scientists know that complicated processes are happening, but researchers so far have mainly tried to understand those subjects using top-down rules, equations and simulations. AI can help scientists approach problems from the bottom up instead—measure lots of data first, and use algorithms to come up with the rules, patterns, equations and scientific understanding later.

If the past few years have seen scientists dip their toes into the shallow waters of AI, the next decade and beyond will be when they have to dive into its depths and swim towards the horizon. ■



打开引擎盖检查

中国车企在欧洲受到审视

欧盟启动反倾销调查

在慕尼黑市中心搭起的光鲜的临时展厅中陈列着宝马、奔驰和大众的最新款车型，这曾是慕尼黑车展的门面——该车展每两年举办一次，今年这一届于9月10日落幕。在几英里之外的一些展馆里，德国的造车实力却没有那么显而易见——正在打入欧洲市场的中国电动汽车在抢夺那里的眼球和展位。一大批来自东方的电动汽车做工和造型都不赖而性价比更高，引发了对它们可能压过欧洲老牌车厂的产品的担忧，欧盟的立法者已经开始有所动作。

欧盟委员会怀疑存在不公平竞争，于9月13日宣布对中国汽车公司开展“反补贴调查”。那些被认定违规的公司可能会被征收远高于目前对中国进口车10%的关税。这部分进口规模不大，但增长迅猛。今年前七个月，欧洲售出了18.9万辆中国车，占汽车总销量的2.8%。但中国产纯电动汽车占了同类车总销量的近8%，施密特汽车研究公司（Schmidt Automotive Research）估计（见图表）。纯电动汽车的销量在过去两年增长了两倍，其中极星和名爵一马当先。爱驰、比亚迪、蔚来、欧拉和小鹏等品牌也在向欧洲出口。领跑等公司也跃跃欲试。瑞银认为，到2030年，中国在欧洲汽车总销量中可能占到20%。这些车将全部都是电动车。

中国这种进展一定程度上是中国政府打造汽车制造强国的愿望促成的。随着中国经济走弱，本土电动汽车销售放缓，大量产能闲置，促使中国车企放眼海外市场。由于美国汽车市场受到更高关税的保护，补贴政策还偏向本国车厂，它们便盯上了欧洲。而且更紧凑小巧的中国车型本来也更符合欧洲人的喜好。

毫无疑问，中国车企受益于中国政府的大力支持，比如低息贷款。但要让反倾销指控能站得住脚不容易。欧洲的汽车产业长期依赖各种各样的政

府支持，发出这样的抱怨显得有些双标。更重要的是，正如瑞银指出的那样，售价低至4.5万欧元（4.8万美元）的比亚迪中档电动车海豹对欧洲竞品车型之所以有25%的成本优势，主要是因为该公司高度的垂直整合和中国低成本的供应链，而不是因为政府补贴。

对于欧盟委员会此番举动是否明智，欧洲汽车制造商的意见不一。在品牌忠诚度高的高端市场，无论有无补贴，蔚来等中国公司都不太可能挑战得了奔驰和宝马。但这次调查会激怒中国政府，危及欧洲车厂在中国的盈利。券商盛博的数据显示，德国汽车公司一半的净利润来自中国市场。相比之下，雷诺等品牌并不依赖中国，但在激烈厮杀的大众市场上面对严峻挑战，它们可能会为这步举措叫好。有了高额关税，它们可能就不必削减成本去和涌入的中国车竞争了。欧洲的购车者可能并不在意电动车便宜是否因为中国政府插了手。他们将承担损失。■



Inspecting under the bonnet

Chinese carmakers are under scrutiny in Europe

The EU launches an anti-dumping investigation

FLASHY TEMPORARY pavilions in Munich's city centre displaying the latest models from BMW, Mercedes-Benz and Volkswagen were the public face of IAA Mobility, Germany's biennial motor show, which ended on September 10th. German automotive might was less in evidence in the show halls a few miles away, where the Chinese electric vehicles (EVs) that are making inroads in Europe vied for attention and floor space. The fear of a flood of well-made, decently styled and better-value EVs from the east outcompeting those from Europe's established carmakers has now jolted the EU's lawmakers into action.

Suspecting foul play, on September 13th the European Commission announced an "anti-subsidy investigation" into Chinese car firms. Those found guilty may be hit with tariffs far above the 10% now levied on Chinese imports. These imports are small but growing fast. In the first seven months of 2023, 189,000 Chinese cars were sold in Europe, equivalent to 2.8% of all car sales. But Chinese pure battery cars made up nearly 8% of sales for this type of vehicle, reckons Schmidt Automotive Research, a consultancy (see chart). These sales have trebled in the past two years, led by Polestar and MG. Brands like Aiways, BYD, Nio, Ora and Xpeng are also on sale. Others, like Leapmotor, are poised to join them. UBS, a bank, reckons China's share of all cars sold in Europe could hit 20% by 2030. All will be electrified.

China's advance is in part a result of its government's desire to create a global force in carmaking. A slowdown in EV sales at home as the economy weakens and lots of spare capacity have encouraged Chinese producers to look abroad. With America's market protected by heftier tariffs and

subsidies favouring domestic carmakers, they are eyeing Europe instead. The more compact Chinese models are anyway more suited to European tastes.

Undoubtedly the Chinese carmakers have benefited from government largesse such as cheap loans. But making anti-dumping charges stick will be tricky. Complaints from a European industry that has long been hooked on all manner of state support look hypocritical. More important, as UBS notes, the 25% cost advantage over European rivals for the BYD Seal, a mid-market EV that will go for as little as €45,000 (\$48,000), are mostly the result of the firm's high degree of vertical integration and the low-cost Chinese supply chain, not government handouts.

Europe's carmakers are split on the wisdom of the commission's move. At the top end of the market, where brand loyalty is strong, Chinese firms like Nio are unlikely to challenge Mercedes and BMW, with or without subsidies. But by enraging the government in Beijing, the investigation endangers European companies' Chinese profits. Half of German car firms' net profits come from China, according to Bernstein, a broker. By contrast, marques such as Renault, which do not rely on China but face a daunting challenge in the cut-throat mass market, will probably cheer. Swingeing tariffs may spare them from having to cut costs to compete with a Chinese influx. European car buyers, who probably don't care if China's government had a hand in keeping down the price of EVs, will be the ones to suffer. ■



【首文】当机器人开始做科研

人工智能如何能彻底改变科学

看看历史上的先例

关于人工智能（AI）的争论往往集中在其潜在危险上——算法偏见和歧视、大规模摧毁就业岗位，甚至有人说会导致人类灭绝。然而，在一些观察家对这些反乌托邦场景感到担忧时，其他人则关注AI可能带来哪些回报。他们声称，AI可以帮助人类解决一些最重大最棘手的问题。他们并指出，AI将以一种非常明确具体的方式做到这一点，那就是从根本上加快科学发现的步伐，特别是在医学、气候科学和绿色技术等领域。德米斯·哈萨比斯（Demis Hassabis）和杨立昆（Yann LeCun）等AI领域的杰出人物相信AI可以加快科学进步，通向一个科学发现的黄金时代。他们有没有可能是对的呢？

这些说法值得探究，而且可能有助于平衡人们对大规模失业和杀手机器人的担忧。当然，之前有许多技术都曾被错误地誉为灵丹妙药。电报在1850年代被认为能够带来世界和平，飞机在1900年代也是如此。1990年代的专家说，互联网将减少不平等，并根除民族主义。但“AI能解决世界的问题”背后的机制有着更有力的历史依据，因为在历史上有那么几个时期，新方法和新工具确实推动了改变世界的一系列科学发现和创新。

在17世纪，显微镜和望远镜打开了科学发现的新视野，促使研究人员更相信自己的观察结果，而不是自古以来的普遍观念；科学期刊的问世则让他们获得了分享和推广这些发现的新途径。结果便是天文学和物理学等领域的迅速发展，以及从摆钟到蒸汽机的一系列新发明问世，而正是蒸汽机推动了工业革命。

之后，从19世纪末开始，把思想、人员和材料以产业规模汇聚在一起的研究实验室建立起来，引发了人造化肥、药品以及晶体管这种计算机的关键元件等更多创新。从20世纪中叶开始，计算机又催生了基于模拟和建模的

新式科学，从设计武器和飞机到更准确的天气预报等。

这场计算机革命可能还没有结束。AI工具和方法现在几乎被应用到每一个科学领域，尽管应用的程度差异很大，例如，2022年发表的物理学和天文学论文中有7.2%涉及AI，而兽医学中仅有1.4%。应用AI的方式多种多样。它可以识别有前景的分析对象，例如可用于研发新药的具有某种特性的分子，或具备电池或太阳能电池所需要的特征的材料。AI可以细查如粒子对撞机或程控望远镜产生的大量数据，从中寻找模式。它还可以对蛋白质的折叠和星系的形成等更复杂的系统做建模和分析。AI工具已被用来识别新的抗生素、揭示希格斯玻色子，以及识别狼嚎的地方“口音”等。

这一切都是值得欢迎的。但科学期刊和实验室曾经走得更远：它们改变了科学实践本身，通过让人员和思想以新方式和更大的规模交流联结，解锁了更强大的科学发现手段。AI也有可能引发这样的转变。

有两个领域看起来尤其具有潜力。第一个是“基于文献的知识发现”（以下简称LBD），它运用ChatGPT式的语言分析来分析现有的科学文献，以寻找人类之前可能漏掉的新假设、关联或想法。LBD已开始在识别可以尝试的新实验上显现前景——它甚至可以推荐研究的合作方。这可以激励跨学科研并促进跨领域创新。LBD系统还可以识别某个领域的“盲点”，甚至可以预测未来会有什么发现，以及谁将做出这些发现。

第二个领域是“机器人科学家”，也称为“自动驾驶实验室”。在系统生物学和材料科学等领域，这些机器人系统利用AI分析现有数据和文献，形成新的假设，然后进行数百或数千次实验来检验这些假设。与人类科学家不同，机器人没那么容易囿于先前的结果，较少受到偏见的影响，而且至关重要的一点是，机器人容易被复制出来。机器人可以扩大实验性研究的规模，发展出意想不到的理论，并探索人类研究人员可能不会考虑的途径。

因此，AI可能会改变科学实践的想法是成立的。不过主要障碍是在社会学的层面：只有人类科学家愿意并且能够使用AI工具，这一前景才可能实现。许多科学家缺乏这方面的技能和培训，有些则担心自己丢掉饭碗。所

幸，现在有了可喜的迹象。以前AI工具都靠AI研究人员推广，而现在其他领域内的专家正在积极尝试它们。

政府和资助机构可以起到推动作用。它们可以敦促更多地使用通用标准，方便AI系统交换和解释实验室结果和其他数据。它们还可以提供更多资金，推动AI智能与实验室机器人的融合，以及发展更多的AI形式——目前私营部门几乎把所有筹码都押在了ChatGPT等基于语言的系统上。基于模型的机器学习等不那么时髦的AI可能更适用于形成假设等科研任务。

在处于科学飞速发展期的1665年，博学的英国人罗伯特·胡克（Robert Hooke）把显微镜和望远镜等新科学仪器的出现比喻为“在自然器官之外加上了人造器官”。这些仪器让研究人员得以探索从前无法涉足的领域，并以新的方式获得新发现，“对各门有用的知识都大有裨益”。对于胡克在今天的后辈科学家们来说，将AI加到科研工具包中有望在未来几年发挥同样的作用，并产生类似的改变世界的结果。 ■



When robots do research

How artificial intelligence can revolutionise science

Consider the historical precedents

DEBATE ABOUT artificial intelligence (AI) tends to focus on its potential dangers: algorithmic bias and discrimination, the mass destruction of jobs and even, some say, the extinction of humanity. As some observers fret about these dystopian scenarios, however, others are focusing on the potential rewards. AI could, they claim, help humanity solve some of its biggest and thorniest problems. And, they say, AI will do this in a very specific way: by radically accelerating the pace of scientific discovery, especially in areas such as medicine, climate science and green technology. Luminaries in the field such as Demis Hassabis and Yann LeCun believe that AI can turbocharge scientific progress and lead to a golden age of discovery. Could they be right?

Such claims are worth examining, and may provide a useful counterbalance to fears about large-scale unemployment and killer robots. Many previous technologies have, of course, been falsely hailed as panaceas. The electric telegraph was lauded in the 1850s as a herald of world peace, as were aircraft in the 1900s; pundits in the 1990s said the internet would reduce inequality and eradicate nationalism. But the mechanism by which AI will supposedly solve the world's problems has a stronger historical basis, because there have been several periods in history when new approaches and new tools did indeed help bring about bursts of world-changing scientific discovery and innovation.

In the 17th century microscopes and telescopes opened up new vistas of discovery and encouraged researchers to favour their own observations over the received wisdom of antiquity, while the introduction of scientific

journals gave them new ways to share and publicise their findings. The result was rapid progress in astronomy, physics and other fields, and new inventions from the pendulum clock to the steam engine—the prime mover of the Industrial Revolution.

Then, starting in the late 19th century, the establishment of research laboratories, which brought together ideas, people and materials on an industrial scale, gave rise to further innovations such as artificial fertiliser, pharmaceuticals and the transistor, the building block of the computer. From the mid-20th century, computers in turn enabled new forms of science based on simulation and modelling, from the design of weapons and aircraft to more accurate weather forecasting.

And the computer revolution may not be finished yet. AI tools and techniques are now being applied in almost every field of science, though the degree of adoption varies widely: 7.2% of physics and astronomy papers published in 2022 involved AI, for example, compared with 1.4% in veterinary science. AI is being employed in many ways. It can identify promising candidates for analysis, such as molecules with particular properties in drug discovery, or materials with the characteristics needed in batteries or solar cells. It can sift through piles of data such as those produced by particle colliders or robotic telescopes, looking for patterns. And AI can model and analyse even more complex systems, such as the folding of proteins and the formation of galaxies. AI tools have been used to identify new antibiotics, reveal the Higgs boson and spot regional accents in wolves, among other things.

All this is to be welcomed. But the journal and the laboratory went further still: they altered scientific practice itself and unlocked more powerful means of making discoveries, by allowing people and ideas to mingle in new ways and on a larger scale. AI, too, has the potential to set off such a transformation.

Two areas in particular look promising. The first is “literature-based discovery” (LBD), which involves analysing existing scientific literature, using ChatGPT-style language analysis, to look for new hypotheses, connections or ideas that humans may have missed. LBD is showing promise in identifying new experiments to try—and even suggesting potential research collaborators. This could stimulate interdisciplinary work and foster innovation at the boundaries between fields. LBD systems can also identify “blind spots” in a given field, and even predict future discoveries and who will make them.

The second area is “robot scientists”, also known as “self-driving labs”. These are robotic systems that use AI to form new hypotheses, based on analysis of existing data and literature, and then test those hypotheses by performing hundreds or thousands of experiments, in fields including systems biology and materials science. Unlike human scientists, robots are less attached to previous results, less driven by bias—and, crucially, easy to replicate. They could scale up experimental research, develop unexpected theories and explore avenues that human investigators might not have considered.

The idea that AI might transform scientific practice is therefore feasible. But the main barrier is sociological: it can happen only if human scientists are willing and able to use such tools. Many lack skills and training; some worry about being put out of a job. Fortunately, there are hopeful signs. AI tools are now moving from being pushed by AI researchers to being embraced by specialists in other fields.

Governments and funding bodies could help by pressing for greater use of common standards to allow AI systems to exchange and interpret laboratory results and other data. They could also fund more research into the integration of AI smarts with laboratory robotics, and into forms of AI beyond those being pursued in the private sector, which has bet nearly all its chips on language-based systems like ChatGPT. Less fashionable forms of

AI, such as model-based machine learning, may be better suited to scientific tasks such as forming hypotheses.

In 1665, during a period of rapid scientific progress, Robert Hooke, an English polymath, described the advent of new scientific instruments such as the microscope and telescope as “the adding of artificial organs to the natural”. They let researchers explore previously inaccessible realms and discover things in new ways, “with prodigious benefit to all sorts of useful knowledge”. For Hooke’s modern-day successors, the adding of artificial intelligence to the scientific toolkit is poised to do the same in the coming years—with similarly world-changing results. ■



交换大队

两轮电动车在亚洲大行其道

跨境合作希望让换电成为主流

在亚洲那些交通拥堵的城市里，各种小车子的引擎和喇叭发出的刺耳声音是最常见的噪音之一。很快，这种标志性的引擎轰鸣声可能就会成为过去，即便喇叭声可能依旧会响起。电动两轮和三轮车及其充电设施的一轮跨境扩张潮正在亚洲各地激起涟漪。

在中低收入国家，踏板车、摩托车和机动三轮车的电动化进程要比汽车顺畅得多。在中国这个全球最大的电动车市场，2021年所售出的两轮和三轮机动车约有一半是以电池为动力的，而在新售出的汽车中只有16%。在印度、印度尼西亚、菲律宾和越南，两轮车数量是汽车的三倍到三十倍不等，两轮车的电动化可以帮助它们脱碳，控制城市里的空气污染。

这让近来的一系列交易成为可喜的进展。9月6日，印尼的GoTo Group宣布与越南公司Selex Motors达成一项交易，后者制造电动两轮车并经营着号称“电池ATM”的网络。GoTo的网约车部门Gojek将在越南使用Selex的电动两轮车和充电基础设施。当电动车电量不足时，骑手可以在换电站用满格电池换掉耗尽的电池。8月底，台湾大型摩托车制造商光阳宣布与泰国国有能源公司PTT达成一项交易，生产新型电动两轮车并提供配套的换电池服务。差不多同一时间，另一家台湾公司Gogoro宣布与菲律宾企业集团Ayala组建了一家合资企业。这将进一步扩大Gogoro的换电网络，该公司称这已经是世界最大的一个换电网络，有超过12,000个电池交换机柜，每个有八到十块电池，分布在台湾的2500多个地点。

最大的商机在印度，那里的电动两轮车市场正飞速发展。尽管一些电动车购置补贴在5月逐步取消，但在这个全球人口最多的国家，电动两轮和三轮车的销量在今年前八个月达到550万辆，比去年同期增长了53%。今年，Gogoro已宣布了两笔交易，与印度外卖配送公司Swiggy和Zomato达

成了电池更换和电动踏板车技术方面的合作。Gogoro还和马哈拉施特拉邦（有1.26亿人口，以及印度商业中心孟买）政府签订了协议，承诺将在八年里投资15亿美元，双方很“谦虚”地称之为“超巨型项目”。

尽管包括中国的蔚来在内的一些汽车制造商正在尝试换电服务，但这种模式在更小车辆上的商业可行性是最明确的。鉴于没几个亚洲国家有足够的财力提供大规模补贴去推广电动车，卖家和买家都要算一算经济账。所幸，这笔账算下来是划算的。理特咨询公司（Arthur D. Little）今年早些时候发布的研究发现，在总体拥有成本上（车辆整个生命周期中平均每公里的用车成本），能更换电池的两轮和三轮电动车低于燃油或只能充电的同类车辆。

这并不是说能换电池的电动两轮车将在一夜之间充斥大街小巷。建设换电网络需要大量资本支出，除非人们购买适配的电动车，否则很难证明这笔支出的合理性。而如果没有既有的换电站网络，人们又不太可能去购买电动车。解决这个先有鸡还是先有蛋的问题在台湾比较容易些，那里人口密集且相对富裕，而印度地域广阔又更贫穷。要避免不必要的基础设施重复建设，还必须实现电池规格标准化。电动车公司抱怨说，印度官方意在提供激励和确定性的换电政策似乎被堵在哪里了。就像在印度的道路上一样，再怎么按喇叭也不可能前进得快一点。 ■



Swap teams

Electric two-wheelers are creating a buzz in Asia

Cross-border tie-ups hope to make battery-swapping mainstream

THE CACOPHONY of small-vehicle engines and horns is one of the most recognisable noises in traffic-choked cities across Asia. Soon that trademark roar may be a thing of the past, even if the horns remain. A wave of cross-border ventures for electric two- and three-wheelers, and the infrastructure required to power them, is rippling across the continent.

The electrification of scooters, motorcycles and auto-rickshaws in poor and middle-income countries is proceeding much more zippily than for larger motors. In China, the biggest market in the world for electric vehicles, about half of two- and three-wheeled machines sold were battery-powered in 2021, compared with 16% of new passenger cars. In India, Indonesia, the Philippines and Vietnam, where two-wheelers outnumber cars by between three and 30 to one, electrifying them can help countries decarbonise and limit air pollution in cities.

That makes the recent flurry of dealmaking a welcome development. On September 6th GoTo Group of Indonesia announced a deal with Selex Motors, a Vietnamese producer of electric bikes and networks of so-called “battery ATMs”. Gojek, GoTo’s ride-hailing arm, will use Selex’s bikes and charging infrastructure in Vietnam. When its electric vehicles run out of juice, drivers can exchange the removable units for fully charged ones at swap stations. In late August Kymco, a large motorcycle-maker from Taiwan, announced a deal with a Thai state-owned energy firm, PTT, to produce new electric two-wheelers and the battery-swapping services to go with them. Around the same time another Taiwanese company, Gogoro, finalised a joint venture with Ayala, a Philippine conglomerate. This would expand

what Gogoro claims is already the largest single battery-swapping network in the world, with more than 12,000 racks, carrying between eight and ten batteries apiece, across more than 2,500 locations in Taiwan.

The biggest prize is India, where the market for electric motorcycles is booming. Despite the phase-out in May of some subsidies for the purchase of e-motorbikes, sales of battery-powered two- and three-wheelers in the world's most populous country reached 5.5m in the first eight months of 2023, a rise of 53% compared with the same period in 2022. This year Gogoro has already announced two deals with Indian food-delivery companies, Swiggy and Zomato, for battery-swapping and scooter technology. The company also signed an agreement with the government of the state of Maharashtra, home to 126m people and to India's commercial capital, Mumbai, promising to invest \$1.5bn over eight years in what the two sides are humbly calling the "Ultra Mega Project".

Although some carmakers, such as Nio of China, are experimenting with battery-swapping, the case for it is most clear-cut for smaller rides. Given that few Asian countries have the deep pockets to encourage adoption of electric vehicles with generous subsidies, sellers and buyers alike need the economics to work. Fortunately, the numbers add up. Research published earlier this year by Arthur D. Little, a consultancy, found that total cost of ownership, which measures how much motorists pay for every mile driven over a vehicle's lifetime, is lower for two- and three-wheelers with a battery-swapping arrangement than for similar vehicles which are petrol-fuelled or home-charged.

That is not to say that e-motorcycles with interchangeable batteries will become ubiquitous overnight. Building battery-swapping networks requires a lot of capital spending, which is hard to justify unless people buy the compatible vehicles. And people are unlikely to make such purchases unless they have access to an existing network of charging stations. Solving

this chicken-and-egg problem is easier in Taiwan, a densely populated and relatively wealthy nation, than in India, a poor and vast one. Standardisation of battery types will be necessary, too, if needless duplication of infrastructure is to be avoided. EV firms grumble that India's official battery-swapping policy, which would provide incentives and certainty, seems to be stuck. And as on India's streets, no amount of honking is likely to speed things along. ■



扛住子弹

来认识一下世界上最经久不衰的产品

皇家恩菲尔德子弹摩托车在它91年的历史中几乎没变过样

公司可能基业长青，但它们的产品往往昙花一现。苹果可能是市值最高的企业，不过，最初为它的成功奠定了基础的Apple II电脑和最早的Mac电脑即便还在，也只能在博物馆里才能找到了。苹果在智能手机上的竞争对手三星靠卖面条起家。福特最新款的F-150“闪电”电动皮卡除了四个轮子外，与T型车几乎没有共同之处。在一个技术、商业模式和消费者喜好不断变化的世界里，“没坏就别修”这句格言没什么分量。

除非——你是皇家恩菲尔德（Royal Enfield）。1932年，这家当时设在英国的摩托车制造商推出了“子弹”（Bullet）。91年后，这家自1994年起由印度人接手的公司推出了这款经典两轮摩托的最新款。它看起来和最初的车型几乎一模一样。

该公司坚称，发动机（据称马力只有原来的三分之二）、底盘和座椅都做了改动。但是，除了少了一个脚踏启动器（引发了一些粉丝的抱怨）、多了一个燃油表（没有引起任何评论）之外，所有改变都不明显。21世纪其他摩托车的常见装置它都没有，比如转速表或温度表，更不用说针对各种用车场景的计算机辅助驾驶模式。正如一位Youtube博主所说的那样，骑上它的感觉，还有“动听的哇嗒嗒的排气声浪”，可能与上世纪30年代差不多。

这让子弹有实力竞逐最持久不变的未停产机动车的名号，以及跻身有史以来最恒久不变的产品（AK-47步枪问世才不过75年）。在印度，它也是一种商业和文化现象。它的销量仍然超过了皇家恩菲尔德的大多数其他产品，包括设计更现代的产品。今年6月，它的一款较早车型售出了8000多辆。印度道路上的子弹摩托车总数很难估计，但几乎可以肯定有几百万辆。而且很少有东西能受到同样程度的喜爱——不仅仅是受印度摩托迷的

喜爱。

印度至少有1200个铁粉骑行俱乐部。锈迹斑斑的老爷摩托缓缓驶过旁遮普的田野，越过拉达克危险的山坡，在城市的街道上躲避奶牛和汽车。它是宝莱坞英雄和反派们不可或缺的装备。1949年，印度军队订购了500辆两轮摩托车，用于在该国北部边境巡逻，首次在印度引发了子弹狂潮。现在，印度军队里有一个专门骑着子弹表演的特技队。2017年，这支名为“龙卷风”的队伍完成了用一辆摩托车搭载58人的壮举。

所有这些，加上这些机器似乎永远不会过期，而且几乎可以在任何地方由任何人修理，构成了子弹经久不衰的原因。对于许多几乎无法想象拥有住房甚至汽车的印度人来说，子弹既让人梦寐以求，而它每辆2400美元的售价咬咬牙又能买得起。有了这样恒久不变的吸引力，谁还需要改变？■



Biding the Bullet

Meet the world's most enduring product

The Royal Enfield Bullet has barely changed in its 91 years

COMPANIES CAN survive for aeons, but their products are usually ephemeral. Apple may be the world's most valuable business, yet the Apple II computer and the original Mac that provided the early foundation of its success live in museums, if at all. Apple's smartphone rival, Samsung, began by selling noodles. Ford's latest F-150 Lightning electric pickup truck shares little with the Model T except for four wheels. The dictum “If it ain’t broke, don’t fix it” carries little weight in a world of evolving technologies, business models and consumer tastes.

Unless, that is, you are Royal Enfield. In 1932 the motorcycle-maker, then based in Britain, launched the Bullet. Ninety-one years later the company, in Indian hands since 1994, has unveiled the latest version of the iconic two-wheeler. It looks virtually identical to the original.

Changes have, the company insists, been made to the engine (which boasts just two-thirds of the original’s horsepower), the chassis and the seat. Yet besides a missing kick-start (which has provoked some grumbling from fans) and an added fuel gauge (which has elicited no comments), these are unnoticeable. Features common on other 21st-century motorbikes, like tachometers or temperature gauges—to say nothing of computer-assisted ride modes for different conditions—are absent. The ride and, as one YouTuber put it, “the sweet crunch sound of exhaust”, are probably much the same as they would have been in the 1930s.

That gives the Bullet a strong claim to being the most unchanging vehicle in continuous production—and among the most immutable products ever

manufactured (the AK-47 rifle has been around for a mere 75 years). It is also, in India, a commercial and cultural phenomenon. It still outsells most of Royal Enfield's other offerings, including more modern designs. More than 8,000 of an earlier version were sold in June. The total number on India's roads is hard to gauge but is almost certainly in the millions. And few items elicit the same degree of affection—not just from the country's motorcycle enthusiasts.

There are at least 1,200 devoted riding clubs. Specimens covered by a rusty patina can be seen chugging through fields in Punjab, over dangerous mountain slopes in Ladakh, and avoiding cows and cars on city streets. It is an indispensable piece of equipment for Bollywood heroes and villains alike. The Indian armed forces, which first sparked the Indian Bullet craze with an order of 500 two-wheelers in 1949 to patrol the country's northern border, has a stunt team who ride exclusively on Bullets. In 2017 the Tornadoes, as the squad is called, performed a feat of carrying 58 people on a single motorcycle.

All this, plus the fact that the machines never seem to expire and can be fixed anywhere by just about anyone, explains the Bullet's enduring popularity. For many Indians who can hardly imagine owning a home or even a car, the Bullet is at once aspirational and, at \$2,400 a pop, just about obtainable. With such unchanging appeal, who needs change? ■



自由交流

中国也将步入“失去的十年”吗？

习手里有避免中国经济重蹈日本覆辙的工具。他应该使用它们

野村综合研究所（Nomura Research Institute）的辜朝明在近期一次演讲中说：“自从中国房地产泡沫破灭以来，我接到了大量来自中国的媒体人、经济学家、投资者的电话，有时还有政策制定者。他们问我，‘我们是不是要走日本的老路了？’”

问辜朝明是有道理的：他毕生都在研究金融过度的后果。1991年，美国经济在第一次海湾战争后复苏乏力，他当时在纽约联储的上司爱德华·弗赖德尔（Edward Frydl）开始担心债务和商业地产积压的问题。弗莱德尔认为，这在“企业和消费者中推动了一种普遍的金融和经济保守主义”。信贷需求受抑制，因为企业“把力气转向了资产负债表重组”。辜朝明创造了“资产负债表衰退”一词来描述这些压力。

辜朝明后来意识到，日本那会儿也在遭遇同样的积压问题，不过要严重得多。1989年日本股市泡沫破灭后，股价在不到三年里暴跌了60%。东京的房价连续下跌了十多年。以某些指标衡量，通缩持续的时间还要更久。就连高尔夫俱乐部会员资格（可以在日本有组织的交易所里交易）的价格都暴跌了94%。许多举债购入房地产或入股其他公司的企业发现自己已经资不抵债，严格来说已经破产。不过它们仍然维持流动性，赚取足够多的收入来偿还存量债务。在生存受威胁之际，用辜朝明的话讲，它们转而致力于债务最小化而非利润最大化。

在一个健康的经济中，企业利用由家庭和其他储户提供的资金，把这些钱投入扩大业务。在后泡沫时代的日本则不然。企业部门不再忙着融资，而开始偿债和积累自己的债权。该部门传统上的财务赤字变成了长期的财务盈余。企业的这种自我抑制抽走了经济中亟需的需求和创业活力，把经济推入了十年乃至二十年的长期通缩。

所以中国是要步日本的后尘了吗？中国企业积累的债务相对于GDP规模而言甚至比泡沫时代的日本企业还要多。中国的房价已经开始下跌，损害了家庭和房地产公司的资产负债表。即便下调了利率，信贷增长仍大幅放缓。而资金流量统计显示近年中国企业的财务赤字有所收窄。辜朝明判断中国已经陷入资产负债表衰退。再加上人口衰减以及一个敌对的美国，人们很容易感到忧虑沮丧。或许能成为日本已经是最好的情况了。

但若仔细观察，会发现情况并没有那么确定。中国企业的大部分债务是国有企业欠下的，而如果中国的政策制定者有要求，国企将在国有银行的支持下继续借贷和支出。民营企业中，债务主要集中在房地产开发商的账上。它们正在减少负债并削减对新住房项目的投资。但是，面对房价下跌和房屋销售疲软，即便是资产负债表稳健的开发商也会同样这么做。

中国一轮房地产繁荣的终结减少了家庭财富。这想来会导致家庭在支出时趋于保守。近几个月来家庭提前还贷也是事实，是导致信贷增长大幅放缓的一个原因。但调查显示家庭负债相对于资产处于低水平。家庭提前还房贷是对利率变化做出的理性反应，而非资产负债表承压的迹象。当中国下调利率时，家庭并不能轻松地以新的较低的利率为其抵押贷款再融资。因此，它们偿还已经签定的相对昂贵的房贷是有道理的，即使这意味着赎回目前回报较低的投资。

那么，由中国的资金流量统计揭示的企业部门转向财务盈余的行为转变又如何呢？美国银行（BOA）的皮晓晴（Xiaoqing Pi，音译）和她的同事指出，这种赤字收窄主要是由官方对影子银行的打击行动驱动的。若不计入金融机构，企业部门仍在从经济的其他部分寻求资金。中国企业并没有群体性地从利润最大化转向债务最小化，而这种自我挫败式的转变导致日本陷入了通缩的十年。

这些差异表明，中国尚未陷入日本式衰退。而且辜本人也很乐于强调两国间存在一个“巨大”不同。当日本陷入资产负债表衰退时，在日本没有人对这一问题有现成的命名，对于该如何对付它也毫无头绪。而今天，他说，许多中国经济学家都在研究他的理念。

他开出的处方简单明了。如果家庭和企业即使在低利率下也不借贷和支出，那么就只能由政府来做这件事。政府的财政赤字必须抵消私营部门的财务盈余，直到私营部门的资产负债表彻底修复完毕。辜打趣说，如果中国最高领导人习近平获得正确的建议，他可以在20分钟内就解决问题。

可惜，中国官员迄今反应迟缓。该国的预算赤字（广义上包括各种地方政府借款）今年有所收缩，加剧了经济下滑。中央政府有增加借款的空间，但似乎不大愿意这样做，而宁可有备无患。这是错误的。如果政府支出得晚，很可能要支出更多。中国面对滑入长期衰退的风险并不是因为私营部门决心清理自己的财务，而是因为中央政府不愿把自己的资产负债表变得足够“脏乱”，这多少有些让人啼笑皆非。 ■



Free exchange

Does China face a lost decade?

Xi Jinping has the tools to escape Japan's fate. He should use them

“EVER SINCE the Chinese housing bubble burst,” said Richard Koo of the Nomura Research Institute in a recent talk, “I’ve been getting tons of calls from Chinese journalists, economists, investors and sometimes policymakers asking me, ‘Are we going the way of Japan?’”

Mr Koo is a good person to ask: he has devoted his career to studying the aftermath of financial excess. When the American economy’s recovery from the first Gulf war faltered in 1991, his then boss at the New York Federal Reserve, Edward Frydl, began to worry about an overhang of debt and commercial property. This was “feeding a pervasive financial and economic conservatism among businesses and consumers”, Frydl argued. Demand for credit was subdued, because firms were “directing their efforts towards balance-sheet restructuring”. To describe these strains, he coined the term “balance-sheet recession”.

Mr Koo later realised that Japan was suffering from the same overhangs, only far worse. After its stockmarket bubble burst in 1989, share prices plunged by 60% in less than three years. Property prices in Tokyo fell for over a decade. Deflation, by some measures, persisted even longer. Even the price of golf-club memberships—tradable on organised exchanges in Japan—tumbled by 94%. Many companies, which had borrowed to buy property or shares in other firms, found themselves technically insolvent, with assets worth less than liabilities. But they remained liquid, earning enough revenue to meet ongoing obligations. With survival at stake, they redirected their efforts from maximising profit to minimising debt, as Mr Koo put it.

In a healthy economy, corporations use funds provided by households and other savers, ploughing the money into expanding their businesses. In post-bubble Japan, things looked different. Instead of raising funds, the corporate sector began to repay debts and accumulate financial claims of its own. Its traditional financial deficit turned to a chronic financial surplus. Corporate inhibition robbed the economy of much-needed demand and entrepreneurial vigour, condemning it to a deflationary decade or two.

So is China going the way of Japan? Chinese enterprises have accumulated even more debt, relative to the size of the country's GDP, than Japan's did in its bubble era. China's house prices have begun to fall, damaging the balance-sheets of households and property firms. Credit growth has slowed sharply, despite cuts in interest rates. And flow-of-funds statistics show a narrowing in the financial deficit of China's corporations in recent years. In Mr Koo's judgment, China is already in a balance-sheet recession. Add to that a declining population and a hostile America and it is easy to be gloomy. Perhaps Japan is a best-case scenario.

Look closer, though, and the case is less conclusive. Much of the debt incurred by China's corporations is owed by state-owned enterprises that will continue to borrow and spend, with the support of state-owned banks, if required by China's policymakers. Among private enterprises, debt is concentrated on the books of property developers. They are reducing their liabilities and cutting back on investment in new housing projects. But in the face of falling property prices and weak housing sales, even developers with robust balance-sheets would be doing the same.

The end of China's property boom has made households less wealthy. This is presumably breeding conservatism in their spending. It is also true that households have repaid mortgages early in recent months, contributing to the sharp slowdown in credit growth. But surveys show that households' debts are low relative to their assets. Their mortgage prepayments are a

rational response to changing interest rates, not a sign of balance-sheet stress. When interest rates fall in China, households cannot easily refinance their mortgages at the lower rates. It therefore makes sense for them to repay old, relatively expensive mortgages, even if that means redeeming investments that now offer lower yields.

What about the switch in corporate behaviour revealed by China's flow-of-funds statistics, which show the corporate sector moving to a financial surplus? This narrowing is largely driven by the crackdown on shadow banks, point out Xiaoqing Pi and her colleagues at Bank of America. When financial institutions are excluded, the corporate sector is still demanding funds from the rest of the economy. Chinese businesses have not made the collectively self-defeating switch from maximising profits to minimising debts that condemned Japan to a deflationary decade.

These differences show that China is not yet in a recession akin to Japan's. And Mr Koo is himself keen to emphasise one "huge" difference between the two countries. When Japan was falling into a balance-sheet recession, nobody in the country had a name for the problem or an idea of how to fight it. Today, he says, many Chinese economists are studying his ideas.

His prescription is straightforward. If households and firms will not borrow and spend even at low interest rates, then the government will have to do so instead. Fiscal deficits must offset the financial surpluses of the private sector until their balance-sheets are fully repaired. If Xi Jinping, China's ruler, gets the right advice, he can fix the problem in 20 minutes, Mr Koo has quipped.

Unfortunately, Chinese officials have so far been slow to react. The country's budget deficit, broadly defined to include various kinds of local-government borrowing, has tightened this year, worsening the downturn. The central government has room to borrow more, but seems reluctant to

do so, preferring to keep its powder dry. This is a mistake. If the government spends late, it will probably have to spend more. It is ironic that China risks slipping into a prolonged recession not because the private sector is intent on cleaning up its finances, but because the central government is unwilling to get its own balance-sheet dirty enough. ■



疫苗

西蒙·沙马的《异物》追述了疫苗的历史

从天花到新冠肺炎，一本新书讲述了疫苗普及的精彩故事【《异物》书评】

《异物》，西蒙·沙马著。Ecco出版社，480页，32.99美元。西蒙与舒斯特出版公司，30英镑。

第一支有记录的疫苗是由英国医生爱德华·詹纳（Edward Jenner）于1796年给八岁男孩詹姆斯·菲普斯（James Phipps）接种的天花疫苗。詹纳（如图）从一名感染了牛痘的挤奶女工的脓包中提取了脓液，接种到菲普斯身上，以预防牛痘和天花。

在詹纳开始疫苗实验之前的一千多年里，人们就一直知道人在感染疾病后会产生免疫。但是，通过有意感染来防止以后得病的想法虽然由来已久，但它在全世界传播并被广泛接受所用的时间之久令人惊讶。

在《异物》（Foreign Bodies）一书中，英国历史学家西蒙·沙马（Simon Schama）讲述了一部关于预防接种的包罗万象的社会史，在这一系列保护人们防范疾病的方法中最终出现了疫苗。在追踪这种方法传播的过程中，沙马的目光从中国一直扫视到殖民时代的欧洲。他聚焦于一些湮没在历史中的人物，其中包括一位希腊妇女，她是最早的也是最富成果的公共卫生工作者之一，她亲手为4000多人接种了疫苗，并且没有造成任何不良反应。这一路上，读者会遇见疫苗最常见的旅伴：怀疑。

沙马以法国哲学家、作家、以笔名伏尔泰更广为人知的弗朗索瓦-马里·阿鲁埃（François-Marie Arouet）的故事作开篇。伏尔泰于1723年患上天花，在高烧不退时喝了200品脱柠檬水，希望“推动异物通过破损皮肤的表面排出”。他还放血并几次催吐。“伏尔泰竟奇迹般地活了下来。”沙马写道。

当伏尔泰在法国备受病痛折磨时，中国朝廷已将种痘防天花定为国家制

度。在中国，造成轻微感染的首选方法是吹鼻种痘法，即把阴干研细的痘痂吹入儿童和成人的鼻子中（这种方法被证实有效）。也可以用针划破皮肤，然后取天花脓液涂抹伤口。然而欧洲的贵族对此心存怀疑，认为东方已经“堕落迷信到无可救药了”。

后来的疫苗接种人员继续遭受质疑。俄罗斯细菌学家瓦尔德马·哈夫金（Waldemar Haffkine）1893年至1915年间在印度工作，他是公共卫生史上的英雄人物，但迄今声名不显。哈夫金发明了从霍乱到黑死病等多种疾病的疫苗，并为很多人接种。他先拿疫苗在自己身上做实验，以在接种对象心中建立信任。

然而要说服政府官员为大规模接种拨款可谓一场苦战——哈夫金认为需要这样广泛的行动来保护民众免于疾病暴发的灾难性后果。他在精英阶层中也不受欢迎，印度总督寇松勋爵（Lord Curzon）指责他在一轮疫苗接种运动中导致旁遮普省的多名村民死亡。寇松随后要求绞死哈夫金。这位微生物学家虽然最终没有被执行死刑，但他的职业生涯也走到了头。

如今，对疫苗和疫苗接种工作者的新一轮疑惧暴发。在新冠肺炎疫情期间担任美国国家过敏和传染病研究所（National Institute of Allergy and Infectious Diseases）所长、也是新冠疫苗接种首席推动者的安东尼·福奇（Anthony Fauci）已经成了许多美国人憎恨的对象。

沙马写道，现代人对疫苗的怀疑接近“高热”。阴谋论者大肆宣扬疫苗接种人员想要通过接种在人体内植入微芯片，这样科技亿万富翁比尔·盖茨就能追踪他们的行踪（对于他为什么会想要这样做语焉不详。）一些反疫苗人士整个排斥科学，另一些则是反对强制接种。这两派都为民粹主义政客提供了拉拢人心的口号。例如佛罗里达州州长、获得共和党2024年总统候选人提名的罗恩·德桑蒂斯（Ron DeSantis）就怒斥企业强制要求员工接种，并放危言要人们警惕出现一个“生物医学安全国家”。

在沙马看来，疫苗的历史就是在医学进步和心存怀疑的公众的抵制之间不断地来回拉扯——“来之不易并经严格检验的真理……总是看似即将超越错

误认知，这时它令人振奋的前进步伐却被投掷而来的义愤阻绊。”■



Vaccines

Simon Schama's "Foreign Bodies" tracks the history of vaccines

From smallpox to covid-19, a new book offers a fascinating story of vaccines' spread

Foreign Bodies. By Simon Schama. Ecco; 480 pages; \$32.99. Simon & Schuster; £30

THE FIRST recorded vaccine—for smallpox—was administered by Edward Jenner, an English doctor, in 1796 to an eight-year-old boy, James Phipps. Jenner (pictured) took fluid from the lesions of a dairymaid who had become infected with cowpox and used it to inoculate Phipps against cowpox and smallpox.

That people could become immune to diseases after being exposed to them had been known for more than a thousand years before Jenner carried out his experiments. But the idea that people could be purposely infected as a way to ward off future illness, though ancient, took a surprisingly long time to spread and become accepted around the world.

In "Foreign Bodies", Simon Schama, a British historian, lays out a sweeping social history of inoculation, a range of methods used to protect people against disease that would eventually include vaccination. In tracing the transmission of this idea, Mr Schama's gaze moves from China to colonial Europe. He highlights forgotten characters, including a Greek woman who was one of the earliest and most prolific public-health servants, inoculating more than 4,000 patients herself and causing no ill effects. Along the way, readers meet vaccination's most regular travelling companion—distrust.

Mr Schama opens his book with the story of François-Marie Arouet, the French philosopher and writer better known as Voltaire, who suffered from smallpox in 1723. As he burned with fever, he drank 200 pints of lemonade

in the hope of “encouraging the coursing of foreign matter towards evacuation through the broken surface of the skin.” He also performed bleeds and several emetic purges. “The wonder is that Voltaire survived,” Mr Schama writes.

While Voltaire suffered in France, the authorities in China had already made inoculation against smallpox a state policy. The preferred way to create a mild infection there was insufflation: blowing dried pus into the noses of children and adults (which works). Inoculation could also be carried out by scratching the skin with a needle and introducing pus into the resulting wound. The nobility of Europe, however, were suspicious, believing that the Orient was “hopelessly mired in decadence and superstition”.

Suspiciousness continued to be directed at later vaccinators, too. Waldemar Haffkine, a Russian bacteriologist working in India from 1893 to 1915, emerges as a heroic and hitherto uncelebrated figure in the history of public health. Haffkine created and administered a range of vaccines against everything from cholera to the bubonic plague. He first tested them on himself in order to build up trust with those he intended to vaccinate later.

Nevertheless, it was a battle to persuade government officials to fund the mass-vaccination campaign that Haffkine thought was needed to protect the population from devastating disease outbreaks. He was also unpopular among the elite, with Lord Curzon, viceroy of India, blaming him for the deaths of Punjabi villagers during a vaccination campaign. Lord Curzon subsequently called for Haffkine to be hanged; the microbiologist was not killed, but his career was over.

Today paranoia about vaccines and vaccinators is experiencing yet another outbreak. Anthony Fauci, who formerly served during the covid-19 pandemic as America’s vaccinator-in-chief and as director of the National Institute of Allergy and Infectious Diseases, has become a hate figure for

many Americans.

Modern suspicions verge on the “feverish”, Mr Schama writes. Conspiracy theorists froth that vaccinators want to puncture people’s skin to pump in tiny microchips, so that Bill Gates, a tech billionaire, can track them. (Why he would want to is unclear.) Some anti-vaxxers simply reject science; others object to making jabs mandatory. Both tendencies have spawned rallying cries for populist politicians. For example, Ron DeSantis, the governor of Florida and a candidate for the Republican nomination for president in 2024, has railed against businesses forcing people to get vaccinated and warns darkly of a “biomedical security state”.

Mr Schama sees the history of vaccines as constantly pulled between medical advances and backlash from a sceptical public: “Hard-earned, exhaustively tested truth...always seems on the verge of overtaking error, when its exhilarating progress is sandbagged by indignation.” ■



巴托比

i人拓展人脉指南

让结识陌生人这件事稍微不那么可怕一些

职场生活中总有一些令人坐立不安的时刻。向老板报告坏消息；面对一排面试官；在大会上做报告。但如果你是一个内向的人，没有什么比社交建人脉更糟糕了。

你参加一个活动，到场后发现每个人好像都已互相认识。定睛看看，你认出了和自己同病相怜的人。居然有人认真在看会议简介。他们在手机上起劲地查看邮件，在办公室时可从没这样过。他们不停在会场里兜圈，就像大海里漂流的塑料碎片，期待着被什么拦下来。当音响师还在调试话筒时，他们就已经在主会场找位置坐了下来。

幸运的是，你可以找到一些关于与陌生人聊天破冰的建议。不幸的是，这些建议都糟透了。一个大聪明建议在排队时与人搭话，因为排队时会更容易与站在前面和后面的人攀谈。所以你要在自动扶梯上、厕所里和排队领取胸牌时突袭别人。在排队拿咖啡时，只要说出令人费解的六字真言便可以打开通往新工作和销售单之门：“开会前提提神？”

这还没完。不要害怕笑出声，因为没有什么比吃吃笑个不停更能消除房间里的紧张气氛了。在交谈中透露一些个人信息，以免别人误以为你参加这个财资管理软件的会议只是为了商业利益。记得称呼对方的名字两次，这样才能显得你全情投入。谈话结束后要做笔记，方便日后跟进。

把这些招数加在一起，你就有了成功的秘诀：

“开会前提提神？”

“什么？”

“开会前提提神？”

“我没听懂。”

(瞄一眼胸牌) “基思，是吗？”

“呃，是的。”

(笑) “我的孩子要出生了，基思。”

“也叫基思？”

(掏出笔记本)

如果这就是人脉拓展之道，难怪人们早早就去主会场坐下了。

在领英这样的网站上与人接触要轻松得多。毕竟那里不需要眼神交流，还有既定的规则可循。而且那些添加好友请求似乎确实都有助于职业发展。领英的卡西克·拉杰库马尔 (Karthik Rajkumar) 和来自学术界的共同作者去年发表了一篇论文，为支持开展各种人际交往的观点找到了经验性证据——那就是联系不太频繁、较疏远的关系（或者称为“弱关系”）能够为你带来新的信息，因此它比紧密的关系更加有用。

研究人员随机改变了领英向用户展示“可能认识的人”的推荐算法，从而使网站用户的好友关系的强弱构成各不相同。实验结果表明，较弱的关系（例如两个用户之间只有一个共同好友）比那些拥有25个或更多共同好友的关系更有可能促成求职和跳槽。

这听起来像是内向者的天堂：只要给每个人发送添加好友请求，关上办公室的门，坐等工作机会便可。但事情并非如此简单。即使是弱关系也需要打理。即使是在线上，当你对人际互动乐在其中时，与人结交也会更容易些。奥古斯塔纳学院 (Augustana College) 的乔安娜·戴维斯 (Joanna Davis) 与合著者对领英的一项调查研究发现，外向型性格是社交能力的预测指标。

对于内向的人来说，没有哪种社交方式是真正没有痛苦的。尽管如此，与

其排着队、指望那个连咖啡机都不会用的人成为你事业成功的敲门砖，还是有一些更靠谱的方法的。

真正的秘诀是把精力留给那些最有可能引起你兴趣的人。例如，拉杰库马尔的研究并没有发现在线上人际联系越弱越好。在领英上建立人脉的最佳战略是找到与你有“稍弱”关系的人：与只有一个共同好友的人相比，连上一个拥有十个共同好友的人，会明显增加跳槽的成功率。

换言之，如果你能慧眼识别能为你带来新信息的人，而且他们离你的圈子足够近（如此这些信息才对你有用），那么建立人脉就会有回报。在线下，运用像ChatGPT这样的工具应该可以更容易从参会人员名单中找到有用的潜在对象。但你仍然需要战胜自己的社恐天性，主动上前攀谈。 ■



Bartleby

Networking for introverts: a how-to guide

Making the business of meeting strangers marginally less awful

CORPORATE LIFE throws up some stressful moments. Bringing bad news to your boss; facing an interview panel; making a big presentation. But few things are worse than networking if you are an introvert.

You arrive at an event to find that everyone there apparently knows each other already. And then you look more closely and spot the fellow-sufferers. They are the people who are actually reading the conference blurb. They look at email on their phones with greater intensity than ever happens at the office. They endlessly circulate the room, like bits of plastic in the ocean waiting to be snagged on something. They take a seat in the main hall while the sound engineers are still testing the microphones.

Fortunately, there is advice out there on how to break the ice with strangers. Unfortunately, it's abysmal. One sage counsels making contact in queues, because it is easier to talk to the person in front of you and behind you. You are meant to ambush people on the escalator, in the toilets and in the queue to get your name tag. In the line for coffee, open the door to jobs and sales by saying six incomprehensible words: "Juicing up for the big keynote?"

On it goes. Don't be afraid to laugh, because nothing drains the tension from a room like someone who cannot stop chuckling. Bring personal information into the conversation, lest people think you are at a conference on treasury-management software only for commercial gain. Use the other person's name twice, to appear truly engaged. And take notes on conversations afterwards so you can follow up with them.

Add these ingredients together, and you have the recipe for success:

“Juicing up for the big keynote?”

“What?”

“Juicing up for the big keynote?”

“I don’t know what that means.”

[Scan name badge] “Keith, is it?”

“Er, yes.”

[Laughing] “I’m having a baby, Keith.”

“Keith?”

[Take out notepad]

If this is how to network, no wonder people go to the main hall early.

Making contacts on a site like LinkedIn is a lot less stressful. There is no eye contact, after all, and the rules of the road are agreed. And all those connection requests do appear to help with careers. A paper published last year by Karthik Rajkumar of LinkedIn and co-authors from academia found empirical evidence for the insight that underpins all kinds of networking—that, because they bring you new information, more infrequent and distant relationships (or “weak ties”) are more useful than close contacts.

The researchers randomly changed the “People You May Know” recommendations algorithm that LinkedIn shows its users, so that the prevalence of weaker and stronger connections varied among people on the site. The experiment showed that weaker ties (where a pair of users had only one mutual friend, say) were more likely to lead to job applications and job

moves than those where people had 25 mutual friends or more.

This sounds like nirvana for introverts: start spamming everyone with connection requests, close the office door and wait for job offers. But it is not that easy. Even weak ties need tending. Even online, interacting with people is easier if you find it energising; a survey-based study of LinkedIn, by Joanna Davis of Augustana College and her co-authors, found that extroversion was a predictor of networking ability.

There isn't a genuinely painless way for introverts to network. Still, methods to do it exist that are wiser than standing in a queue and hoping the guy who doesn't know how to get coffee out of the machine is your ticket to career success.

The real secret is to save your energy for the people who are most likely to be interesting to you. In the online realm, for instance, Dr Rajkumar's study does not find that the weaker the tie, the better. The sweet spot in networking on LinkedIn is someone with moderately weak ties to you: connecting with a person with ten mutual friends markedly increases the probability of changing jobs compared with someone with just one shared friend.

In other words, networking pays off if you can identify people who can bring you new information but are close enough to your world that this information is useful. In the offline world, a tool like ChatGPT should make it easier to find useful prospects in a list of event attendees. But you still need to overcome all your instincts and approach them. ■



岛上购物

TikTok攻入东南亚电商战场

遭受痛击的既有企业准备好迎接一场代价高昂的战斗

今年3月，TikTok的首席执行官周受资现身华盛顿，接受怒气冲冲的议员就错误信息到心理健康等问题长达五小时的盘问。这个短视频应用在它最大的市场美国面对被封禁的威胁。类似的声音在其他西方政府也此起彼伏。TikTok隶属一家名为字节跳动的中国公司，自2020年以来已被它的另一个大市场印度以国家安全为由拒之门外。

与此形成鲜明对比的是周受资6月在雅加达受到的欢迎。在印尼首都，包括政府官员在内的一群人拜倒在他的西装裤下，他承诺未来几年TikTok将在东南亚投资“数十亿美元”。TikTok已于2020年将全球总部迁至新加坡。由于在世界其他地方的前景不明，它盯上了东南亚的近7亿消费者以改善自己的处境。周受资的言语收获了认可乃至溢美之词——唯已在该地区扎根的数字公司除外。

这是因为TikTok在东南亚的野心并不止于展示傻气的舞蹈视频。2021年，它推出了TikTok Shop，用户可以直接从这个应用购物。根据新加坡研究公司Momentum Works的数据，去年该平台在全球销售了价值约50亿美元的产品。今年的销售目标是200亿美元，其中四分之三将来自东南亚人的腰包。

TikTok此番进军电子商务正赶上该地区电商生意的动荡期。在去年东南亚约1000亿美元在线商品销售额中占了近一半的虾皮购物（Shopee）（见图表1）已经连续两个季度报告销售下滑。目前它的新加坡母公司冬海集团（Sea Group）的市值仅为2021年10月时达到的2000亿美元的十分之一。冬海裁减了员工，退出了东南亚以外的业务，并在8月请投资者做好亏损的准备，因为它正在增加支出以应对竞争升级。总部位于新加坡的电子商务平台Lazada可能还没有盈利过，却已经换上了过去五年里的第五位

首席执行官。3月，它的中国母公司阿里巴巴把自己分拆成六家公司，更增添了骚动。

TikTok能趁竞争对手深陷麻烦时发力吗？这款应用看起来无疑很符合东南亚的网购习惯。它在该地区已经拥有超过3亿用户。咨询公司贝恩

（Bain）和拥有Facebook和Instagram的Meta开展的一项研究发现，近一半的东南亚消费者在网上购物时使用社交媒体来查找产品，尤其是通过短视频和即时通讯应用。投资公司海登资本（Hayden Capital）的弗雷德·刘（Fred Liu，音译）指出，和在“社交商务”的故乡中国一样，娱乐和商业之间的界限在那些“移动优先”的购物者心目中已变得模糊。为了减少对直播带货的依赖，TikTok正在其应用中测试一个商城标签，让卖家可以在平台上上架自己的商品，而不必花钱请网红把产品挂在他们的视频中。

不过，别以为那些区域性的老企业就此出局了。TikTok Shop上销售的主要是那些最适合用视频推广和冲动消费的商品，比如衣服和化妆品，而它的竞争对手们提供的商品种类更广泛，从小设备到家具不一而足。

Momentum Works的维昂·邱（Vion Yau，音译）估计，TikTok平均一个订单的价值约为5美元，而虾皮和Lazada分别为8美元和10美元。

虾皮、Lazada和另一家当地的领军企业Tokopedia还建立了自己的物流网络和支付系统，以克服东南亚半岛和群岛星罗棋布的棘手地理特性，以及往往简陋破败的基础设施。这使得这些公司的运营效率要高于TikTok，后者依赖外部供应商存储和运输产品，以致降低了自己对购物体验的控制，并侵蚀了利润率。此外，尽管东南亚人会用TikTok等社交媒体应用来发现新产品，但直接从那里下单购买的几率较低。根据贝恩和Meta的报告，到了真的要买东西时，超过一半的购物者还是会被更好的质量和更快的配送时间吸引，转向传统的电子商务网站。

TikTok可能会攻克这些障碍。得益于其中国母公司2200亿美元的估值，它的财力比大多数公司都雄厚。但虾皮勒紧裤腰带的动作让冬海有了现金缓冲来捍卫自己的地盘。7月，Lazada获得了阿里巴巴8.45亿美元的注资。当地的既有企业并不是TikTok唯一的竞争对手。上个月，中国另一家大型电

子商务公司拼多多的子公司Temu的网店在菲律宾悄然开张。争夺东南亚在线购物者的战斗才刚刚打响。 ■



Island shopping

TikTok is wading into South-East Asia's e-commerce wars

Battered incumbents brace for a costly fight

IN MARCH TIKTOK'S chief executive, Shou Zi Chew, faced angry lawmakers in Washington, who grilled him for five hours on topics ranging from misinformation to mental health. A threat of a ban in America, the short-video app's largest market, looms large. Other Western governments are making similar noises. TikTok, which is owned by a Chinese firm called ByteDance, has already been locked out of India, another big market, since 2020 on grounds of national security.

Contrast that with the welcome Mr Chew received in June in Jakarta. He charmed a crowd in the Indonesian capital that included government officials with his plans for the company in South-East Asia, promising to invest “billions of dollars” in the region over the next few years. As uncertainty looms over its prospects elsewhere in the world, TikTok, which in 2020 moved its global headquarters to Singapore, is eyeing South-East Asia’s nearly 700m consumers to bolster its fortunes. Reactions to his talk ranged from favourable to gushing—except among the region’s digital incumbents.

That is because TikTok’s ambitions in South-East Asia go beyond silly dance videos. In 2021 it launched TikTok Shop, which lets users buy products directly from the app. According to Momentum Works, a research firm in Singapore, last year products worth around \$5bn were sold globally on its platform. This year the target is \$20bn, with three-quarters of that coming from South-East Asian wallets.

This foray into e-commerce comes at a volatile time for the sector in the

region. Shopee, which accounted for almost half the \$100bn or so in goods sold online last year in South-East Asia (see chart 1), has reported two quarters of declining sales on its platform. The market value of its Singaporean parent company, Sea Group, is a tenth of the \$200bn it reached in October 2021. Sea has cut staff, retreated from ventures beyond South-East Asia and, in August, told investors to brace for losses as it boosts spending in the face of rising competition. Lazada, a Singapore-based e-commerce platform that has probably never turned a profit, is on its fifth CEO in as many years. In March its Chinese parent, Alibaba, added more commotion by splitting itself into six companies.

Can TikTok take advantage of its rivals' troubles? The app certainly looks well-suited to South-East Asian online-shopping habits. It already has more than 300m users in the region. A study by Bain, a consultancy, and Meta, which owns Facebook and Instagram, found that nearly half of consumers there use social media, particularly short-video and messaging apps, to find products when shopping online. As in China, the home of "social commerce", the line between entertainment and commerce is blurred among those "mobile first" shoppers, notes Fred Liu of Hayden Capital, an investment firm. To lessen its reliance on live-streamed product reviews, TikTok is testing a marketplace tab in its app, which lets sellers list their goods on the platform without having to pay influencers to plug products in their videos.

Don't count the regional incumbents out just yet, though. Whereas TikTok Shop is dominated by things best-suited for promotional video and impulse purchases, such as clothes and cosmetics, its rivals offer a broader assortment of wares, from gadgets to furniture. Vion Yau of Momentum Works estimates that the average order value on TikTok is around \$5, compared with \$8 at Shopee and \$10 at Lazada.

Shopee, Lazada and Tokopedia, another local champion, have also built

their own logistics networks and payment systems to get around South-East Asia's tricky peninsular and archipelagic geography, and often shabby infrastructure. This allows the companies to operate more efficiently than TikTok, which relies on external suppliers to store and ship its products, giving it less control over the shopping experience and eating into margins. And though South-East Asians use social-media apps like TikTok to discover new products, they are less likely to buy them there. According to the report by Bain and Meta, more than half of shoppers switch to old-school e-commerce sites at the time of sale, lured by better quality and faster delivery times.

TikTok may overcome these hurdles. Thanks to its Chinese parent's \$220bn valuation its pockets are deeper than most. But Shopee's belt-tightening has given Sea a cash buffer to defend its turf. Lazada got an injection of \$845m from Alibaba in July. And the local incumbents are not TikTok's only competition. Last month Temu, an offshoot of Pinduoduo, another large Chinese e-commerce firm, quietly launched its online store in the Philippines. The battle for South-East Asia's online shoppers is only getting started. ■



溢出不止

中国增长放缓令亚洲经济体惶惶不安

各地政府匆忙限制损失

巴厘岛是印度尼西亚的度假胜地，釜山是韩国的一个港口，这两个地方不容易混淆。前者基本不生产什么工业机械；后者也没有一年到头的热带天气。但它们有某种共同点。由于中国经济的重新开放不像预期那样引人瞩目，而且面临长期增长放缓，亚洲一些区域眼下受到拖累，这两个地方都在其中。

过去二十年来，亚洲许多国家受益于中国的增长，变得和这个世界第二大经济体交织在一起。如今中国陷入房地产危机，今年前七个月房地产投资下降9%，这些国家开始感到头疼。中国不再像以前那样大量购买它们的产品。9月7日发布的数据显示，8月的进口同比下降了7.3%。

在亚洲较富裕的地区，半导体电路和汽车零部件的制造商正在遭受损失。韩国对中国的出口在8月同比下降了20%。今年早些时候，韩国政府推出了税收减免等计划，到9月4日又承诺推出新的支持措施，宣布为出口商提供高达181万亿韩元（1360亿美元）的贷款。1月到7月，台湾对中国大陆和中国香港的出口同比下降了28%。高盛估计，台湾近10%的GDP都是由中国大陆的消费和投资驱动的。

一些出口商可能期望中国因受全球电子产品销售放缓的影响而加剧的经济下滑已经触底，因为进口的同比下滑已经企稳。但大多数出口商并没有指望出现快速反弹。大韩商会最近调查了302家对华出口的韩国公司，其中近五分之四预计低迷会持续下去。如果中国政府不祭出更充分有力的刺激措施，这样的低预期很可能会变成现实。

在东南亚，游客数量也还远没有恢复到疫情前水平。今年1月至7月，仅有180万中国游客到访泰国，而2019年有超过1100万。泰国新政府近日宣布将放宽签证申请以鼓励中国游客回流。东南亚的一些国家旅游业规模之庞

大，足以影响它们的总体贸易平衡。在疫情暴发前的2019年，柬埔寨、老挝、马来西亚和泰国的旅游业占总出口的9%到25%不等，而中国是这四个国家最大的游客来源地。

龙洲经讯的文森特·徐（Vincent Tsui，音译）表示，印度、印尼和菲律宾等几个亚洲国家受中国衰退的影响较少。这些国家的产业基础较薄弱，因而在过去二十年里和中国建立的连结更少。徐认为，这种更小的关联度解释了为何今年这些国家的货币对美元的表现较好（见图表）。

即使在经济低迷期，也不是所有事情都同向变动。泰国的榴莲（这种气味刺鼻的水果不知怎地在亚洲大部分地区都很受欢迎）出口商就是近期的赢家。今年前七个月，中国进口的榴莲同比增长了52%。泰国官方认为促成这种增长的是新的交通线路，特别是一条连接老挝和中国的铁路线。亚洲其他地方就没这么幸运了，毕竟不是人人都在泰国种榴莲。 ■



Spillovers aren't over

China's slowdown is rattling Asian economies

Governments are rushing to limit the damage

BALI, A HOLIDAY destination in Indonesia, and Busan, a port in South Korea, are not easily confused. The former produces little industrial machinery; the latter falls short on year-round tropical weather. But the two have something in common. They are among the regions of Asia now imperilled by the less-than-impressive reopening of China's economy, and the prospect of a prolonged slowdown.

Many Asian countries benefited from Chinese growth over the past two decades, becoming entwined with the world's second-largest economy. Since China is in the midst of a real-estate slump, with property investment down 9% in the first seven months of the year, these countries now face a headache. China is less of a big buyer of their wares than it was. According to data released on September 7th, its imports dropped by 7.3% in the year to August.

In the richer parts of the continent, makers of semiconductor circuits and car parts are nursing losses. South Korean exports to China fell by 20% year on year in August. On September 4th the government pledged fresh support, announcing loans for exporters worth up to 181trn won (\$136bn), in addition to tax breaks and other schemes earlier in the year. Between January and July exports from Taiwan to mainland China and Hong Kong fell by 28% against a year before. Almost 10% of the country's GDP is driven by mainland Chinese consumption and investment, estimates Goldman Sachs, a bank.

Some exporters may hope that China's slump, which has been exacerbated

by a global slowdown in sales of electronic goods, has bottomed out, since the year-on-year decline in imports has stabilised. But most do not expect a rapid turnaround. The Korean Chamber of Commerce and Industry recently published a survey of 302 domestic companies that export to China. Almost four in five expected the slump to continue. Without more fulsome stimulus from the Chinese government, such low expectations are likely to be met.

In South-East Asia tourist numbers are yet to return to anything like their pre-covid levels. Thailand received just 1.8m Chinese travellers between January and July, compared with more than 11m in 2019. A new government in Bangkok announced earlier this month it would relax visa rules to encourage Chinese visitors to return. Several countries in the region have tourism industries large enough to affect their overall balance of trade. In Cambodia, Laos, Malaysia and Thailand, tourism accounted for between 9% and 25% of total exports in 2019—before covid struck—with China the largest source of visitors to all four.

A few Asian countries, such as India, Indonesia and the Philippines, are less exposed to the slowdown, according to Vincent Tsui of Gavekal Research. Their smaller industrial bases mean they have forged fewer Chinese connections over the past two decades. Mr Tsui believes this lower exposure accounts for the better performance of the countries' currencies against the dollar this year (see chart).

Even during an economic slump, not everything moves in the same direction. Thailand's exporters of durian, a pungent fruit that is inexplicably popular across much of Asia, have been recent winners. In the first seven months of the year, Chinese imports of the fruit have risen by 52%, relative to the same period last year. Thai officials credit new transport links, particularly a train line connecting Laos and China, for the boom. Sadly for the rest of Asia, not everyone is a Thai durian farmer. ■



轻松的野外考察

只需擦拭树叶即可追踪动物

DNA无处不在。现在可以轻松采集了【新知】

做生物田野调查可能得去异国他乡的奇异地点。但这项工作本身可能非常乏味，尤其当你试图追踪的对象还踪迹难寻时。最常见的做法就是找几个热情高涨又有几周空闲时间的研究生，让他们带上红外触发相机去完成任务。但这可能很快就会改变了。由哥本哈根大学的克里斯蒂娜·林加德（Christina Lynggaard）和德国亥姆霍兹大健康研究所（Helmholtz Institute for One Health）的扬·戈嘉顿（Jan Gogarten）领衔发表在《当代生物学》（Current Biology）上的一篇论文提出了一种更简单的方法：只需要拿根拭子在周边的树叶上抹几下采集些DNA就可以了。

这里所说的DNA被称为“环境DNA”（简称eDNA）。它指的是动物在日常的呼吸、排尿、走动或以任何方式与环境互动时散落的各种遗传信息。近年来，基因测序技术已经变得足够快速和灵敏，可以从这种无处不在的eDNA中识别出是哪种动物（包括人类）留下了基因序列。

一种做法是用过滤器过滤空气，再分析过滤器捕获的信息来判断附近有哪些动物。戈嘉顿和林加德了解这种技术，但他们想知道是否有更简单的方法。空气采样系统可能需要几天的时间才能得出结果。系统需要维护，并且必须经常更换过滤器。但顾名思义，eDNA是散布在生态系统中各处的，两位研究人员想知道它是否会聚集在叶子上。

许多植物的叶子都有蜡质层，而且有点粘。两位研究人员推测，eDNA可能还是会附着在叶面上，这样就可以通过擦拭叶子来收集。他们在乌干达基巴莱国家公园（Kibale National Park）茂密的雨林中测试了自己的想法。为防止样本被自己的DNA污染，他们戴上了口罩和手套，用简单的棉签在公园内的三个区域各收集了八个拭子，然后将它们带回哥本哈根做分析。

对拭子的分析显示出存在26种鸟类、24种哺乳动物、一种两栖动物和一种鱼，每个拭子平均含有来自八种动物的DNA。超过一半的样本质量足以确定上面的DNA来自哪个具体物种。最小的（仅重19克）是深居简出的斯特拉木鼠。最大的是重达3.8吨的非洲象。分析结果显示那条鱼是鲶鱼，研究人员猜想是一只鸟吃了鱼，然后将含有鱼DNA的粪便排泄到了叶子上。

用拭子追踪动物的做法看来是有效的，而且便宜、简单、快捷。以后研究生就算想多花些时间去偏远地带搜寻样本，恐怕也没那个机会了。■



Easy fieldwork

Animals can be tracked by simply swabbing leaves

DNA gets everywhere. Now it is possible to harvest it

BIOLOGICAL FIELDWORK can mean trips to exotic places. But the work itself can be tedious, especially when you are trying to track down elusive subjects. The most common method is to send a few eager graduate students armed with camera traps and several weeks of spare time. But perhaps not for much longer. A paper published in Current Biology, whose lead authors are Christina Lynggaard at the University of Copenhagen and Jan Gogarten at the Helmholtz Institute for One Health in Germany, suggests an easier method: simply swabbing nearby leaves for DNA.

The DNA in question is called “environmental DNA” (eDNA for short). It refers to all the genetic information that animals shed as they go about their daily business: breathing, urinating, moving around, or interacting with their environment in any way. In recent years gene-sequencing technology has become quick and sensitive enough to pick out genetic sequences from particular animals—including humans—from this ubiquitous eDNA.

One way of doing so is simply to blow air through filters, then analyse them to see which critters live in the vicinity. Aware of that technique, Drs Gogarten and Lynggaard wondered if there might be a simpler approach. Air-sampling systems can take days to do their work. Maintenance must be done, and filters must be changed. But given that eDNA is literally blowing around ecosystems, the researchers wondered if it might be collecting on leaves.

The leaves of many plants are waxy and somewhat sticky. The researchers theorised that eDNA might end up stuck to leaves and that it could

subsequently be collected by swabbing them. They tested their theory in the dense rainforests of Kibale National Park, in Uganda. Using simple cotton swabs, and wearing masks and gloves to prevent contaminating the samples with their own DNA, they visited three areas of the park and collected eight swabs at each site, then took them back to Copenhagen for analysis.

The swabs revealed the presence of 26 birds, 24 mammals, one amphibian and one fish, with each swab containing DNA from eight animals on average. More than half the samples were good enough to work out the precise species they came from. The smallest (weighing just 19 grams) was the reclusive Stella wood mouse. The largest was the 3.8-tonne African elephant. The fish turned out to be a catfish that the researchers suspect was eaten by a bird, which then defecated some fishy DNA onto the leaves.

Swabbing for animals, then, seems to work. Moreover it is cheap, easy and fast. Graduate students will have to be content spending less time specimen-hunting in far-flung parts of the world. ■



名利双收

百万亿美元的全球富豪抢夺战

两家金融巨头很有胜算【深度】

为了让自己的生活更轻松，超级富豪们会雇用各种人员——打理花园的园艺师、收拾房屋的管家、带孩子的保姆等等。然而要论重要性，或许没有人比得上被雇来保护资本的理财经理了。

这些顾问散布在日内瓦、纽约等全球各地的城市，他们被聘为受托人，意味着他们必须基于客户的利益行事。他们自然也就对这些富豪名流的私生活知情，因为这些人必须向他们吐露秘密，才有可能在诸如私生子遗产继承等问题上获得建议。顾问还帮助家庭分配投资、隐匿财产、减少纳税、制定退休计划、安排财产继承，以及满足各种离奇的愿望等。一位驻新加坡的理财经理回忆说，他被告知要将家族财富“两位数”的比例拿来投资专为赛马培育的“纯种马”——他在会面后赶紧查阅了这个词。

几十年来，理财一直是项小众服务，为金融业的其他部门所轻视。而现在，它可能是整个行业里最具吸引力的生意。在2007至2009年全球金融危机后出台了对资本和流动性的要求，这加大了贷款或交易等需要庞大規模资产负债表的业务的运营难度和成本。相比之下，提供理财建议几乎不需要资金。达到一定规模的财富管理公司通常能实现25%左右的利润率。高客户粘度意味着收入稳定可靠。而其他那些曾经利润丰厚的资产管理业务，比如共同基金，由于竞争激烈，利润空间已受到挤压。尽管指数基金和交易所交易基金巨头贝莱德（BlackRock）和先锋领航（Vanguard）管理着规模庞大的资产，但它们从每一笔投资中只收取很小一部分费用。财富管理公司每年的标准收费是客户资产的1%。

理财业务的迅速扩张更是增加了它的吸引力。在过去20年里，世界经济的增速相当可观，达到每年3%以上。但它还是远远赶不上财富的增速。2000年至2020年间，全球财富总额从160万亿美元增加到510万亿美元，

从相当于全球经济产出的四倍增加到六倍。尽管这些财富中有很大一部分绑定在房地产和其他资产上，但流动资产的规模仍然很大，占总财富的四分之一。贝恩咨询公司估计，到2030年，流动资产的规模将从目前的130万亿美元出头扩大到近230万亿美元，这意味着有100万亿美元的商机有待争夺。他们预计这一场繁荣将帮助全球财富管理收入从2550亿美元提升至5100亿美元。

地理、人口结构和技术都会促进这场繁荣。随着新市场中创造出跨世代的财富，一些最大的财富管理公司正试图把触角伸向世界各地愈来愈多的角落。婴儿潮一代是可以依靠固定收益退休金来养老的最后一代，更多人将必须决定要如何靠自己的财富养老。与此同时，软件正在精简那些曾是财富管理公司绊脚石的繁文缛节，使它们能以更低的成本服务更多客户，并帮助公司实现自动化获客。有了这些助益，大银行的服务对象将从超级富豪扩大到包括普通富人。从拥有千百万美元可投资资产的超高净值和高净值客户，到只有大约十万美元的普通人，公司已经在顺着财富阶梯往下爬了。

贝恩的马库斯·哈贝尔（Markus Habbel）认为这与蓬勃发展的奢侈品行业有相似之处。手袋过去之所以备受青睐，不仅因为其外观，还因为不是人人都能拥有。但它们如今在社交媒体上已是随处可见——网红们都在兜售葆蝶家的手拿包和爱马仕的手袋。他指出：“想想路易威登或古驰。他们的客户与（与理财公司）的目标客户大体相同，并且从40年前的4000万（客户）增加到现在的四亿人。”上流社会买家并没有觉得扫兴。

哪些公司会抓住这100万亿美元的商机？目前而言，理财业务仍很分散。巴西的BTG等本地银行在其国内市场占有很大份额。区域性的头部银行雄霸金融枢纽，比如亚洲的新加坡银行和星展银行。在美国，诸如零售理财机构爱德华·琼斯（Edward Jones）这样的专业公司为大众提供服务，顾问的报酬是根据基金的销售额提成。只有高盛和摩根大通等少数一些机构真正在全球范围内竞争。但最大的两家当属摩根士丹利和面貌一新的瑞银，后者刚刚并购了其在国内的老对手瑞信。过去十年，摩根士丹利陆续收购了几家规模较小的财富管理公司，它目前管理着约六万亿美元的财富资

产。并购后的瑞银目前管理着5.5万亿美元的资产。

这种散布的状态不太可能持续下去。“这个行业正朝着赢家通吃的方向发展。”哈贝尔预测道，因为它变得“非常关乎规模、技术，以及全球覆盖”。摩根大通的高管詹妮弗·皮普扎克（Jennifer Piepszak）声称，摩根大通对第一共和银行（First Republic，一家为富人服务的银行，于今年5月倒闭）的收购是摩根大通在实现其财富管理雄心的过程中“一次重要的加速”。花旗集团挖走了美国银行（Bank of America）的理财主管安迪·西格（Andy Sieg）以改进自己的业务。2021年，先锋领航收购了财富科技公司Just Invest。

瑞银和摩根士丹利的雄心更大。这两家公司的策略反映了它们截然不同的背景，并最终可能引发一场交锋。尽管摩根士丹利参与全球竞争，但还是在美国占据主导地位，并且专注于面向大众的理财服务，这一点从它2020年收购经纪平台E*TRADE可以看出来。摩根士丹利的老板詹姆士·戈尔曼（James Gorman）表示，如果公司继续保持目前每年5%左右的新资产增长率，大约十年后，它管理的资产将达到20万亿美元。

鉴于摩根士丹利现有的规模，它有可能做到这一点。2009年，摩根士丹利同意以135亿美元收购花旗的财富管理部门美邦（Smith Barney），此举曾帮助它将利润率从金融危机前几年的约2%提高到10%出头。如今它的利润率达到了27%左右，这反映出利用科技进入到向普通富人提供咨询的业务中。财富管理部门负责人安迪·萨珀斯坦（Andy Saperstein）指出，摩根士丹利在2019年以仅九亿美元收购了小型股票计划管理公司Sodium，这对建立一个强大的客户转介机制至关重要。“当时没有人关注股票计划管理公司，因为它们根本不赚钱。”他表示。但这些公司“拥有庞大的客户群，（客户）时不时就会查看股权何时授权、价值多少，以及何时可以使用它。”

瑞银的战略要更老派一些，却带有一次向全球的转身。在收购了国内的竞争对手后，瑞银获得了一个难得一遇的机会，可以在巴西、东南亚等瑞信已经做得风生水起的地方巩固领先地位。如果能巧手完成这场合并，将把

瑞银送上几乎世界各地的领跑者之位。因此，至少就目前而言，面貌一新的瑞银还是会更多地专注在地域广度上而不是普通富人上。

通过不同的路径，摩根士丹利和瑞银都在设法继续扩大规模。客户在聘请理财经理时，往往是寻求以下两者之一。一是在一些财务问题上帮助他们做决定，这类决策“如果做错，代价会很高”，萨珀斯坦说，比如为自己退休或子女的教育规划储蓄。二是某种独有的东西，比如获得普通证券账户接触不到的投资机会。

对于财富管理公司来说，能够向客户提供投资私募基金或资产的渠道可能会变得越来越重要。私募股权巨头黑石集团的琼·索罗塔（Joan Solotar）表示，黑石如今已有四分之一的资产来自个人，而且大部分是通过大银行募集的。财富管理公司的规模愈大，在与私人市场公司谈判以获得排他性交易时的议价能力也就愈强，比如为客户提供私募基金或降低费用等。即将继承财富的年轻一代预期会要求有一些更具环保和社会意识的选择，比如不单单将石油公司排除在外，还要专注于投资清洁能源等领域。十年前，如果理财顾问跳槽到一家新公司，客户往往也会追随而去。只开放给部分客户的高端基金加大了这种外流的难度。

人工智能（AI）可能会加速赢家通吃的趋势，而拥有更多技术预算的大公司已经在这方面占得了先机。AI可以用来创建三种工具。第一种工具可以摄取资产配置建议书或研究报告等公司自己的专有数据，生成顾问可拿来帮助客户的信息。这样的工具开发起来最容易，也不会引致什么监管问题，所以创建它们的尝试很常见。

第二种工具要使用客户信息（而不是公司的专有数据）来训练自己，甚至可能监听顾问与客户之间的对话。经过训练后，这种工具就能够汇总信息并为顾问创建自动操作，提醒他们向客户发送详细资料或跟进某些事项。第三种工具最令人向往。它将是一个执行工具——顾问向它大声说出要求，比如购买基金份额或进行外汇交易，然后它就会让公司的系统代表顾问来自动执行，节省了时间。

这么说来，要赚钱就得先花钱。那些最大的财富管理公司已经有了丰厚的利润、能让客户获得他们想要的产品，并且在技术上先人一步，这让它们可能进一步领先于人。“我们目前是一家成长型公司。”摩根士丹利的萨珀斯坦声称，这句话在过去15年里很少被用来谈论银行。“我们才刚刚开始。”

不过这两家巨头都在经历转型期。合并两家大银行需要一场开胸手术，瑞银的挑战才刚刚开始。与此同时，缔造了摩根士丹利的财富战略的戈尔曼将在未来九个月内退休。萨珀斯坦与另外两位高管——泰德·皮克（Ted Pick）和丹·西姆科维茨（Dan Simkowitz）之间的接班人争夺战已经打响。两家公司都可能摔跟头。尽管它们遵循的战略不同，但彼此间发生冲突无疑只是时间问题。瑞银正在美国大举招聘；摩根士丹利正考虑向包括日本在内的一些全球市场扩张。

而尽管规模会带来优势，规模较小的公司也很难完全被淘汰出局。从以客户为导向的经纪平台（比如嘉信理财，它同时也作为受托人向自己最富有的客户提供建议），到资产管理公司（比如富达和先锋领航，它们拥有数百万可能寻求理财建议的客户），大量不同类型的理财机构都各有立足点。“过去，当我们刚开展理财项目的时候，重点是如何利用共同基金帮助人们管理财富。但这项业务已经发生了变化。”富达的里奇·康普森（Rich Compson）表示。富达的财富部门管理着1.8万亿美元的资产，它也就如何利用单个证券、交易所交易基金和另类投资等向客户提供建议。

1980年去世的威利·萨顿（Willie Sutton）人称“狡猾的威利”，是个衣冠楚楚的大盗。当被问及为什么抢劫银行时，他回答说：“因为钱在那里。”这个金句有助于解释华尔街的策略——为何各家公司都在竞相把握100万亿美元的财富管理商机。理财业务曾是金融行业里一个了无生气、没什么技术含量的角落。如今它是金融业的未来。 ■



Rich and famous

The \$100trn battle for the world's wealthiest people

Two financial giants look likely to crush the competition

THE ÜBER-RICH hire all kinds of people to make their lives easier. Landscapers maintain gardens, housekeepers tidy homes, nannies raise children. Yet perhaps no role is as important as that of the wealth manager, who is hired to protect capital.

These advisers are scattered across the globe in cities like Geneva and New York, and are employed as fiduciaries, meaning they are required to act in the interest of their clients. As such, they are privy to the intimate lives of the rich and famous, who must expose their secrets so advice may be offered on, say, the inheritance of a child born of an extramarital affair. Advisers also help families allocate investments, stash cash in boltholes, minimise tax bills, plan to retire, arrange to pass down wealth and satisfy unusual wishes. A Singapore-based manager recalls being told to invest a “double-digit” percentage of a family’s wealth in “bloodstock horses”—steeds bred especially for racing—a term he hurriedly looked up after the meeting.

For decades wealth management was a niche service, looked down upon by the rest of finance. Now it is perhaps the most attractive business in the industry. Capital and liquidity requirements set after the global financial crisis of 2007-09 have made running balance-sheet-heavy businesses, such as lending or trading, difficult and expensive. By comparison, doling out wealth advice requires almost no capital. Margins for firms that achieve scale are typically around 25%. Clients are loyal, meaning that revenues are predictable. Competition has crushed profits in other formerly lucrative asset-management businesses, such as mutual funds. And whereas the pools of assets managed by BlackRock and Vanguard, the index- and

exchange-traded-fund giants, are huge, they collect a fraction of a penny on every dollar invested. A standard fee for a wealth manager is 1% of a client's assets, annually.

Wealth management is all the more appealing because of how quickly it is expanding. The world economy has grown at a decent enough clip over the past two decades, at more than 3% a year. Yet it has been left in the dust by growth in wealth. Between 2000 and 2020 the total stock rose from \$160trn, or four times global output, to \$510trn, or six times output. Although much of this wealth is tied up in property and other assets, the pool of liquid assets is still vast, making up a quarter of the total. Bain, a consultancy, estimates that the pool will expand from just over \$130trn to almost \$230trn by 2030—meaning that a \$100trn prize is up for grabs. They expect the boom to help lift global wealth-management revenues from \$255bn to \$510bn.

It will be fuelled by geography, demography and technology. The biggest managers are attempting to cover ever more of the globe as dynastic wealth is created in new markets. Baby-boomers are the last generation that can rely on defined-benefit pensions for their retirement; more people will have to take decisions about how their own wealth will support them. Meanwhile, software is streamlining the bureaucracy that once waylaid wealth managers, enabling them to serve more clients at lower cost, and helping firms automate the acquisition of new ones. These gains will allow big banks to serve the merely rich as well as the über-wealthy. Firms are already climbing down the rungs of the wealth ladder, from ultra-high-net-worth and high-net-worth clients, who have millions of dollars to invest, into the lives of those with just \$100,000 or so.

Markus Habbel of Bain sees a comparison to the booming luxury-goods industry. Handbags were once prized for their exclusivity as much as their appearance, but have become ubiquitous on social media, with influencers touting Bottega Veneta pouches and Hermès bags. “Think about Louis

Vuitton or Gucci. They have basically the same clients as [wealth managers] target and they increased from 40m [customers] 40 years ago to 400m now," he notes. Upper-crust buyers have not been put off.

Which firms will grab the \$100trn prize? For the moment, wealth management is fragmented. Local banks, such as BTG in Brazil, have large shares of domestic markets. Regional champions dominate in hubs, including Bank of Singapore and DBS in Asia. In America the masses are served by specialist firms such as Edward Jones, a retail-wealth-management outfit in which advisers are paid based on commissions for selling funds. Only a handful of institutions compete on a truly global scale. These include Goldman Sachs and JPMorgan Chase. But the two biggest are Morgan Stanley and a new-look UBS, which has just absorbed Credit Suisse, its old domestic rival. After acquiring a handful of smaller wealth-management firms over the past decade, Morgan Stanley now oversees around \$6trn in wealth assets. Following its merger, UBS now oversees \$5.5trn.

This patchwork is unlikely to last. "The industry is heading in a winner-takes-all direction," predicts Mr Habbel, as it becomes "very much about scale, about technology and about global reach". Jennifer Piepszak, an executive at JPMorgan, has reported that her firm's takeover of First Republic, a bank for the well-heeled that failed in May, represents a "meaningful acceleration" of its wealth-management ambitions. Citigroup has poached Andy Sieg, head of wealth management at Bank of America, in an effort to revamp its offering. In 2021 Vanguard purchased "Just Invest", a wealth-technology company.

UBS and Morgan Stanley have grander ambitions. The firms' strategies reflect their contrasting backgrounds, and may in time produce a clash. Morgan Stanley competes globally but dominates in America, and is focusing on wealth services for the masses, as shown by its purchase in

2020 of E*TRADE, a brokerage platform. James Gorman, the bank's boss, has said that if the firm keeps increasing new assets by around 5% a year, its current growth rate, it would oversee \$20trn in a decade or so.

This may be possible thanks to Morgan Stanley's existing scale. In 2009 the bank agreed to acquire Smith Barney, Citi's wealth-management arm, for \$13.5bn, which helped boost margins to the low teens from 2% or so in the years before the financial crisis. Today they are around 27%, reflecting the use of tech to move into advising the merely rich. Andy Saperstein, head of the wealth-management division, points to the acquisition of Solium, a small stock-plan-administration firm, which Morgan Stanley purchased for just \$900m in 2019, as crucial for building a strong client-referral machine. "No one was looking at the stock-plan-administration companies because they didn't make any money," he says. But these firms "had access to a huge customer base and [clients] were constantly checking to see when the equity was going to vest, what it was worth and when they would have access to it."

UBS is employing a more old-school approach, albeit with a global twist. Having taken over its domestic rival, the Swiss bank has a once-in-a-generation chance to cement a lead in places where Credit Suisse flourished, such as Brazil and South-East Asia. Deft execution of the merger would make the firm a front-runner in almost every corner of the globe. Thus, for now at least, the new-look UBS will focus more on geographic breadth than the merely rich.

In differing ways, both Morgan Stanley and UBS are seeking even greater scale. When clients hire a wealth manager they tend to want one of two things. Sometimes it is help with a decision "when the cost of making a bad choice is high", says Mr Saperstein, such as working out how to save for retirement or a child's education. Other times it is something exclusively available, such as access to investments unobtainable through a regular

brokerage account.

Being able to offer clients access to private funds or assets will probably become increasingly important for wealth managers. Joan Solotar of Blackstone, a private-equity giant, says that a quarter of the firm's assets already come from individuals, and most arrive via big banks. Greater scale for wealth managers means greater bargaining power when negotiating with private-markets firms to secure exclusive deals, such as private funds for customers or lower fees. Younger generations, which will soon be inheriting wealth, are expected to demand more environmentally and socially conscious options, including those that do not just screen out oil companies, but focus on investing in, say, clean energy. A decade ago a client would tend to follow their wealth adviser if he or she moved to a new firm. Exclusive funds make such a switch more difficult.

The winner-takes-all trend may be accelerated by artificial intelligence (AI), on which bigger firms with bigger tech budgets already have a head-start. AI could be used to create three kinds of tool. The first would take a firm's proprietary information, such as asset-allocation recommendations or research reports, and spit out information that advisers can use to help their clients. Attempts to build such tools are common, since they are the easiest to produce and pose few regulatory issues.

The second type of tool would be trained on client information rather than companies' proprietary data, perhaps even listening in on conversations between advisers and clients. Such a tool could then summarise information and create automatic actions for advisers, reminding them to send details to clients or follow up about certain issues. The third kind of tool is the most aspirational. It would be an execution tool, which would allow advisers to speak aloud requests, such as purchasing units in a fund or carrying out a foreign-exchange transaction, and have a firm's systems automatically execute that transaction on their behalf, saving time.

It will take money to make money, then. The biggest wealth managers already have hefty margins, access to products their clients want and a head start on the tech that might put them even further ahead. “We are a growth company now,” claims Mr Saperstein of Morgan Stanley, a sentence that has rarely been uttered about a bank in the past 15 years. “We are just getting started.”

Yet the two giants are both going through periods of transition. UBS has barely begun the open-heart surgery that is required when merging two large banks. Meanwhile, Mr Gorman, the architect of Morgan Stanley’s wealth strategy, will retire some time in the next nine months. The succession race between Mr Saperstein, Ted Pick and Dan Simkowitz, two other executives, is already under way. Either firm could falter. Although the two are chasing different strategies, it is surely only a matter of time before they clash. UBS is on an American hiring spree; Morgan Stanley is eyeing expansion in some global markets, including Japan.

And despite the advantages offered by scale, smaller firms will be hard to dislodge entirely. Lots of different types of outfit have a foothold, from customer-directed brokerage platforms, like Charles Schwab, which also offer their richest customers advice from a fiduciary, to asset-management firms, such as Fidelity and Vanguard, which have millions of customers who might seek advice. “Back in the day, when our programme was started, it was focused on how you help people manage their wealth using mutual funds. But the business has evolved,” says Rich Compson of Fidelity. The firm’s wealth arm, which oversees \$1.8trn, also offers advice on ways to use individual securities, exchange-traded funds and alternative investments.

When Willie Sutton, a dapper thief also known as Slick Willie who died in 1980, was asked why he robbed banks, he replied that it was “because that’s where the money is”. The aphorism helps explain strategy on Wall Street, as firms race to take advantage of the \$100trn opportunity in wealth

management. Once the business was a sleepy, unsophisticated corner of finance. Now it is the industry's future. ■



【首文】要钱还是要混乱

新中东腰包更鼓，混乱更少。至少目前是如此

经济蓬勃发展，战争逐渐减少。但气候变化迫在眉睫

如果你认为中东经济停滞不前，那可得再想一想了。本月初布伦特原油价格回升超过每桶90美元，海湾地区经济体由此跻身全球最富裕、最有活力的国家之列。350万亿美元的化石燃料红利正被用在方方面面：从本土人工智能模型、沙漠中崭新的城市，到填满在全球资本市场上四处寻找交易的巨型主权财富基金的金库，等等。

随着现金的流入，混乱也有消退的迹象，这要归功于数十年来最大规模的外交活动。自1979年伊朗革命以来，沙特和伊朗一直处于敌对状态，如今通过谈判实现了缓和。由于支持国寻求缓和局势，叙利亚和也门的内战造成的死亡人数正在减少。继以色列与一些阿拉伯国家政府达成亚伯拉罕协议之后，沙特阿拉伯正在考虑承认这个成立75年的犹太国家。该地区的全球影响力正在上升——这里有四个国家即将加入由希望世界不再由西方主导的不结盟大国组成的金砖俱乐部（BRICS）。

这些转变开启了中东的新篇章，其中既有新的机遇，也有新的危险。该地区的领导人正在测试已经在世界许多地方流行起来的理念，包括以专制实用主义取代民主，以多极外交取代1945年后美国主导的秩序。2030年代将笼罩世界的那些威胁可能在中东提前显现，包括核扩散、极端天气，以及随着弱国进一步落后于人而愈加严重的不平等。

许多白宫主人离任时都希望能忘掉中东问题。但无论你是经营一个超级大国还是一家小企业，中东问题都一如既往地重要。虽然中东人口只占世界总人口的6%，但它却扼住了全球经济的咽喉。作为成本最低的石油生产国，它占原油出口份额的46%，而且还在不断上升。自俄罗斯通往欧洲的管道关闭后，液化天然气的需求量很大，中东占出口份额的30%，并且也在不断上升。由于地理位置优越，30%的集装箱贸易和16%的航空货运都

经过该地区。其主权财富基金拥有3万亿美元的资产，是世界上最大的主权财富基金之一。这里的战争和动乱经常跨越国界；这里的难民影响着远在欧洲的政治。

过去二十年，中东经历了苦难。民主事业以失败和流血告终——在2003年美国领导的入侵之后的伊拉克，以及2011年阿拉伯之春之后的几个国家都是如此。伊斯兰国试图通过杀戮建立哈里发国，而在叙利亚，巴沙尔·阿萨德则用氯气和神经毒剂屠杀自己的人民。

然而现在，随着战事逐渐平息，三个重大变化显见出来。首先，随着美国军事干预意愿的消失，该地区不得不为自身安全承担更多责任。与此同时，贸易模式也变得多极化：国际货币基金组织（IMF）估计，中东有26%的商品出口到中国和印度，几乎是2000年的两倍，也大约是出口到美国和欧洲的两倍。最近，这种地缘调整导致人们希望缓和冲突。

其次，能源转型迫切需要摆脱人们熟悉的石油繁荣与萧条的模式。相反，海湾地区有强大的动力来在未来十年内，在需求永久性减少之前提高化石燃料的产量，并将收益用于当地经济的多元化发展。

最后的转变是公众舆论的厌倦。无论是民主还是伊斯兰，政治实验都已黯然失色。相反，整个中东地区的人都渴望经济机遇。忘掉加拿大或瑞典吧：民意调查显示，阿拉伯年轻人最崇拜的国家是阿联酋。在铁腕王朝的统治下，阿联酋局势稳定，经济繁荣。与此同时，西方在安全和贸易方面的参与减少，也意味着人权或民主方面的压力减小了。

该地区的一些变化令人啼笑皆非——想想像NEOM这样好大喜功的项目吧，沙特阿拉伯的实际统治者穆罕默德·本·萨勒曼（Muhammad bin Salman）正耗资约5000亿美元建造一座华而不实的新城。但其他变化却是持久而深刻的。海湾地区有工作的女性越来越多了。以色列游客涌入迪拜。在整个地区，非石油经济正以每年4%的速度健康增长，跨境跨国投资也在增加。可以想象，稳定与和平的良性循环能够带来更多的投资和贸易，从而提高生活水平，扩大繁荣，扭转世界上这个拥有约5亿人口的地

区长期陷于失败漩涡的局面。

然而，要实现这一点，中东必须克服一些大问题。其中有许多是老问题。该地区比较开明的独裁者认为，他们面临着一种必须改善人民命运的“业绩问责制”。但实行绝对统治的政权往往会走向衰败。还有一些新的危险，或者说，这些危险比以往任何时候都更加迫在眉睫。现在，伊朗即将成为一个拥有核武器的国家，核扩散的危险沉重地压在人们心头。气候变化意味着世界上最炎热、最干旱的地方之一将面临更加极端的天气。只有一些国家有能力进行维持适宜居住的环境所需的投资，如重新设计城市和海水淡化项目。

最赤裸裸的问题是，新中东比人们最近记忆中的更加两极分化。成功的海湾地区和以色列只占人口的14%，但却拥有60%的GDP、73%的货物出口和75%的外来跨国投资。从以色列和约旦河西岸到沙特阿拉伯和也门，现代经济的隔壁就是陷入绝望的地区。黎巴嫩深陷金融危机，埃及可能步其后尘。新中东的赢家体现了一种交易性心态，这种心态可能会让他们变得更加富有。失败者则敲响警钟：在一个规则和原则越来越少的世界里，没有人会来拯救你。当你给汽车加油或等待空运包裹时，请记住它们依赖的地区是一个经济和政治实验室——希望这个实验不会爆炸。■



Cash v chaos

The new Middle East has more money and less mayhem. For now

Economies are booming and wars are fading. But climate change is looming

IF YOU THOUGHT the Middle East was stagnant, think again. The Gulf economies are among the richest and most vibrant on the planet, helped by a Brent crude oil price that rose back to over \$90 per barrel this week. A \$3.5trn fossil-fuel bonanza is being spent on everything from home-grown artificial intelligence models and shiny new cities in the desert, to filling the coffers of giant sovereign-wealth funds that roam the world's capital markets looking for deals.

As the cash flows in, the chaos shows signs of receding, thanks to the biggest burst of diplomacy for decades. Saudi Arabia and Iran have negotiated detente in a rivalry that has lasted since the Iranian revolution in 1979. Civil wars in Syria and Yemen are killing fewer people, as their sponsors seek de-escalation. Following the Abraham accords between Israel and some Arab governments, Saudi Arabia is considering recognising the Jewish state, 75 years after its creation. The region's global clout is rising—four countries are about to join the BRICS club of non-aligned powers that want a less Western-dominated world.

As our Briefing explains, these shifts begin a new chapter in the Middle East marked by fresh opportunities and new dangers. The region's leaders are testing ideas that have caught on in much of the world, including embracing autocratic pragmatism as a substitute for democracy, and multipolar diplomacy instead of the post-1945 American-led order. The Middle East is also a place where threats that will menace the world in the 2030s may play out early, including nuclear proliferation, extreme weather and even greater inequality, as weak countries fall further behind.

Many occupants of the White House have left office wishing they could forget all about the Middle East. But whether you run a superpower or a small business, it matters as much as ever. Although it has only 6% of the world's people, it has a chokehold on the global economy. As the lowest-cost oil producer, its share of crude exports is 46% and rising. Its share of exports of liquefied natural gas, in great demand since Russia's pipelines to Europe shut down, is 30% and going up, too. Thanks to its location, 30% of all container trade and 16% of air cargo passes through the region. With \$3trn of assets, its sovereign-wealth funds are among the world's largest. Its wars and disorder often spill across borders; its refugees affect politics as far away as Europe.

The past two decades have been miserable in the Middle East. Democratic projects ended in failure and bloodshed, in Iraq after the American-led invasion of 2003 and in several countries after the Arab spring in 2011. Islamic State sought to kill its way to creating a caliphate, while in Syria Bashar al-Assad doused his own people in chlorine and nerve agents.

Yet now, as the fighting ebbs, three big changes are visible. First, the region is having to take more responsibility for its own security, as America's appetite to intervene militarily has evaporated. Alongside this, trade patterns have become multipolar: the IMF reckons 26% of Middle Eastern goods exports go to China and India, almost double the level in 2000 and roughly twice the share headed for America and Europe. Recently, this geopolitical realignment has led to a desire to de-escalate conflicts.

Second, the energy transition creates an urgent need to escape the familiar pattern of oil booms and busts. Instead there is a powerful incentive for the Gulf to lift fossil-fuel production in the next decade before demand dwindles permanently, and spend the proceeds on diversifying local economies.

The final shift is a weariness in public opinion. Political experiments, whether democratic or Islamist, are tarnished. Instead, people across the Middle East yearn for economic opportunity. Forget Canada or Sweden: polls show the country young Arabs admire most is the UAE, with its stability and thriving economy under iron-fisted dynastic rule. At the same time, less Western involvement in security and trade also means less pressure for human rights or democracy.

Some of the region's changes invite ridicule—think of a vanity project like NEOM, a gaudy new city being built for an estimated \$500bn by Muhammad bin Salman, Saudi Arabia's de facto ruler. But other changes are durable and profound. More women are working in the Gulf. Israeli tourists are thronging to Dubai. Across the region, the non-oil economy is growing at a healthy annual rate of 4% and cross-border multinational investment is rising. It is possible to imagine how a virtuous cycle of stability and peace might lead to more investment and trade that raises living standards and broadens prosperity, reversing a long-lasting spiral of failure in a part of the world with some 500m people.

Yet to achieve that, the Middle East will have to overcome some big problems. Many of these are familiar. The region's more enlightened autocrats argue that they face a kind of "performance accountability" to improve the lot of their populations. But regimes with absolute rule tend towards decay. Other dangers are new—or, rather, looming more menacingly than ever. Now that Iran is on the threshold of becoming a nuclear-armed state, proliferation is a grave worry. Climate change means that one of the world's hottest, driest places faces even more extreme weather. Only some countries can afford the investments, such as redesigned cities and desalination projects, that they need to remain habitable.

Most starkly, the new Middle East is more lopsided than in recent memory.

The success stories, the Gulf and Israel, account for only 14% of the population but 60% of GDP, 73% of goods exports and 75% of inward multinational investment. From Israel and the West Bank to Saudi Arabia and Yemen, modern economies border places trapped in despair. Lebanon is mired in financial crisis; Egypt could be heading the same way. The new Middle East's winners embody a transactional mindset that may yet make them richer. Its losers are a reminder that in a world with fewer rules and principles, no one is coming to the rescue. As you fill up your car or wait for your air-freighted parcel, remember they depend on a region that is an economic and political laboratory—and hope the experiment does not blow up. ■



冷静盘算

袖珍计算器如何为数字时代铺平道路

计算器的演变为计算的历史提供了新视角【《总和帝国：袖珍计算器的风光史》书评】

《总和帝国：袖珍计算器的风光史》，基思·休斯顿著。W.W.诺顿出版社，384页；32.50美元。10月将于英国出版，25英镑。

你上一次用计算器是什么时候？这些曾经看似神奇的小玩意在20世纪70年代经历了短暂的辉煌，现在大部分都在书桌抽屉里吃灰。基思·休斯顿（Keith Houston）写了一部活泼有趣的计算器历史，要让这块迈向数字时代路上的垫脚石得到应有的认可。他认为，计算器“帮助我们开创了普适计算的世界”。

计算器的故事从在南非发现的一根有4.2万年历史的计数棒开始，接着来到手指计数法，再到算盘和计算尺。但休斯顿叙事的真正开启是17世纪发条计算装置的出现。这些装置后来被越来越小、越来越强大的电气设备取代，它们先是用继电器，然后是阀门，最后用晶体管来计算。

作者的叙述诙谐幽默，还穿插了很多数学、科学和社会历史。现代术语有着深厚的历史根源：“digit”和“digital”（“数字”和“数字的”）让人联想起扳手指计数；“calculi”（微积分一词calculus的复数形式）是罗马人在类似算盘的计数板上所用的鹅卵石；“cursor”（光标）最初是计算尺上的游标，由牛顿首创；“computer”（计算机）一词最初指的是人，其中许多是女性，她们通常组队进行计算。

大多数人类计算员都名不见经传——1944年，美国政府的一个委员会甚至用“一千名女计算员”（kilogirl）作为算力单位。但也有例外。根据休斯顿的叙述，美国宇航员约翰·格伦（John Glenn）曾坚持让轨道力学专家凯瑟琳·约翰逊（Katherine Johnson）用Friden STW-10机电计算器手工验证他的航天器轨道。

第一部纯电子计算器是卡西欧14-A桌面计算器，它显示了之后的发展方向。美国、欧洲和日本公司之间的激烈竞争催生了更小、更便宜的机型。计算器的开发曾是计算的前沿领域。第一个微处理器Intel 4004是为日本Busicom公司生产的一款计算器而设计的。惠普于1972年推出的HP-35计算器是第一款广受欢迎的消费电子产品。计算器推动了计算的小型化和民主化。

而启动个人计算的是一款计算应用程序VisiCalc，史上第一个电子表格程序。今天要快速算一笔账，在手机或电脑上打开应用要比从抽屉里拿出计算器更快。休斯顿写道，现在计算器“无处不在，却又无处可寻”。他的观点是有道理的。总而言之，他令人信服地说明了计算器的重要地位。■



Coolly calculating

How the pocket calculator paved the way for the digital age

The evolution of the calculator offers a new perspective on the history of computing

Empire of the Sum: The Rise and Reign of the Pocket Calculator. By Keith Houston. W.W. Norton & Company; 384 pages; \$32.50. To be published in Britain in October; £25

WHEN WAS the last time you used a calculator? Having enjoyed a brief heyday in the 1970s, these once miraculous-seeming gizmos now mostly languish in desk drawers. Keith Houston's sprightly history aims to give the calculator the recognition it deserves as a stepping stone to the digital era. Calculators, he argues, "helped usher in the world of ubiquitous computing".

It is a tale that starts with a 42,000-year-old tally stick found in South Africa and moves through finger-counting systems to the abacus and the slide-rule. But Mr Houston's narrative really gets going with the advent of the clockwork calculating devices in the 17th century. These in turn gave way to ever smaller and more capable electrical devices in which numbers were crunched by relays, valves and ultimately transistors.

All this is recounted with wry wit, plus numerous detours into mathematics, science and social history. Modern jargon has deep roots: "digit" and "digital" recall finger-counting systems; "calculi" were pebbles used by Romans on abacus-like counting boards; a cursor was originally a sliding indicator on a slide-rule, pioneered by Isaac Newton; and computers were originally people, many of them women, who performed calculations, often in teams.

Most human computers were anonymous—in 1944 an American

government committee even used “kilogirl” as a unit of computing power—but not all. Mr Houston explains how John Glenn, an American astronaut, insisted on having the trajectory of his spacecraft hand-checked by Katherine Johnson, an expert in orbital mechanics, using a Friden STW-10 electro-mechanical calculator.

The first purely electrical calculator, the desk-sized Casio 14-A, showed where things were heading. Fierce competition between firms in America, Europe and Japan led to smaller, cheaper models. Calculator development was computing’s cutting edge. The first microprocessor, the Intel 4004, was designed for a calculator made by Busicom, a Japanese firm. Hewlett-Packard’s HP-35, launched in 1972, was the first smash-hit consumer-electronics product. Calculators drove the miniaturisation and democratisation of computing.

And it was a calculating app—VisiCalc, the first spreadsheet program—that kick-started personal computing. To do a quick sum today, it is quicker to open an app on your phone or computer than to reach into a drawer. Calculators, Mr Houston writes, are now “everywhere and nowhere at once”. His thesis adds up. He makes a convincing case, in sum, for the significance of the calculator. ■



熊彼特

美国的老板不退场。这可能有麻烦

鲍勃·艾格不是唯一一个在位太久的

在CEO们头脑里盘旋的众多忧虑中，没什么比接班人问题更叫人不安的了。千辛万苦才爬到公司最高层，许多老板很难想象要让出控制权，把自己的天下交到另一个人手中。

越来越多的美国老板索性就把此事容后再议了。根据数据供应商MyLogIQ的数据，截至去年底，标普500企业中已有101名CEO驻守该职位超过十年，而十年前仅为36人。尽管有些人是所经营公司的创办者——比如其中任职时间最长的沃伦·巴菲特在位53年——大多数人都是从外部请来的。许多人比其前任在位更久，包括摩根大通银行的杰米·戴蒙（Jamie Dimon）、软件公司Adobe的尚塔努·纳拉延（Shantanu Narayen），以及特许经营酒店希尔顿的克里斯·纳塞塔（Chris Nassetta）。过去十年里，这些长期在位的CEO把标普500企业老板的平均任期从六年延长到了七年。

一些老板因不肯让位而臭名昭著。今年早些时候，霍华德·舒尔茨（Howard Schultz）结束了他身为咖啡连锁店星巴克老板的第三次任期。去年年底，鲍勃·艾格（Bob Iger）从他选择的继任者鲍勃·查佩克（Bob Chapek）手中拿回了对媒体巨头迪士尼的控制权。今年7月，他的两年合同被延长至2026年底。继任问题长期笼罩在巴菲特的企业集团伯克希尔哈撒韦之上。

当然，很多长久在位的领导都把公司管理得很好。而随着人们保持健康的年数普遍变得更长，一到人为设定的退休年龄就强迫老板离职的做法（许多公司仍然这样做）是没有必要的。但是，美国商界领袖的任期延长仍然令人担忧。

1991年，当时就读于哥伦比亚商学院的唐纳德·汉布里克（Donald

Hambrick) 和格雷戈里·福富富 (Gregory Fukutomi) 发表了一篇关于CEO任期“赛季”的颇具影响力的论文。他们指出，在最初的几年里，随着老板们开始摸到门道，绩效会提高，但后来又会下降，因为他们变得更抗拒变化了，对工作的投入度也会减退。波士顿大学的弗朗索瓦·布罗切特 (Francois Brochet) 及其合著者在2015年发表了一篇论文，试图通过研究美国上市公司的市值与CEO任期的关系来量化这一临界点。他们发现，在CEO工作的大概头十年里绩效一直上升，然后趋于平缓，在大约15年后开始下降。

“最终你不再那么干劲十足，创造力也会减退。”曾经营医疗科技公司美敦力 (Medtronic)、目前在哈佛商学院任教的比尔·乔治 (Bill George) 说。这种活力在一家公司需要自我重塑时尤其重要。微软在萨蒂亚·纳德拉 (Satya Nadella) 的领导下转型为站在人工智能前沿的云计算巨头。假如带领这家公司捱过2000年至2014年停滞期的史蒂夫·鲍尔默 (Steve Ballmer) 还在老位子上，这可能永远不会发生。

即使一位CEO的出色表现配得上长任期，延期逗留仍有其风险。艾格在担任迪士尼一把手的最初15年里三度延迟了退休，这让一些潜在继任者只能转战他处碰运气。猎头公司史宾沙 (Spencer Stuart) 的杰森·鲍姆加滕 (Jason Baumgarten) 指出，如果董事会等着找到一位能与现任CEO的经验相媲美的接班人，必然會发现拖得越久就越难找到。

咨询公司毕马威 (KPMG) 的克劳迪娅·艾伦 (Claudia Allen) 表示，理想情况下，继任计划应该从CEO上任那天就启动。这包括建立候选人管道、评估他们的技能，并制定一个填补空白的计划。最好避免像曾经强大的美国工业巨头通用电气那样，上演为杰克·韦尔奇物色继任人的六年大戏。把CEO和董事会主席的角色分开也会有所帮助（靠任命一位首席独立董事很少能牵制得了一个兼任两职的全能老板，更不用说让这样一个大老板下台了）。标普500企业在位超过10年的CEO有三分之二同时担任董事会主席，而在全部CEO中这一比例为五分之二。

或许，继任方案中最重要的规则是一刀两断。在任期结束后阴魂不散的老

板会给他们的继任人帮倒忙。最有害的例子是CEO继续担任“执行董事长”——一个定义松散的头衔，赋予其持有者干涉重大决策的权利，同时却不需要承担运营责任。摩根士丹利的詹姆斯·戈尔曼（James Gorman）在未来几个月辞去该行CEO后就会担任这个职务。

去年，15%的标普500公司仍有一名话事的执行董事长。贝索斯和默多克等一些企业创始人渴望在自己创办的公司中保有发言权。而对于其他人来说，这个角色可能看起来是实现平滑交接的一种好用方法。但它会带来危险。前任老板们可能很难接受战略转变，到底由谁说了算的混沌不明也挥之不去。在艾格担任迪士尼执行董事期间，他和查佩克在一些重大决策上发生了冲突，削弱了查佩克的公信力。

CEO们发现自己很难撒手，这不奇怪，而且不仅仅是因为权力的诱惑力使然。乔治表示，许多人很难适应在事业巅峰上下来后无事可干。相比在退休后过上闲适生活，他建议老板们为自己积累的智慧找到用武之地。有些人可能会选择出任董事会成员。其他人可能会像他一样做导师。还有些人可能尝试涉足政坛。在最近一次重返星巴克之前，舒尔茨曾考虑过竞选总统。一些人建议戴蒙也去试试。要接受你领导的组织在没了你的情况下仍活得好好地有点不是滋味。但让位并不意味着就要从此湮没无闻。美国的许多老板仍有很多可以给予的——尤其是给下一代老板一试的机会。■



Schumpeter

America's bosses just won't quit. That could spell trouble

Bob Iger is not the only one hanging around for too long

OF THE MANY worries that whirl around the minds of chief executives, few are more unsettling than the question of succession. Having toiled their way to the top of the corporate ladder, many bosses struggle to imagine relinquishing control and placing their legacy in the hands of another.

A growing number of America's bosses have instead opted to defer the matter altogether. By the end of last year 101 S&P 500 CEOs had held the corner office for more than a decade, up from just 36 ten years earlier, according to figures from MyLogIQ, a data provider. Although some, like Warren Buffett, the longest-serving of the lot with 53 years on the clock, built the companies they run, most are hired hands. Jamie Dimon of JPMorgan Chase, a bank, Shantanu Narayen of Adobe, a software firm, and Chris Nassetta of Hilton, a hotel franchise, are among the many who have outlasted their predecessors. Such long-serving chief executives have pushed up the average tenure of S&P 500 top dogs from six years to seven over the past decade.

Some bosses have become infamous for their reluctance to move on. Earlier this year Howard Schultz ended his third stint as boss of Starbucks, a coffee chain. Late last year Bob Iger took back the reins at Disney, a media giant, from his chosen successor, Bob Chapek. In July his two-year contract was extended until the end of 2026. The question of succession has long loomed over Mr Buffett's conglomerate, Berkshire Hathaway.

Of course, plenty of companies are well served by chiefs who hang around. And with populations healthier for longer, forcing bosses out once they

reach an arbitrary retirement age, as many firms still do, is unnecessary. Yet the lengthening tenures of America's business leaders is a cause for concern.

In 1991 Donald Hambrick and Gregory Fukutomi, then both at Columbia Business School, published an influential paper on the "seasons" of a chief executive's tenure. They suggested that, in the early years, performance improves as the boss learns the ropes, but later declines as they become more resistant to change and less engaged in the job. A paper in 2015 by Francois Brochet of Boston University and co-authors sought to quantify that tipping-point by studying the relationship between market value and CEO tenure among listed American firms. They found that performance rose through roughly the first decade on the job before flattening off, then starting to dip after around 15 years.

"Eventually you lose the oomph and the creativity," says Bill George, who once ran Medtronic, a medical-technology company, and now teaches at Harvard Business School. That vigour is especially crucial when a company is in need of reinvention. Microsoft's transformation under Satya Nadella into a cloud-computing giant in the vanguard of artificial intelligence may never have happened had Steve Ballmer, who led the business through a period of stagnation from 2000 to 2014, stuck around.

An extended stay carries risks even when a chief executive's long stint seems justified by stellar performance. Mr Iger delayed retirement three times during his original 15-year spell as Disney's boss, leading a number of potential successors to try their luck elsewhere. Boards waiting to find a replacement CEO with experience comparable to the incumbent's necessarily find it harder the longer they delay, notes Jason Baumgarten of Spencer Stuart, a headhunting firm.

Ideally, succession planning should begin the day the CEO starts, says

Claudia Allen of KPMG, a consultancy. That involves building a pipeline of candidates, assessing their skills and developing a plan to fill gaps. Public spectacles like the six-year saga to replace Jack Welch at GE, a once-mighty American industrial giant, are best avoided. Separating the roles of chief executive and chairman of the board can help, too (appointing a lead independent director is seldom sufficient to keep in check an almighty boss with both jobs, let alone sack one). Two in three S&P 500 CEOs who have been in the role for longer than a decade also chair the board, compared with two in five for the whole group.

Perhaps the most important rule for succession is to make a clean break. Bosses who hang around after their turn has ended do their successors a disservice. The most pernicious example of this is the chief executive who stays on as “executive chairman”, a loosely defined title that gives its bearer the right to meddle in big decisions while shirking operational responsibility. James Gorman of Morgan Stanley will take on the title when he steps down as the bank’s CEO in the coming months.

Last year 15% of S&P 500 companies were presided over by an executive chairman. Some, like Jeff Bezos and Rupert Murdoch, are founders eager to maintain a say over the companies they built. For the rest, the role may look like a handy way to smooth a transition. But it brings dangers. Predecessors may struggle to accept shifts in strategy, and confusion may reign as to who is ultimately in charge. During Mr Iger’s stint as executive chairman of Disney, he and Mr Chapek clashed over a number of big decisions, denting the new hand’s credibility.

That CEOs find it hard to let go is unsurprising, and not only because power is seductive. Many struggle with the sense that, having reached their professional pinnacle, there is little left to do, says Mr George. Rather than retiring to a life of leisure, he counsels bosses to find ways to make use of their wisdom. Some may choose to sit on boards. Others, like him, may

teach. Others still may try their hand at politics. Before his latest return to Starbucks Mr Schultz toyed with a presidential bid; Mr Dimon is being urged by some to pursue one. It is uncomfortable to accept that an organisation you lead will survive without you. But stepping down need not mean stepping into obscurity. Many of America's bosses still have plenty to give—not least a shot for the next generation. ■



居家办公的未来

尼古拉斯·布鲁姆预测，居家工作的走势将先抑后扬

这位斯坦福大学的经济学家认为，企业、员工和社会都将受益【约稿】

媒体上满是从亚马逊到Zoom的公司将员工拉回办公室的报道。那么居家办公的日子是到头了？还是说远程工作本来就只是疫情时代的产物，不过是因为劳动力市场紧张才多存在了一阵？

不是的。我相信，已经稳定下来的远程工作模式很快就会重新开始增长。它将呈现一个先抑后扬的走势，形如耐克的对钩标志：在疫情过后先下降，然后走入目前的稳定阶段，接着便是未来的长久上扬。

在疫情前，欧洲和美国大约有5%的完整工作日是在家度过的。专业人士偶尔才会居家工作，也许是为了照顾生病的孩子，或者接待水管工上门。现在，大约25%的劳动人口采用混合工作制，通常每周在家工作一到两天。另有8%的人完全采用远程工作。总的来说，现在人们大约20%的工作日是在家工作。放眼未来，两股强大的经济力量将推动居家办公上行，10年后人们可能有30%的工作日是居家工作。

第一股也是最强劲的力量是技术的持续改善。1965年，美国只有0.4%的工作日是在家完成的。在技术进步的推动下，这一比例大约每15年翻一番，直到2019年。这些技术进步包括上世纪80年代个人电脑的流行、90年代笔记本电脑的普及、本世纪头十年互联网的爆炸式发展，以及最近期的云文件共享和视频通话。

这些技术使远程工作变得更加容易。试想在没有电脑或互联网的情况下居家工作会是什么样子。我幼年时父母两人都工作，得以目睹了这种情景。我父母偶尔会在紧急需要照看孩子时在家工作，过程充满挑战。80年代的远程工作需要携带大量文件往返办公室，还会被排除在会议和关键决策之外。现在，我们都在时髦的笔记本电脑上举行视频会议，即时云共享文件，并与远程的同事（还算）无缝地连接。

在熊彼特式的“市场规模效应”经济学的作用下，技术进步正在加速。当市场增长时，企业希望通过创新来服务新扩大的、更有利可图的市场。随着居家办公自2019年以来大幅增长，生产最好的摄像头、视频会议工具包或日程管理软件的回报也已飙升。

在我居住的硅谷，我目睹了由此引发的一场虚拟淘金热。风险投资家、创业公司和老牌科技公司都在竞相开发下一个爆款远程工作设备或应用程序。对此，一项指标是向美国专利局提交的申请。在全球进入由新冠疫情引发的封锁后，提到“远程办公”、“居家工作”或“远程工作”等词的新申请占比猛增，目前仍是疫情前水平的两倍。居家办公的激增已经为它在未来的加速埋下了技术的种子。

支持远程办公的第二股力量是企业的“族群效应”。数据显示，较年轻的创业公司往往更注重远程工作。这些公司生逢一个办公室可有可无、在网上与客户和商业伙伴会面是标配的时代。许多人认为放弃办公室、采用更多远程办公人员是节省成本的关键策略。结果，相比已创立30年的公司，如今新公司的员工在家工作的天数几乎多了一倍。

社会应该敞开怀抱接纳居家办公的耐克对钩走势。员工们会受益。他们认为混合工作的价值相当于加薪8%。事实上，与我交谈过的招聘人员认为，养老金和医保这“两大”就业福利已经变成了“三大”——多了个远程办公。

公司也会从中受益。研究发现，混合工作可以将员工流失率减少30%至50%，还可以节省办公成本，并让公司更好地利用全球市场寻觅人才。事实上，美国公司在2022年报告了创纪录的利润，美国经济的年劳动生产率增长也从疫情前五年的1.2%加速到疫情后的1.5%。当然，有很多因素在起作用，但远程工作激增是这种生产率复兴的一个潜在推动力。

这种积极效应可能显得扑朔迷离，因为眼下一些高管正在抱怨居家办公损害生产率。这里有两点没有厘清。首先，尽管完全远程工作可能会降低个人的工作效率，但在欧美，采用混合工作模式的人数是完全远程工作者的

三倍。研究表明，混合工作制让人们每周在办公室工作几天，再在家里清净而投入地工作，还能省下几个小时令人筋疲力尽的通勤时间，实际上提高了生产率。

此外，即使完全远程工作降低了个体的生产率，但也释放了数十亿美元的办公和运输资本供经济的其他部分使用，从而推动了总生产率的提高。生产率是产出与投入之比，尽管完全远程工作人员每小时的产出可能减少了，但他们使用的资本也大大减少，因此他们对总生产率的影响很可能是积极的。

减少通勤对环境也有好处。与疫情前的水平相比，居家办公使全球每年的通勤里程减少了惊人的500亿英里。最后，让父母能有更多的时间待在家里、减轻幼托负担，并更多地参与抚养下一代，社会也会受益。

这种向混合工作方式的转变可能是自电脑问世以来，办公室生活发生的最彻底的变化。再过十年，我在斯坦福大学的学生们回想起疫情前每周在办公室工作五天的常态时，可能就会像我们看到西装革履的上班族狂敲打字机的老照片时惊奇不已一样，觉得它古旧、令人费解，感觉像是上个时代的东西。

尼古拉斯·布鲁姆是斯坦福大学威廉·D·埃伯利经济学讲席教授。 ■



The future of WFH

Nicholas Bloom predicts a working-from-home Nike swoosh

Firms, employees and society will all benefit, reckons the Stanford economist

THE MEDIA are full of stories of how firms from Amazon to Zoom are dragging their employees back into the office. So is working from home (WFH) over? Was this simply a pandemic-era remote-work boom extended by tight labour markets?

No. I believe that, having stabilised, WFH will soon start growing again. Remote working is set to undergo a Nike swoosh, with an initial post-pandemic drop, followed by its current stabilisation and a future long-run surge.

Before the pandemic about 5% of full paid days were worked from home across Europe and America. Working from home was something professionals would do occasionally, perhaps to look after a sick child or let in the plumber. Now about 25% of the workforce is on a hybrid schedule, working from home typically one or two days a week. Another 8% are working a fully remote schedule. Overall, about 20% of all days are now worked from home. Looking ahead, two powerful economic forces will drive WFH up, perhaps to 30% of days worked a decade from now.

The first and most powerful of these is improving technology. In 1965 just 0.4% of days were worked from home in America. The share then doubled roughly every 15 years until 2019, driven by technological advances. These included the personal computer in the 1980s, the spread of laptops in the 1990s, the explosion of the internet in the 2000s and most recently cloud file-sharing and video calls.

These technologies made it easier to work remotely. Imagine trying to work

from home without a computer or the internet. I saw this first-hand as a child of two working parents. My parents would occasionally work from home when child-care emergencies happened, and it was a challenging experience. This remote work in the 1980s required carrying wads of paper to the office and back, and being excluded from meetings and key decisions at work. Now we all video-conference on sleek laptops, instantly cloud-sharing files, and connect (fairly) seamlessly with remote colleagues.

The rate of technological progress is accelerating thanks to the Schumpeterian economics of “market-size effects”. When markets grow, firms want to innovate to serve the newly enlarged and more profitable market. As WFH has jumped since 2019, the rewards from producing the best video camera, video-conference package or desk-scheduling software have also shot up.

I see the virtual gold rush that this has provoked in Silicon Valley, where I live: venture capitalists, startups and established technology firms are racing to build the next remote-working gadget or app. One indicator of this is filings with America’s patent office. The share of new filings mentioning words such as “telework”, “work from home” or “remote work” spiked after the world went into covid-induced lockdown and remains at double the pre-pandemic level. The surge in WFH has sown the technological seeds of its own future acceleration.

The second force supporting remote working is business “cohort effects”. Data show that younger startups tend to be more remote-focused. These firms have been born in an era when having an office is optional and meeting customers and business partners online is standard. Many see forgoing offices and using more remote workers as a key cost-saving strategy. As a result, employees at today’s new firms work almost twice as many days from home as those at firms founded 30 years ago.

Society should embrace the Nike swoosh of WFH. Employees gain. They put a value on hybrid working that is equivalent to an 8% pay increase. Indeed, recruiters I talk to argue that the “big two” employment perks—pensions and health care—have become the “big three” with the addition of remote working.

Firms gain, too. Studies find that hybrid working can reduce employee turnover by 30-50%, as well as saving office costs and allowing companies to better tap global markets for talent. Indeed, American firms reported record profits in 2022 and the American economy has seen annual labour productivity growth accelerate from 1.2% in the five years before the pandemic to 1.5% since. There are many factors at play here, of course, but the surge in remote working is one potential contributor to this productivity renaissance.

This positive impact may seem puzzling given complaints by some executives that WFH is damaging productivity. There are two confusions here. First, while fully remote work can potentially reduce individual productivity, three times as many Europeans and Americans work a hybrid schedule as a fully remote one. Research suggests that the blend provided by hybrid working—a few days a week in the office, quiet time at home for deep work and hours of exhausting commuting time saved—increases productivity.

Furthermore, even if fully remote working reduces individual productivity, by releasing billions of dollars of office and transportation capital for other parts of the economy to use, it stokes a rise in aggregate productivity. Productivity is about outputs relative to inputs, and although fully remote workers may produce less per hour they use a lot less capital, so their impact on aggregate productivity is likely to be positive.

With less travelling to work, the environment also benefits. WFH has

reduced global commuting by a staggering 50bn miles a year from the pre-pandemic level. Finally, society gains by allowing parents to spend more time at home, easing the burdens of child care, and to be more involved in raising the next generation.

This shift to hybrid working has been perhaps the most radical change to office life since the introduction of the computer. A decade from now my Stanford students may look back to the pre-pandemic norm of five-day weeks in the office the same way we marvel at old photographs of besuited office workers bashing away on typewriters: quaint, puzzling and something that feels like a bygone era. ■

Nicholas Bloom is the William D. Eberle Professor of Economics at Stanford University. ■



【首文】温和护卫大丹犬

要修复失灵的抵押贷款市场，不妨学学丹麦

不断上涨的利率暴露了大量住房贷款存在的问题

抵押贷款一旦出问题，便事关重大。住房贷款支撑起了数十万亿美元的金融资产，更不用说它还关乎人生中一些最重要的交易。好在目前富裕国家没有了那种导致2007至2009年全球金融危机的肆意放贷，但抵押贷款市场仍然存在很多问题。过去一年半里利率飙升，让这些问题暴露了出来。

在美国，由于有联邦政府的背书，购房者长期享受着可提前偿还的30年期固定利率抵押贷款。联邦政府为抵押贷款支持证券提供隐性担保，这些证券通过房利美（Fannie Mae）和房地美（Freddie Mac）等机构出售给投资者。目前30年期抵押贷款平均利率超过7.2%，是2001年以来的最高水平。现在很清楚的是，所有在2021年初利率为2.7%时贷款的人，都抓住了千载难逢的机遇——尤其是房价已经一路上涨了近三分之一。

问题在于这样的房地产金融体系已经扰乱了房地产市场。换房意味着要以高得多的利率重新贷款。因此，那些可能经常搬家的房主转而选择按兵不动。在一个除此之外都很火热的经济体中，二手房销售量少之又少，几乎相当于2020年疫情封锁期间的水平。买家只能去抢购存量少得多的新房，新房销售量比一年前高出近三分之一。首次加息后曾经短暂下跌的房价再次达到历史高点。

如果说美国提供了一个显示政府干预是如何扭曲市场的研究案例，那么其他国家的体系则表明利率攀升对一些家庭构成的威胁有多严重。在英国，贷款人的利率固定期限通常只有几年。因此，当贷款人重新申请低息贷款时，他们的还款压力就会越来越大。到2026年底，他们中有200万人每年将会多支付3600多英镑（4570多美元）的抵押贷款还款——超过家庭收入中位数的10%。瑞典的情况也类似，几乎90%的贷款的固定利率期限为两年或更短。在新西兰，单是利息成本很快就可能超过借款家庭可支配收入

的五分之一。

没有人强迫房主贷款买房，而且他们往往较为富裕。但是，在崇尚居者有其屋的国家，家庭像完成人生必经仪式一般在利率上押下重注（或许还是稀里糊涂地）可不是理想的情形。如果有得选，他们会选长期固定利率——就像许多美国人那样。

幸运的是，在因干预而扭曲的美国体系和不加管制的自由浮动利率之间，有一个经过考验的折衷方案。在丹麦，购房者贷款时可以选择30年期固定利率，并且可以提前还贷。约有一半的贷款人把还款期限定为30年。不过这里不存在房主“被锁定”的问题，因为卖房者可以以市场价（当利率上升时，市场价会下降）买回房子，终止抵押贷款，从而将利率固定带来的价值变现。或者，他们也可以将抵押贷款转移给新的房主。这增加了市场活力：2023年第一季度，丹麦的房屋交易量与去年同期相比仅下降了6%，而美国二手房的交易量则下降了22%。

政府不提供任何担保。在丹麦，美国房利美和房地美的角色由资本雄厚的抵押贷款银行充当。它们有厚实的安全“缓冲垫”，因此在2007至2009年金融危机时没有像房利美和房地美那样需要政府全面救助。它们与房利美和房地美的不同之处还在于，它们发放贷款，并为流向投资者的还贷提供担保，这促进了审慎放贷。

但这里也存在潜在的问题：抵押贷款银行受到对债权人友好的规则的保护以防损失，包括快速止赎程序，以及给宣告破产设置障碍等。但是，当许多国家的抵押贷款市场要么扭曲了经济，要么造成生活困境时，丹麦体系提供的灵活性和安全性就很让人羡慕了。其他国家不妨借鉴一下。■



Great Danes

To fix broken mortgage markets, look to Denmark

Rising interest rates have exposed the problems with many home loans

IT MATTERS WHEN mortgages malfunction. Home loans underpin tens of trillions of dollars of financial assets, not to mention some of life's most important transactions. And though the rich world is mercifully free of the tearaway lending that caused the global financial crisis of 2007-09, mortgage markets remain riddled with problems. The sharp rise in interest rates over the past year and a half has exposed them.

In America buyers have long enjoyed 30-year fixed-rate prepayable mortgages courtesy of the federal government. It implicitly guarantees mortgage-backed securities that are sold to investors through agencies such as Fannie Mae and Freddie Mac. The average 30-year rate stands at over 7.2%, the highest since 2001. It is now clear that anyone who borrowed in, say, early 2021, when the rate was 2.7%, secured the deal of a lifetime—especially as house prices have gone on to rise by nearly a third.

The trouble is that the system has gummed up the housing market. Moving home means borrowing afresh at much higher rates. So homeowners who might usually up sticks are instead staying put. In an otherwise hot economy, sales of existing homes are almost as rare as they were during pandemic lockdowns in 2020. Buyers have been left competing for the much smaller stock of new homes, sales of which are nearly a third higher than a year ago. And house prices, having dipped briefly after rates first rose, are once again reaching all-time highs.

If America offers a case study in how government intervention can distort the market, other systems show how severely higher rates threaten some

households. In Britain borrowers typically fix their interest rate for only a few years. As a result the screw is steadily turning on borrowers as they refinance cheap loans. By the end of 2026, 2m of them will have faced a rise in annual mortgage payments of more than £3,600 (\$4,570)—over 10% of median household income. The situation is similar in Sweden, where almost 90% of loans have a fixed-rate period of two years or less. In New Zealand interest costs alone could soon exceed a fifth of borrowing households' disposable income.

Nobody forced homeowners to borrow, and they tend to be well-off. But it is not ideal that, in countries where homeownership is prized, households take enormous, perhaps unwitting, bets on interest rates almost as a rite of passage. Many would take out interest-rate fixes if they could—as many Americans do.

Fortunately there is a proven middle ground between the distorted American system and a floating-rate free-for-all. In Denmark homebuyers can borrow at 30-year fixed rates, and mortgages are prepayable. About half of borrowers fix for three decades. Yet there is no problem of “locked in” homeowners because a seller can end a mortgage by buying it back at its market value, which falls when rates rise, thereby cashing out the value of their interest-rate fix. Alternatively they can transfer their mortgage to the home’s new owners. The result is greater dynamism: in the first quarter of 2023 housing transactions were down by only 6% on a year earlier, compared with 22% for existing homes in America.

The government provides no guarantees. The role that Fannie and Freddie play in America is fulfilled in Denmark by highly capitalised mortgage banks. Their thick safety buffers meant that, unlike Fannie and Freddie, they did not require a full-scale government rescue in 2007-09. And unlike America’s agencies, they originate the loans whose payments to investors they guarantee, which encourages prudent lending.

There are catches: mortgage banks are protected from losses by creditor-friendly rules, including swift foreclosure procedures and barriers to declaring bankruptcy. But the flexibility and protection the Danish system offers is enviable when many mortgage markets are either distorting economies or causing hardship. Other countries would do well to try it. ■



遍布、晦暗、缠结

影子银行威胁中国的金融体系

经济增长乏力让危机更易蔓延

中国影子银行新华信托所持有的股权正以地板价出售。该公司于今年5月破产，成为中国二十多年来首家倒闭的信托公司。自那以后，该公司的大块资产就以七折的价格在电商平台淘宝上出售。最近，公司名下的汽车也进入司法拍卖。捡漏者只需花12,000元就能买下新华信托持有的几个注册商标。

这家贷款机构的倒闭是一记警钟：击垮它的力量正在席卷拥有21万亿元资产的中国信托行业。中国的经济增长弱于预期，而房地产开发商深陷一轮可怕的违约和重组潮。将投资者的资金投向基础设施、房地产等领域的中国信托公司因此受到双重冲击。虽然新华信托的破产相对简单明了，但作为中国最大信托公司之一的中融信托却恐怕要爆更大的雷，该公司在8月中旬出现逾期兑付。恐慌的投资者担忧会有更多公司卷入其中，接连的崩盘将引发更多经济问题。

在中国经济强劲增长的年代里，信托公司及其投资者意气风发，投资产品的年回报率往往达到 10% 甚至更高。房地产开发商和地方政府愿意支付高昂的利率；与银行贷款相比，交易受到的监管审查较少。认为投资者的钱像银行存款一样受政府保护的普遍认知让信托公司受益。如今这种观念早已不复存在，而随着越来越多的开发商违约，很可能会有更多的影子银行无力兑付。

中融截至去年年底管理着约达6300亿元的信托产品，它显示了疼痛如何从房地产蔓延到金融体系。去年中国第五大开发商融创违约之后，地方政府开始冻结该公司资金以确保项目完工。实施冻结的地区包括华中城市武汉，其中就涉及了与中融关联的投资。截至今年3月底，全行业约有7%的信托产品投资于房地产业。澳新银行（ANZ）的分析师认为，再加上通过

证券进行的间接投资，这一比例可高达30%。

信托放贷无处不在、晦暗不明，投资于信托生成了缠结的关系，因此危机蔓延的风险很高。8月29日，中融最大的投资者、国资背景的经纬纺机以“市场变化”为由，宣布将从深圳证券交易所退市。其他投资了中融产品的上市公司称该公司逾期兑付。与此同时，信托公司在股票、债券和其他基金上的投资约为4.6万亿元。它们还为地方政府项目提供贷款——而现在中国各地省市都出现偿债困难，2022年底的债务余额估计达到57万亿元。

麻烦还可能经由另一条通道蔓延。中融由一家名为中植的规模更大的投资管理公司控制，中植旗下各部门管理着约1万亿元的资产。而中植也陷入了流动性危机，据说已无力偿付约15万投资者2300亿元的债权。在全国各地，类似的资管公司拥有数百万客户。据另一家资管公司的高管称，自从中植爆雷的消息传出后，电话就一直响个不停，忧心忡忡的客户想要确认自己的存款是否安全，其中许多人是普通白领。

信托公司、地方政府和开发商之间的这种关联，以及更大规模的金融公司也被卷入危机的可能性，令投资者感到恐慌。事实上，中融的困境已经拖累了中国股市。基准股指沪深300在8月下跌超过6%。政府祭出各项干预措施，包括8月27日下调印花税，但收效甚微。

官员们知道这些问题。毕竟，其中许多是他们在无意间促成的。自2017年以来，为了将不透明的表外借贷转到银行，中国的影子银行一直受到严格审查。2020年，国家对房地产开发商的杠杆率实施严格限制，官方打击力度进一步加大。研究机构凯投宏观（Capital Economics）的数据显示，由于这些举措，今年上半年影子银行产品的发行量为十年来最低。打击措施削弱了市场的流动性和信心，把开发商和信托公司都推向了违约的境地。

短期内，富有的投资者将承担大部分苦果：投资信托的资金门槛通常超过30万元。产品一般设有禁止撤资的条款，有时长达两年，因此多数投资者甚至无法要求返还初始投资。这或许避免了因影子银行挤兑而引发全面的金融危机，也给政府争取了收拾局面的时间。彭博社报道称，中国银行业

监管机构已经成立了一个特别工作组调查中植系的问题。鉴于这类公司与整个经济千丝万缕的联系，调查结果恐怕难以令人安心。■



Ubiquitous, opaque, tangled

China's shadow-banking industry threatens its financial system

Weak economic growth means the country is particularly vulnerable to contagion

SHARES IN XINHUA TRUST, a Chinese shadow lender, are selling for rock-bottom prices. The outfit went bankrupt in May, becoming the first Chinese trust to fall in more than two decades. Since then chunks of the firm have been put up for sale on Taobao, an online e-commerce platform, at a 30% discount. Its company cars were recently added to the auction, which has been mandated by a court. A bargain-hunter could snap up Xinhua trademarks for just 12,000 yuan (\$1,650).

The lender's demise was a warning: the same forces that brought it down are now ripping through China's trust industry, which has assets of 21trn yuan. The country's economic growth has been weaker than expected, and property developers are caught in a daunting wave of defaults and restructurings. China's trusts, which channel funds from investors to infrastructure, property and other opportunities, are exposed to both developments. Although Xinhua's bankruptcy has been straightforward, a bigger blow-up may be on the way at Zhongrong, one of the country's largest trusts, which missed client payments in mid-August. Panicked investors fear more firms will be ensnared, and that collapses will lead to further economic problems.

During China's years of strong growth, trusts and their investors flourished, with investment products often offering annual returns of 10% or more. Property developers and local governments were willing to pay lofty interest rates, transactions required less regulatory scrutiny than bank lending and trusts benefited from the widespread perception that investors' cash was safeguarded by the state in a fashion similar to bank deposits. That

perception is now long gone—and as more developers default, it is likely that more shadow banks will be unable to pay out.

Zhongrong, which managed about 630bn yuan in trust products at the end of last year, shows how pain has spread from property to the financial system. When Sunac, China's fifth-largest developer, defaulted last year, local governments began freezing company funds in order to ensure that projects were finished. One place where funds were frozen was Wuhan, a city in central China, and the money included investments linked to Zhongrong. Across the industry, about 7% of trust products were invested in the property sector at the end of March. Indirect investments via securities push that exposure to as much as 30%, reckon analysts at ANZ, a bank.

The risk of contagion is high because lending by trusts is ubiquitous and opaque, and investment in them produces tangled ties. On August 29th Jingwei Textile Machinery, a state-backed firm and Zhongrong's largest investor, announced it would delist from the Shenzhen stock exchange, citing "market changes". Other listed firms that invest in Zhongrong's products say the company has missed payments. Trusts have meanwhile invested about 4.6trn yuan in stocks, bonds and other funds. They have also lent to local-government projects—and now cities and provinces across China are struggling to repay debts, which are estimated to have hit 57trn yuan at the end of 2022.

There is another avenue through which trouble may spread. Zhongrong is controlled by a larger investment manager, called Zhongzhi, which has about 1trn yuan in assets under management across an array of divisions. Zhongzhi has also been thrown into a liquidity crisis and has reportedly been unable to pay the 230bn yuan it owes to some 150,000 investors. Across the country, similar investment-management firms have millions of customers. Since news of Zhongzhi's troubles broke, phones have been ringing off the hook as worried clients, many of whom are regular white-

collar workers, seek to confirm their savings are safe, reports an executive at another of these companies.

These sorts of links between trusts, local governments and developers, and the possibility of larger financial firms getting caught in the trouble, have spooked investors. Indeed, Zhongrong's troubles have contributed to the poor performance of the Chinese stockmarket. The CSI 300, a benchmark index, fell by more than 6% in August. Government interventions, which included a cut to stamp duty on August 27th, have had little impact.

Officials are aware of these problems. After all, they inadvertently brought many into being. Since 2017 China's shadow banks have been under intense scrutiny as part of an effort to transfer opaque off-balance-sheet lending to banks. The official attack was ramped up in 2020 when the state introduced sharp restrictions on leverage at property developers. As a result of such moves, the issuance of shadow-banking products in the first half of this year was at its weakest in a decade, according to Capital Economics, a research firm. The crackdown has sapped liquidity and confidence from the market, pushing both developers and trust firms towards default.

In the short term, much of the pain will be borne by wealthy investors: the threshold for putting money into a trust is usually more than 300,000 yuan. Most cannot even demand the return of initial investments, since products usually have terms that prevent investors from withdrawing, sometimes for up to two years. This may stop a fully fledged financial crisis caused by a run on shadow lenders, and will give the government time to deal with the mess. Bloomberg, a news service, has reported that China's banking regulator has already set up a task force to examine the problems at Zhongzhi. Given the connections such firms have across the economy, inspectors might not like what they find. ■



购物频道

亚马逊拥有好莱坞最烂的剧和最好的商业模式

它的目标是把做电子商务的那一套拿来让视频内容赚钱【深度】

一辆高速列车正穿行在意大利境内的阿尔卑斯山区，乘客中有一名前世界小姐和一伙间谍。在子弹纷飞之际，观众定然是万万想不起购物这件事的。然而，如果他们在这时按下暂停键，就会看到一个购买剧中物品的选项：女主角的金项链、红色连衣裙，或者她脚上的恨天高——踩着它们还能暴打反派，真是不可思议。唯有她那瓶变成了炸弹的香水还没有上架。

亚马逊Prime Video上的谍战剧《堡垒》（Citadel）展示了当全球最大的在线零售商跻身最大娱乐制作公司之列时，会是什么情景。除了可以在亚马逊电子商务网站上购买剧中出现的商品，观众还可以在Amazon Music上收听该剧的原声大碟，或在亚马逊的姊妹网站IMDb.com上了解其制作过程。其跨国演员阵容和剧情以及计划推出的多语种衍生作品都经过精心挑选，以吸引世界各地的购物者。

面对亚马逊在视频上的动作，老牌好莱坞公司不大放在眼里。这也有道理。尽管《城堡》的预算据称高达3亿美元，让它成为史上制作成本第二高的电视剧（仅次于亚马逊的另一部剧集《权力指环》），但反响平平，且未能跻身美国最热播的十部流媒体剧集之列。（亚马逊表示该剧在国际市场上的表现更好）。评论人士认为该剧是该公司在视频领域花钱多、水花小的典型。今年，亚马逊将在流媒体内容上砸下120亿美元，仅次于奈飞（见图表）。它也制作出了一些热门剧，包括《侠探杰克》（Reacher）和《黑袍纠察队》（The Boys）。但在即将到来的艾美奖中它仅获得45项流媒体提名（这已经是亚马逊的最好成绩），不到奈飞或华纳兄弟探索（Warner-Discovery）的流媒体平台Max的一半。“亚马逊的命中率不高，与其支出不符。”一位前高管承认。

然而，尽管亚马逊在内容制作方面成绩不佳，它却在悄悄打造出大多数竞

争对手都未能做到的东西——一种让流媒体赚钱的模式。亚马逊的剧集可能不够惊艳，但它正准备把它们和它强大的广告机器结合起来，把它的流媒体应用转变为供第三方销售的高利润市场，就像其所向披靡的电子商务网站一样。好莱坞有时可能会对亚马逊出品嗤之以鼻，但笑到最后的可能会是这家西雅图的公司。

亚马逊2006年开始涉足视频业务，那一年它推出了类似iTunes的下载平台Unbox。从那时起，该公司就以科技巨头的气魄打开了支票簿，要成为好莱坞最强大的力量之一。其主要流媒体服务Prime Video（每月收费8.99美元，亚马逊Prime会员免费）每月在全球有约1.56亿观众，数量与Disney+相当，仅次于奈飞。亚马逊带广告的免费流媒体服务Freevee另外还有4000万左右的观众。其在2014年收购的直播网站Twitch每天约有3500万访客，主要是观看电子游戏内容。

根据数据公司TechInsights的统计，亚马逊的Fire TV系列智能电视和流媒体棒的销量超过了除三星之外的所有品牌，全球在用设备有近1亿台。为了吸引人们进入Fire生态系统，亚马逊推出了大幅折扣。今年早些时候，亚马逊推出了99美元的43英寸Fire电视。

亚马逊试水视频业务最明显的动机是增加Prime会员福利包的价值，以吸引会员不断回到它的电子商务网站上购物。但视频本身也可能成为摇钱树，方法有两种。

首先是广告。在十年略多一点的时间里，亚马逊创建的数字广告业务打破了谷歌和Meta双头垄断的局面。据研究公司Insider Intelligence估计，今年其广告收入将达到约450亿美元，约占全球数字广告的7.5%。这已经超过Meta广告业务规模的三分之一，而且增长迅速。但谷歌和Meta都拥有健康的视频广告业务（分别通过YouTube和Reels），而亚马逊主要依靠其电子商务网站上的付费搜索排名结果。

这似乎正在变化。亚马逊的一位高管表示，Prime Video基本上没有广告，以保持“高级会员”感。但奈飞和Disney+去年推出广告，为其他公司

效仿此举开了绿灯。亚马逊一直在尝试在Prime的体育节目上投放广告，并把更多的老片子转移到带广告的流媒体Freevee上。分析师预计，Prime很快就会有更多的插播广告。

在一众流媒体中，亚马逊在广告业务上独具优势。奈飞承认自己主要局限于泛泛的“品牌”广告，而亚马逊通过其电子商务网站和生鲜杂货门店Amazon Fresh积累了足够多的客户信息，可以针对他们投放高度个性化的广告。更重要的是，它可以通过观察广告观众在其商店中的后续行为来衡量这些广告的效果。

亚马逊还尚未充分利用这种能力，但观众将在本月晚些时候有所体验，预计届时亚马逊将在其《周四橄榄球之夜》节目中投放可衡量效果的定向广告。11月，它还将直播史上第一场在黑色星期五（当天标志年度圣诞购物季开启）举行的美国职业橄榄球联盟（NFL）赛事，届时会插播大量视频广告。

Insider Intelligence的安德鲁·利普斯曼（Andrew Lipsman）表示，这将使今年成为亚马逊视频广告业务的“奠基之年”。“他们的视频广告策略将在未来实现强大影响力。”他预测道。根据摩根士丹利的预测，两年之内，亚马逊新生的视频广告业务仅在美国的价值就将突破每年50亿美元。从长远来看，亚马逊对观众的深入了解可能会使它的广告收费高过任何其他视频平台。

随着观众转向流媒体，这种能力将变得更有价值。互联网电视广告约占美国电视广告支出的三分之一。一位亚马逊前高管表示，随着这一份额上升，数字广告的卖家将“大赚一笔”。更重要的是，利普斯曼指出，“当你引入数据时，它就会改变市场”。电视广告被认为是最有效的广告方式之一，但其影响难以衡量。随着广告主逐渐能够了解客户对其广告的反应，目前美国每年价值约900亿美元的电视广告市场势必会增长，其中大部分新增业务将流向那些最擅长衡量广告效果的公司。

亚马逊通过视频赚钱的第二种方法是不仅向观众出售自己的作品，还出售

其他公司的内容。打开奈飞或Disney+应用的观众只能看到这些平台的节目单，而用Prime Video的观众可以看到一批其他流媒体的内容。如果用户通过Prime订阅了其他某个流媒体，或者购买或租借某个节目，亚马逊据信会抽成20%到50%。当观众通过Prime观看某个免费频道时，亚马逊会从广告收入中抽成，或者在那个频道的某些时段出售自己的广告。

研究公司Enders Analysis的汤姆·哈林顿（Tom Harrington）认为这种方法与亚马逊久经考验的零售战略相似。该公司起家的时候就是先销售自己的产品，然后向其他商户开放它的卖场。如今，亚马逊网站上三分之二的销售额是由第三方实现的，亚马逊收取佣金，利润率要比销售自己的商品高得多。哈林顿认为它的目标是同样成为视频领域里的“房东”。

这一分析揭示了制作《城堡》这样的大预算剧集的目的。亚马逊会继续在其电子商务网站上供应自家产品以维持价格竞争，并确保这个平台能提供足够丰富的产品以吸引回头客。Prime Video的内容扮演着类似的角色，它提供一些备受瞩目的节目和体育赛事直播（这是大多数其他流媒体所无法提供的）吸引人们打开应用，同时保证有丰富的内容可供选择。“真正的问题不在于有多少人看了《力量之戒》，”哈林顿说，“而在于有多少人因为这部剧而成为Prime会员……继而在其他内容上[花了]更多钱。”

亚马逊似乎成功将用户吸引到了自己的平台上。虽然进入前十榜单的作品相对较少，但尼尔森（Nielsen）的数据显示，Prime Video在美国流媒体观看时长中所占份额比Disney+高出约70%，是Max的两倍多，7月约占观看时长的8.9%。

成为内容房东并不容易。相比数百万小卖家使用其平台的电子商务领域，亚马逊在视频领域对供应商的议价能力较弱，毕竟该领域里的一些大型制片公司自己就有直接面向消费者的渠道。亚马逊对视频消费者的控制也较弱，虽然该公司占美国电子商务销售额的近40%，但其Fire TV平台上的流媒体流量仅占美国的15%左右。

尽管如此，亚马逊仍在一个烧钱不断的行业中开辟着赚钱的路径。亚马逊

可能不会狂揽艾美奖或统治尼尔森的前十榜单。但一位前高管表示，其视频业务的主要目标是让人们通过其硬件观看电视、通过其商店购买内容并观看通过亚马逊投放的广告。即使《城堡》的口碑没有起色，它仍可能已经完成了它的任务。 ■



The shopping channel

Amazon has Hollywood's worst shows but its best business model

It aims to make video pay by applying the techniques of e-commerce

AS BULLETS FLY around a high-speed train carrying a former Miss World and a gang of spies through the Italian Alps, shopping is surely the last thing on viewers' minds. Yet should they press pause, they will see an option to buy items from the show: the heroine's gold necklace, her red dress, or the teetering stilettos in which she is improbably running rings around the villains. Only her exploding perfume is not yet for sale.

“Citadel”, a thriller on Amazon Prime Video, shows what happens when the world’s biggest online retailer becomes one of its biggest entertainment producers. As well as buying merchandise from the show on Amazon’s e-commerce site, audiences can listen to its soundtrack on Amazon Music, or read about its production on Amazon’s sister site, IMDb.com. Its multinational cast and plot, and planned spin-offs in a variety of languages, have been carefully chosen to appeal to shoppers around the world.

Hollywood old hands are snooty about Amazon’s video efforts, and understandably so. Despite a reported budget of \$300m, making it the second-priciest TV series in history (after “The Rings of Power”, another Amazon project), “Citadel” received lukewarm reviews and failed to crack the top ten most-streamed shows in America (Amazon says it has done better internationally). Critics see it as emblematic of the company’s high-spending, low-impact record in video. This year Amazon will blow \$12bn on streaming content, second only to Netflix (see chart). It has had some hits, including “Reacher” and “The Boys”. But its 45 streaming nominations at the upcoming Emmy awards—a record for Amazon—is less than half as many as Netflix or Warner-Discovery’s service, Max. “Amazon’s hit rate is not good,

nor consistent with its spend,” admits one former executive.

Yet despite its creative misfires, Amazon is quietly assembling something that has eluded most of its rivals: a model for how to make streaming pay. Its shows may underwhelm, but it is preparing to pair them with its formidable advertising machine, and is turning its streaming app into a high-margin marketplace for third-party sales, along the lines of its all-conquering e-commerce site. Hollywood might sometimes snigger at the quality of Amazon’s output. But the Seattle firm may yet have the last laugh.

Amazon has been in the video business since 2006, when it launched Unbox, an iTunes-like downloading platform. Since then the company has deployed its tech-sized chequebook to become one of the biggest forces in Tinseltown. Its main streaming service, Prime Video (\$8.99 a month, or free as part of Amazon’s broader Prime membership), attracts some 156m monthly viewers worldwide—about as many as Disney+ and second only to Netflix. Freevee, its free streaming service with ads, has another 40m or so. Twitch, a live-streaming site it acquired in 2014, attracts around 35m visitors a day, mainly to watch video-gaming content.

Fire TV, Amazon’s range of internet-connected TV sets and streaming sticks, outsells every brand bar Samsung, with nearly 100m devices in use worldwide, according to TechInsights, a data firm. Heavy discounting has been deployed to lure people into the Fire ecosystem: earlier this year Amazon offered a 43-inch Fire television for \$99.

The most obvious motive for Amazon’s video experiments is to increase the value of the Prime bundle, which keeps members coming back to shop on the e-commerce site. But video also has the potential to become a moneyspinner in its own right, in two ways.

First, advertising. In little more than a decade Amazon has created a digital-

ads business that has disrupted the old duopoly of Google and Meta. Its ad revenue this year will be around \$45bn, making up about 7.5% of worldwide digital advertising, estimates Insider Intelligence, a research company. It is already more than a third the size of Meta's ad business, and growing fast. But whereas Google and Meta both have healthy video-advertising operations (through YouTube and Reels, respectively), Amazon's inventory mainly consists of sponsored search results on its e-commerce site.

That seems to be changing. Amazon has kept Prime Video largely ad-free to preserve a “premium” feel, says one senior executive. But the introduction of commercials last year by Netflix and Disney+ has given a green light to others to do the same. Amazon has been experimenting with running ads alongside sports shows on Prime, and has shifted more of its back-catalogue to Freevee, its ad-supported streamer. Analysts expect to see more commercial breaks on Prime soon.

Among streamers, Amazon is uniquely well placed in the advertising game. Whereas Netflix acknowledges that it is mainly limited to generic “brand” advertising, Amazon has enough information on its customers, through its e-commerce site and its Fresh grocery stores, to target them with highly personalised ads. What’s more, it can measure the effectiveness of those ads, by observing viewers’ subsequent behaviour in its shops.

It has yet to exploit this ability fully, but viewers will get a taste of it later this month when Amazon is expected to run targeted, measured ads alongside its “Thursday Night Football” programme. In November it will show a blizzard of video commercials when it airs the first American-football game to coincide with Black Friday, an annual holiday to honour the shopping gods.

That makes this a “foundational year” for Amazon’s video-ad business, says Andrew Lipsman of Insider Intelligence. “The future of their advertising

strategy on video is going to really take hold,” he predicts. Morgan Stanley, a bank, forecasts that within two years Amazon’s nascent video-ad business will be worth more than \$5bn a year in America alone, and that in the long run its superior intel on its viewers could allow it to charge higher rates for its ads than any other video platform.

Such an ability will become more valuable as viewing shifts to streaming. Advertisements on internet-connected television make up about a third of TV ad spending in America. As that share rises, a “pot of gold” awaits sellers of digital advertising, says a former Amazon executive. What’s more, points out Mr Lipsman, “When you introduce data, it transforms markets.” TV ads are reckoned to be among the most effective, but their impact is hard to measure. As advertisers gain the ability to see how customers respond to their commercials, the TV advertising market, which is currently worth about \$90bn a year in America, stands to grow, with the lion’s share of new business going to the companies that offer the best measurement.

Amazon’s second approach to making video pay is to sell viewers not just its own output but other companies’ content, too. Whereas viewers opening the Netflix or Disney+ app see only shows on those platforms, those opening Prime Video are offered content from a range of other streamers. If a customer subscribes to one of those other services via Prime, or buys or rents a show, Amazon takes a cut, reckoned to be between 20% and 50%. And when a viewer watches a free channel via Prime, Amazon takes a slice of the advertising revenue or sells its own ads in some of the channel’s slots.

Tom Harrington of Enders Analysis, a research firm, likens the approach to Amazon’s tried-and-tested strategy in retail. The company began by selling its own products, before opening its marketplace to other traders. These days two-thirds of sales on Amazon.com are made by third parties, with Amazon taking a commission—a much higher-margin business than selling its own wares. Its aim is to be the same kind of “landlord” in video,

believes Mr Harrington.

This analysis sheds light on the purpose of big-budget shows like “Citadel”. Amazon continues to stock its e-commerce site with first-party products, to maintain price competition and ensure that the marketplace has a broad enough offering to keep customers returning. Prime Video content plays a similar role: high-profile shows and live sports—something not available from most other streamers—get people to open the app, while guaranteeing them a wide range of content to choose from. “The real question isn’t how many people watched ‘Rings of Power’,” says Mr Harrington. “It’s how many people went into Prime because of ‘Rings of Power’...and then [spent] more on other content.”

Amazon seems to be succeeding in getting people to spend time on its platform. Although relatively few of its shows break into the top ten individually, Nielsen’s figures show that Prime Video’s share of streaming in America—about 8.9% of hours watched in July—is about 70% greater than that of Disney+, and more than twice that of Max.

Becoming a content landlord is not easy. Amazon’s bargaining power over suppliers is weaker in video, where there are a few big studios with their own direct-to-consumer offerings, than in e-commerce, where millions of tiny sellers use its marketplace. Amazon’s hold over consumers is weaker, too: whereas the company accounts for nearly 40% of e-commerce sales in America, its Fire TV platform handles only about 15% of streaming traffic there.

Still, the company is carving out ways of making money in an industry that is drowning in losses. Amazon may not dominate the Emmy awards, or Nielsen’s top ten. But, says a former executive, its chief aims in video are for people to watch TV through its hardware, to buy content through its store and to watch commercials served by Amazon advertising. Even if “Citadel”

remains a critical flop, it may have done its job. ■



下一场大地震

日本正在为大地震做准备

关东大地震一百周年带来了焦虑，也给世界带来了经验教训

每年的9月1日，日本的国务大臣们都会步行前往首相官邸，参加危机模拟演习。全国各地的官员和学生也会进行防灾演练。1923年的这一天，东京一带爆发了一场7.9级的地震，也就是关东大地震。随之而来的灾难造成至少10.5万人丧生（其中东京就有约七万人），摧毁了37万所房屋，也改变了日本的历史进程。

今年是关东大地震一百周年，人们在大张旗鼓纪念的同时，也忧心忡忡。下一次大地震来袭时会发生什么？地震学家无法预测地震，但他们根据以往的地震活动规律建立的统计模型可以预估地震发生的概率。东京市政府的专家估计，在未来30年内，东京发生七级或以上地震的概率为70%。不过由于更先进的技术和更合理的规划，地震导致的死亡人数可能会大大少于1923年的关东大地震：在最坏的情况下，东京会有约6000人遇难。但数百万人的生活将发生天翻地覆的变化。

另一种发生概率接近的情况可能会有糟糕得多的后果。如果日本工业中心关西以南的南海海沟发生地震，则可能引发海啸；一项官方估计认为，这可能导致多达32.3万人死亡。日本应对此类大灾难风险的方法为不断变暖、灾害更加频发的世界提供了启示。

名古屋大学的福和伸夫表示，这种等级的地震可能“让日本作为一个国家的生存受到挑战”，并波及全球经济。下一次东京地震过后，城市基本功能恢复可能需要数周时间，首都重建可能需要多年；仅直接损失就可能高达11万亿日元（750亿美元）。一项研究估计，如果南海海沟真的发生地震，日本的GDP将下降11%。

这些损失可能让日本的巨额公共债务出现危机。全球供应链将面临严重破坏。1923年关东大地震之后，排外谣言四起，至少6000名居住在日本的朝

鲜人因此被残杀；一些历史学家认为这场地震让日本加速走上了法西斯道路。虽然现代日本不太可能发生类似的转变，但仍可能发生危险的政治余震。

1923年的地震发生在东京以南相模湾的一个俯冲带，当时正近中午时分，东京近400万居民中的许多人都在用明火做午饭。同一天，东京北部正遭受台风袭击。火势在南下强风的助推下蔓延开来。由于余震不断，地晃屋塌，大火持续了将近两天；半个城市被大火横扫。“如果这里不是地狱，还有哪里是？”一名目击者发问。

未来的地震可能会同样开始于俯冲带，或者开始于更靠内陆的断裂带。其威力可能是毁灭性的。在各个现代化的“生命安全学习”中心，东京人可以体验模拟的地震场景。笔者曾在模拟的七级地震中被震得俯卧在地，紧紧抓着一条桌腿。

正如中心里的教员所说，幸存下来靠的不是运气，而是准备。在许多方面，东京都已准备充分。而在1923年，相关科学知识几乎没有进步，民间信仰认为地震是由地底下的一条巨型鲶鱼引起的。“当时没有人知道地震是什么。”东京大学地震学家、东京市政府地震调查委员会委员长平田直解释道。

关东大地震之后，日本建立了一些研究机构，从此开启了日本的现代地震学。之后发生的多次地震，特别是1995年袭击神户的阪神大地震以及2011年袭击东北地区并导致福岛核泄漏的东日本大地震，更是加深了人们对板块构造的了解。日本收集了大量数据，并拥有世界一流的地震监测网络和预警系统。（联合国估计，世界上只有一半的国家配备了充足的灾害预警系统。）

日本还关注那些将自然灾害转为人类灾难的因素。虽然人类无法阻止地震的发生，但可以设法让震区居民少受伤害。1995年以后，民间救灾团体的数量激增。志愿者组织在一起，举行演习、培育社区关系，为最坏的情况做准备。2011年的东日本大地震发生后，日本新出台了《复兴基本法》，

要求采取更全面细致的预防和减灾措施，其中特别关注东京或南海海沟发生大地震的可能性。去年，东京政府拨出六万亿日元专款，在十年内用于“东京复兴计划”。几乎所有的细节都被考虑到了。东京防灾部门的滨中晃弘在被问及什么事情最让他担心时，稍作停顿后说：“厕所。”

基础设施的改善大大提高了东京的安全度。关东大地震促使日本政府推出了抗震建筑规范。这些规范分别在1981年和2000年进行了重大修订。如今东京大约92%的建筑符合规范，而十年前这一比例为81%。这样的提升让预估死亡人数减少了3000多人。

大型建筑公司鹿岛建设的栗野治彦表示，灾害风险意识让日本的建筑公司和开发商热衷于在高于法定标准的安全措施上投资。不久前，鹿岛建设在东京市中心40层的惠比寿花园广场大厦的顶部新装了一个1350吨重的摆锤，目的是将这座摩天大楼的晃动幅度减半。（今年早些时候，土耳其南部发生的地震造成五万多人死亡，就与建筑规范执行不力有直接关系。）

1923年地震中约90%的伤亡都是大火造成的。在随后的几十年里，政府购买土地以拓宽主要道路，并建立了防火带来阻止火势蔓延。建筑商改用不那么易燃的材料。惨痛的经验表明，需要有精心设计的疏散路线：关东大地震期间，东京东部仅一地就因被大火包围而有近四万人遇难。如今各个社区都清楚地标明了疏散地点。（而在8月夏威夷小镇拉海纳燃起大火之前，毛伊岛当局就没有发布山火疏散地图。）

尽管有了这些改进，现代东京又有了新的薄弱点。该市人口已激增至1400万。东京大学的广井悠认为，虽然火灾发生的几率可能有所降低，但因为住户数量增多，“绝对风险加大了”。东京仍然有许多易燃木质房屋集中的社区。各种避难所可容纳320万人，但可能会有大约500万人流离失所。规划人员担心会发生复合灾害，比如在大流行病期间发生地震。即便是最周密的计划，往往也会被灾难打乱。“不确定性是灾难的核心问题。”东京都立大学的市古太郎表示。

东京人生活方式的变化也加大了抗灾难度。越来越多的人独居；政府调查

显示，单人户的防灾意识和准备措施往往较为不足。老式的木制房屋虽然易燃，但相对而言社区关系更为紧密，邻里更互帮互助；在现代的高楼大厦里，住户之间可能互不相识。而在一个老龄化的日本，会有越来越多邻居需要额外的帮助。日本人谈论国家安全往往着眼危险邻国构成的威胁。但他们脚下的土地也很危险。 ■



The Next Big One

Japan is preparing for a massive earthquake

The centenary of the Great Kanto earthquake brings angst, and lessons for the world

EVERY YEAR on September 1st, Japan's ministers trek by foot to the prime minister's office to take part in a crisis simulation. Across the country, local officials and schoolchildren drill for disasters. The date marks the Great Kanto earthquake, a 7.9-magnitude tremor that struck near the capital back in 1923. The ensuing disaster killed at least 105,000 people, including around 70,000 in Tokyo itself, destroyed 370,000 homes and changed the course of Japanese history.

This year's centenary of the disaster has occasioned much commemoration—and angst. What will happen when the next Big One hits? Seismologists cannot predict earthquakes, but their statistical models, which are based on past patterns, can estimate the likelihood of one. The city government's experts reckon there is a 70% chance of a magnitude 7 or higher quake hitting the capital within the next 30 years. Far fewer people will probably die than during the disaster in 1923, thanks to better technology and planning: the worst case foresees some 6,000 deaths in the city. But millions of lives will be upended.

Another, similarly likely scenario could be much worse. A Nankai Trough earthquake, envisaged south of Kansai, Japan's industrial heartland, could trigger a tsunami; as many as 323,000 might be killed, according to an official estimate. Japan's approach to the risks of such catastrophes offers insights for a warming world facing more frequent disasters.

Quakes of this size could “challenge the survival of Japan as a state” and send economic shock waves around the globe, says Fukuwa Nobuo of Nagoya

University. After the next Tokyo quake, recovering basic city functions could take weeks and rebuilding the capital could take years; direct damage alone could run to as much as 11trn yen (\$75bn). One piece of research estimates that GDP would dip by 11% following a Nankai earthquake.

The costs could trigger a crisis over Japan's substantial public debt. Global supply chains would face severe disruptions. In 1923 xenophobic rumours after the quake led to the massacre of at least 6,000 Koreans living in Japan; some historians argue that the disaster hastened Japan's descent into fascism. Modern Japan is unlikely to take a similar turn, but the political aftershocks could still be nasty.

The shaking in 1923 began just before noon, at a subduction zone in Sagami Bay, south of Tokyo. Many of the city's nearly 4m residents were preparing lunch over open flames. Fires spread, helped by strong winds blowing from the north, where a typhoon hit the same day. The conflagration raged for nearly two days as aftershocks kept the ground unsteady; half of the city burned. "If this were not hell, where would hell be?" one observer asked.

A future earthquake might begin the same way, or at faultlines farther inland. The force could be devastating. At modern "Life Safety Learning" centres, Tokyoites can experience a simulated version. At magnitude 7, your correspondent was left prostrate, clutching a table leg.

As instructors at the centre explained, survival is a matter not of luck but of preparation. In many respects, Tokyo is well prepared. Back in 1923 scientific knowledge had progressed little beyond the folk belief that shaking was caused by namazu, giant catfish living under the surface of the earth. "Nobody knew what an earthquake was," explains Hirata Naoshi, a seismologist at the University of Tokyo who chairs the city government's expert panel on seismic scenarios.

Modern seismology in Japan dates back to research institutions set up after the quake. Subsequent rumblings, in particular the Great Hanshin earthquake that struck Kobe in 1995 and the Great East Japan earthquake that hit Tohoku and caused the meltdown at Fukushima in 2011, have led to even better understanding of plate tectonics. Japan collects vast amounts of data and has world-beating seismometer networks and early-warning systems. (The UN reckons only half the world's countries are equipped with adequate early-warning systems for the hazards they face.)

Japan has also focused on what turns natural hazards into human disasters. Although earthquakes cannot be stopped, people living within their range can be made less vulnerable. Disaster-related civic groups have proliferated since 1995; volunteers organise to hold drills, cultivate community ties and prepare for the worst. After the disaster in 2011 a new National Resilience Act mandated more thorough prevention and mitigation measures, with a particular eye on the possibility of a major quake under Tokyo or in the Nankai Trough. Last year the Tokyo government earmarked 6trn yen over ten years for a "Tokyo Resilience Plan". Few details go unconsidered. When asked what worries him most, Hamanaka Akihiko of Tokyo's disaster-prevention division pauses briefly, then says: "Toilets".

Infrastructure improvements have made Tokyo much safer. The Great Kanto earthquake prompted the Japanese government to introduce seismic building codes. They were substantially updated in 1981 and again in 2000. Some 92% of Tokyo structures meet the codes; bringing that number up from 81% a decade ago reduced the casualty estimates by over 3,000.

Awareness of disaster risk makes Japanese construction companies and developers keen to invest in safety measures beyond what is legally mandated, says Kurino Haruhiko of Kajima, a big construction firm. On top of the 40-floor Ebisu Garden Place Tower in central Tokyo, Kajima recently installed a new 1,350-tonne pendulum designed to reduce the skyscraper's

sway by half. (Lax enforcement of building codes meant that an earthquake in southern Turkey earlier this year killed more than 50,000 people.)

Flames killed around 90% of the casualties in 1923. Over the ensuing decades the government purchased land in order to widen key roads, creating fire-protection belts to stop the spread. Builders switched to less flammable materials. Bitter experience had shown the need for well-designed evacuation routes: during the Kanto disaster nearly 40,000 people died in a single field in east Tokyo, where flames closed in from all sides. Neighbourhoods now have clearly marked evacuation sites. (Authorities in Maui had not posted evacuation maps for wildfires before the blaze in Lahaina in August.)

Despite the improvements, modern Tokyo is vulnerable in new ways. The city's population has ballooned to 14m. While the rate of fire outbreak may be lower, with a greater number of households "the absolute risk is greater", reckons Hiroi Yu of the University of Tokyo. Many neighbourhoods with concentrations of flammable wooden houses remain. Shelters have space for 3.2m people; some 5m people may be displaced. Planners fret about compound disasters, such as an earthquake during a pandemic. Disasters tend to upend even the best-laid plans. "Uncertainty is at the core of disasters," says Ichiko Taro of Tokyo Metropolitan University.

Tokyoites' lifestyles have also changed in ways that make it harder to respond to disasters. More people live alone; government surveys show that single-person households tend to be less aware of and prepared for disasters. Old-style wooden houses burned easily, but they fostered closer communities and more mutual aid than modern high-rises, where residents may hardly know their neighbours. And in ageing Japan, ever-more neighbours will need extra help. Japanese tend to speak about national security in terms of threats from their menacing neighbours. But the earth beneath them is also dangerous. ■



经济学人视频

热浪是如何形成的？ - 下

研究者认为气候变化让以往不可能出现的极端高温变得更常见。



The Economist Film

Heatwaves: The Essentials - part 2

Researchers say climate change made unlikely high temperatures much more likely.



火山惹人爱

长久以来让人恐惧的火山对地球有益

一本新书认为火山能帮助碳捕获和环境恢复【《火之山：火山的秘密生活》书评】

《火之山：火山的秘密生活》，克莱夫·奥本海默著。芝加哥大学出版社；352页；27.5美元。霍得斯托顿出版社；20英镑。

埃里伯斯火山（Mount Erebus）是世界上位置最靠南的活火山，它的名字取自希腊神话中的一位创世神，也就是混沌之神卡俄斯（Chaos）的儿子黑暗之神。去过太空的人都比去过南极洲并踏足埃里伯斯火山（见上图）的人多。这并不奇怪。人们在1900年代初首次攀登了这座火山，途中多次遇到暴风，有时会生冻疮，靠一碗碗“杂锅菜”（把不易变质的干制牛肉和脂肪煮沸做出的油乎乎的饱腹浓汤）果腹。

剑桥大学的火山学教授克莱夫·奥本海默（Clive Oppenheimer）13次在埃里伯斯火山顶峰附近居住考察，加起来有一整年的时间。在《火之山》（Mountains of Fire）一书中，他为读者奉上他自己及之前的探险者那些扣人心弦的故事。他不只描述了火山的样貌，还讲述了它们给人的感受，以及对那些遇见它们的人意味着什么。

一座火山就是地壳上的一个破口。通过这个破口，熔岩和高热气体泄漏出来。有时候是突然而剧烈地喷射火山灰和蒸汽，有时候是不断地涌出熔岩，把所经之处破坏殆尽。可能是由于火山的危险性，它们的长期存在和重要性往往被忽视。但这些火山已经存在了千百万年，它们释放的气体来自地球内部。可能正是这些气体在几十亿年前形成了地球的大气。火山“把地球改造得适合人类生存”，奥本海默写道。

他总计考察了超过100座不同的火山。很少有人像奥本海默一样与这么多喷火的山峰有过接触。但有亿万人生活在火山周围：大约有8亿人在距离活火山100公里以内的地方生活。有超过100万爪哇人生活在默拉皮火山（Merapi）附近，对其中一些人来说，这座印度尼西亚的火山是一个幽灵

之国，现实世界和灵魂世界在那里汇聚。有一位看守人负责每天观察和每年做仪式来维护这座火山的“均衡”。2010年，即使发生了地震和气体喷发，预示着火山可能爆发，那位看守人仍然拒绝离开岗位。后来，人们发现了他烧焦的遗体，他仍保持着祈祷的姿势。

火山可怕又可叹，它们带来的远不止是剧烈的地质运动，奥本海默在他上一本著作《那些震惊世界的火山爆发》（Eruptions that Shook the World）中记录了这些运动。《火之山》是一封写给火山的情书，也是一份调查报告，研究火山已经并将继续支撑人类存续的方方面面——既有精神上的，也有科学上的。

火山地区是生物多样性的温床。加拉帕戈斯群岛中的那些熔岩岛就是活生生的进化教科书。火山爆发可以起到重置的作用：当熔岩凝固、开始长年累月的侵蚀，释放出的营养物和矿物质就形成了肥沃土壤。世界上一些最高产的丰饶农业区就是得益于过去的火山爆发，比如印度尼西亚和中美洲。火山还能帮助加强地下含水层。例如，如果没有乍得以北、利比亚以南的提贝斯提高原（Tibest）和之上的五座火山，东撒哈拉还会更加干燥。

生活在火山之中及其附近的微生物体仍有许多未解之谜，有待科学探究。它们在最恶劣的环境中生存，例如爪哇岛伊真火山（Ijen）的热酸性火山湖。也许有一天，人们会发现这些微生物在医药或空气净化方面的用途。火山还会产生地热，地热发电占相当比例的国家正越来越多，包括萨尔瓦多、肯尼亚和新西兰。最常见的火山岩玄武岩能永久地封存二氧化碳，因此火山在碳捕获和储存中扮演重要角色。长久以来火山一直被视为文明的可怕敌人，而今可能又会变为拯救者。■



Some like it hot

Long feared, volcanoes help the planet

A new book argues that volcanoes aid with carbon capture and environmental resets

Mountains of Fire: The Secret Lives of Volcanoes. By Clive Oppenheimer. University of Chicago Press; 352 pages; \$27.50. Hodder & Stoughton; £20

MOUNT EREBUS—named after one of the primordial beings in Greek mythology, son of Chaos, personification of darkness—is the southernmost active volcano in the world. More people have been to space than have travelled to Antarctica and set foot on Mount Erebus (pictured). That is for good reason. When humans first climbed it in the early 1900s, the journey involved violent winds, occasional frostbite and bowls of “hoosh” (a potent, greasy combination of boiled, dehydrated beef and fat, which would not go bad).

Clive Oppenheimer, a professor of volcanology at Cambridge University, has spent 13 seasons—cumulatively an entire year of his life—living near the summit of Mount Erebus. In “Mountains of Fire” he regales readers with gripping stories of his travels, as well as those of adventurers past. He does not just describe what the volcanoes look like, but how they feel and what they mean to the people who encounter them.

A volcano is a rupture in the crust of a planet. Through that opening, molten rock and hot gases escape. This can be a sudden and thunderous puff of ash and steam, or it can be a protracted ooze of lava, razing everything in its path. Perhaps because of volcanoes’ danger, their longevity and importance are often overlooked. But they live hundreds of thousands of years, and the gases they release come from the inside of the Earth. They are probably the very gases that created Earth’s atmosphere billions of years ago. Volcanoes

“made the world fit for human purpose”, Dr Oppenheimer writes.

In total he has visited more than a hundred different volcanoes. Few people have come into contact with as many fiery mountains as Dr Oppenheimer has. Yet millions live close to them: around 800m people have their home within 100km of an active volcano. For some of the more than 1m Javanese who have settled in the shadow of Merapi, a volcano in Indonesia, it is a kingdom of ghosts, where the physical and spirit world merge. A gatekeeper is charged with maintaining the volcano’s “equilibrium” through daily observances and annual ceremonies. In 2010, even after ominous earthquakes and belching gas, the gatekeeper at the time refused to leave his post. He was found afterwards, his body scorched in the position of prayer.

Both awful and awesome, volcanoes have much more to offer than dramatic geological events, which Dr Oppenheimer documented in his previous book, “Eruptions that Shook the World”. “Mountains of Fire” is a love letter to volcanoes and an investigation into all the ways that they have and continue to sustain humanity—spiritually and scientifically.

Volcanic regions are hotbeds of biodiversity. The lava islands of the Galapagos are textbook examples of evolution in action. Volcanic eruptions can act as a reset button; as lava hardens and begins to erode over the course of years or centuries, the released nutrients and minerals create rich soil. Some of the world’s most productive regions for farming, such as in Indonesia and Central America, owe their abundance to eruptions past. Volcanoes can also help build up underground aquifers. For example, without the Tibesti and its five volcanoes in the north of Chad and in southern Libya, the eastern Sahara would be even more arid.

Science still has a lot to learn from the tiny organisms that live in and near volcanoes, in the harshest environments, such as the hot-acid crater lake of Ijen on Java. Some might one day find a use for these micro-organisms

in medicine or air purification. Volcanoes also produce geothermal energy, which accounts for significant shares of electricity supply in a growing number of countries, including El Salvador, Kenya and New Zealand. The most common type of volcanic rock, basalt, is capable of permanently trapping carbon dioxide, making volcanoes an important player in the game of carbon capture and storage. Long viewed as a fearsome enemy of civilisation, volcanoes may yet become a saviour. ■



巴托比

最好的老板知道怎么给工作做减法

减法思维可能有违直觉，但它至关重要

公司惯于庆祝加法。利润、客户和股价都应该是上涨而不是下降。创新就是增加新产品。数字变大是衡量职业成功与否的标准：经理们写更多报告、管理更高的预算、拿更高的薪水，才能在公司阶梯上爬得更高。真正的超级明星不只是做加法，他们还做乘法。最好的软件程序员会被贴上“10x开发人员”的标签，因为他们的生产率据信是一般程序员的10倍。

公司也并不总是反对做减法。有一些减少是好的：最明显的当然是碳排放。降低成本是管理中必不可少的部分，尽管不得人心。但做减法的价值被低估了。最好的老板是那些既能做加法又能做减法的人。

这意味着要腾出时间让员工完成工作。会议几乎总是由老板召集的。有些是有用的，但很多会议的活力和效果和超速警示教育课一个样。今年年初，电子商务公司Shopify从公司日历上删除了1.2万个经常性会议，并要求所有人在重新填上这些会议前慎重考虑。该公司称，在删减会议之后，生产率提高了。

唯一比参加太多会议更糟糕的是根本没被邀请参加会议。因此，无论何时开会，出席的人都多得吓人。懂得做减法的管理者会允许没必要出席的员工不出席。

同样的道理，好老板只在必要的时候给员工发信息，而不是一想到什么好点子就发。他们会让员工有时间集中精力做事，让工作节奏放缓些。好老板清楚事情的轻重缓急。伦敦商学院的劳拉·久尔杰（Laura Giurge）和康奈尔大学的瓦妮莎·博恩斯（Vanessa Bohns）近期的一项研究发现，收到电子邮件的人通常会误会以为寄件人希望他们很快回复。

减法不仅仅是消除日常的干扰。它还意味着决定放弃那些毫无进展的项目

和产品，把精力集中在最重要的业务上。元老级管理理论家彼得·德鲁克（Peter Drucker）倡导“有计划地放弃”，这将把被束缚在收益微薄的活动上的资源释放出来，用到更能获利的地方。他建议高管们对业务的各个方面经常性地问同一个问题：“假如我们还没有做这个，以我们现在知道的情况，我们还会去做它吗？”

麻省理工学院斯隆管理学院的泽伊内普·托恩（Zeynep Ton）在新作《为好工作辩护》（The Case for Good Jobs）中指出，做减法往往有商业上的合理性。美国高口碑零售商开市客（Costco）相信“明智的销售损失”，它有意限制了产品范围。这意味着它可以更有效地集中购买力，更准确地预测需求，并更高效地利用员工的时间。

对客户来说，“少”听上去可能不是个好的结果，但当选项多到一定程度时，做选择题是非常让人疲惫的。当你花在流媒体上选片子的时间比去电影院看两遍《奥本海默》还长时，选择不多似乎就挺有吸引力了。

做得少、提供得少在很多方面都有违惯常倾向。一方面是人类的脑回路决定的。托恩引用了弗吉尼亚大学的加布里埃尔·亚当斯（Gabrielle Adams）和合著者于2021年在《自然》上发表的一项研究。这项研究要求人们想办法改进某些东西（比如对一个迷你高尔夫球洞的设计）或是解决一个问题（比如让网格上的图案对称）。研究人员发现，在没有明确提示可以考虑做减法的情况下，参与者都会不假思索地增加特性，而不是删减。

拥抱减法思维还有很多其他障碍。“沉没成本谬误”使得管理者很难放弃那些无底洞项目。公司往往害怕放弃选择权：如果这个不起眼的新项目变成下一个大事件怎么办？发发电子邮件、把日程安排填满能让人感到忙碌，即便没有完成多少有价值的事情。

招聘流程和绩效评估强化了加法活动的重要性——毕竟也不大见到哪个求职者吹嘘自己没做成的事。但是，修枝剪叶应该是管理者工具箱的重要组成部分。增加价值。减少活计。 ■



Bartleby

The best bosses know how to subtract work

The minus mindset may be unintuitive but it is essential

COMPANIES ARE used to celebrating addition. Profits, customers and share prices should go up rather than fall. Innovation is the adding of new products. Larger numbers are a measure of career success: managers climb the corporate ladder by taking on more reports, running heftier budgets and trousering bigger salaries. Genuine superstars don't just add. They multiply. The best software programmers are tagged as "10x developers", for supposedly being ten times more productive than their peers.

Firms are not always opposed to subtraction. There are good kinds of cuts: carbon emissions, most obviously. Reducing costs is a necessary part of management, though not a welcome one. But the value of doing less is underestimated. The best bosses are those who take things away as well as add them on.

That means clearing time for employees to get work done. Meetings are almost always called by bosses. Some are useful; many of them have all the pizzazz and impact of a speed-awareness course. Shopify, an e-commerce firm, began the year by deleting 12,000 recurring meetings from corporate calendars, and asking everyone to think carefully before reinstating them. The company reports a rise in productivity as a result of the cull.

The only thing worse than having too many meetings is not being invited to them at all. So whenever meetings do take place, surprisingly large numbers of people can turn up. Minus-minded managers will give employees permission not to attend if they are not needed.

By the same token, good bosses will send messages when necessary, not

every time a bright idea pops into their head. They will reduce the tempo of work, by leaving employees time to concentrate. They will be clear if something is urgent or not. A recent study by Laura Giurge of London Business School and Vanessa Bohns of Cornell University found that receivers of an email routinely overestimate how quickly its sender expects a reply.

Subtraction is not just about removing day-to-day distractions. It's also about taking decisions to kill off projects and products that are going nowhere, and to focus efforts on the most important bits of the business. Peter Drucker, the doyen of management theorists, was an advocate of "planned abandonment", so that resources that are tied up in marginal activities are freed for more profitable use. Executives should, he advised, routinely ask the same question of every aspect of the business: "If we did not do this already, would we go into it now knowing what we now know?"

In "The Case for Good Jobs", a new book, Zeynep Ton of MIT Sloan School of Management argues that doing less can often make commercial sense. Costco, a well-regarded American retailer that believes in the "intelligent loss of sales", has a deliberately limited product range. That means it can focus its buying power more effectively, forecast demand more accurately and use its employees' time more productively.

Less may not sound like a great outcome for customers, but at some point choice is deeply wearying. When you have spent more time trying to decide what to watch on a streaming service than it takes to go to the cinema and watch "Oppenheimer" twice, scarcity seems pretty attractive.

Doing and offering less goes against the grain in many ways. One is how humans are wired. Professor Ton cites a study, published in Nature in 2021 by Gabrielle Adams of the University of Virginia and her co-authors, in which people were asked to think of ways to improve something (like the

design of a miniature-golf hole) or solve a problem (such as making the pattern on a grid symmetrical). The researchers found that, without an explicit prompt to think about subtraction, participants systematically defaulted to adding features rather than taking them away.

There are plenty of other hurdles to embracing the minus mindset. The “sunk-cost fallacy” means that managers find it hard to abandon projects that have already soaked up money. Firms are often scared to give up optionality: what if this tiddly new venture turns into the next big thing? Sending emails and filling the calendar is a way to feel busy even if not much of value is getting done.

Recruitment processes and performance reviews reinforce the importance of additive activity; it is unusual for a job candidate to brag about the things they didn’t achieve. But getting rid of work ought to be a vital part of the managers’ toolkit. Add value. Do less. ■



巨人的胜利

美国的企业巨头越来越难以撼动

从沃尔玛到通用汽车，老牌企业正在反击颠覆者

参加任何商业会议或者翻开任何管理书籍，几乎肯定会碰到同一个信息的不同表述：商业变革的步伐正在加速，没有人能免于颠覆的冲击。最近人工智能（AI）领域的突破让许多企业巨人紧张地等待着大卫的投石索，担心自己会像柯达和百视达（Blockbuster）这两家巨头那样被数字革命击倒。

管理学大师克莱顿·克里斯坦森（Clayton Christensen）在1997年的开创性著作《创新者的窘境》（The Innovator's Dilemma）中指出，老牌企业由于担心损害现有业务的盈利能力，不愿追求能够使其产品或服务变得更便宜或更方便的激进创新。在技术剧变时期，这为没有这种顾虑的后起之秀创造了机会。然而，令人惊讶的是，美国企业在互联网时代却几乎没有遇到过竞争性颠覆。老牌企业非但没有被削弱，似乎反而更稳固了。而且有充分的理由相信它们将保持这样的地位。

以《财富》世界500强为例，从沃尔玛到富国银行，这些收入最高的美国企业占了就业人口的约五分之一、销售额的一半，以及利润的三分之二。本刊考察了各家公司的年龄，把合并和分拆等导致它们貌似年轻的因素考虑在内。

1990年是我们对互联网时代开启的分界点，我们发现在500强企业中只有52家是“90后”，其中包括Alphabet、亚马逊和Meta，但不包括苹果和微软这两家中年科技巨头。在500强企业中，只有七家诞生于2007年苹果推出首款iPhone之后，而有280家在美国参加第二次世界大战之前就已经成立（见图表 1）。事实上，新企业巨头的崛起速度一直在放缓。1990年，《财富》500强中有66家公司年龄不超过30岁。从那以后，500强的平均年龄从75岁上升到90岁。

伦敦商学院的朱利安·伯金肖（Julian Birkinshaw）指出，一种解释是，数字革命在某些经济领域并没有带来翻天覆地的变革。通信、娱乐和购物都已经改头换面，但从地下开采石油和通过电线输送电力基本还是老样子。一些备受瞩目的失败案例也让其他公司不敢轻易尝试颠覆自己所在的行业，例如曾被大肆炒作的共享办公公司WeWork如今徘徊在倒闭边缘；还有试图通过使用建筑预制件和减少中间商来改造建筑业的Katerra也以失败告终。

另一个原因是惰性拖慢了许多行业竞争性剧变的步伐，为老牌企业争取到了适应数字技术的时间。尽管现在有65%的美国人使用网上银行，但他们用的几乎都是老字号——包括摩根大通和美国银行在内的《财富》500强银行的平均年龄为138岁。咨询公司科尔尼（Kearney）的数据显示，去年更换了银行的美国人不足一成。这种粘性使得潜在的颠覆者很难在老牌企业模仿其创新之前就形成规模。错综复杂的监管体系有利于拥有完善合规部门的大型机构。保险行业也差不多，同样由AIG和大都会人寿（MetLife）这样的老牌巨头统霸。

这种模式并非金融服务业独有。美国第一大零售商沃尔玛差点就错过了电子商务的崛起。记者杰森·戴尔·雷（Jason Del Rey）最近出版的《赢家通卖》（Winner Sells All）一书称，沃尔玛1990年代的老板戴维·格拉斯（David Glass）曾预测，网上销售额永远不会超过他手下最大的一家仓储式零售店。尽管如此，沃尔玛的雄厚财力和庞大客群还是给了它机会在后来改弦更张。如今它在美国的线上销售额仅次于亚马逊。美国最大的两家汽车制造商福特和通用汽车近来电动汽车销量增长也是一例。在造车新势力融资日益困难之时，这两家公司凭借庞大的资产负债表，投入巨资重塑业务。

美国老牌企业长盛不衰的第三个解释是，它们的规模形成了自身的创新动力。提出“创造性破坏”一词的经济学家约瑟夫·熊彼特（Joseph Schumpeter）最初认为，经济进步主要是由新进入者推动的；他在1911年出版的《经济发展理论》（The Theory of Economic Development）中指出，“建造铁路的一般不会是驿站马车主”。到1942年出版巨著《资本主

义、社会主义与民主》（Capitalism, Socialism and Democracy）时，他的想法改变了。事实上，正是大公司——甚至是垄断企业——推动了创新，这要归功于它们有能力在研发上大举注资，并利用现有的客户和业务将突破性成果迅速变现，因为它们时刻担心被颠覆而不敢松懈。

美国的科技巨头就是典型例子。去年，Alphabet、亚马逊、苹果、Meta和微软的研发投入合计达2000亿美元，相当于它们利润总和的80%，以及美国所有上市公司研发支出的30%。没那么显眼的例子也比比皆是。成立于1837年的约翰迪尔（John Deere）是美国最大的农业机械设备公司，引领着无人驾驶拖拉机和利用机器学习来识别和定位杂草的智能喷药系统等创新。该公司的目标是到2030年实现农业生产完全自主化。它招揽被硅谷裁撤的技术人员，现在雇用的软件工程师数量已经超过了机械工程师。

在创新过程中，在位者和新来者也常常形成互补。经济学家威廉·鲍莫尔（William Baumol）在2002年撰文描述了“大卫与巨人的共生关系”——独立创新者带来激进性突破，再由老牌企业发扬光大。慕尼黑工业大学（Technical University of Munich）的安妮特·贝克尔（Annette Becker）及合著者在2020年发表了一篇论文，将样本企业的研发支出分类为偏探索性的“研究”和偏商业性的“开发”，结果发现企业的规模越大，研究的相对比重就越低。同样，芝加哥大学的乌富克·阿克西吉特（Ufuk Akcigit）和哈佛商学院的威廉·科尔（William Kerr）在2018年的一篇论文发现，大公司产生的专利相对不太激进，而更侧重于对现有产品和流程做渐进式改良。

这种分工或许可以解释为什么许多创业公司会被老牌企业收购。例如，约翰迪尔在2017年收购了Blue River，从而获得了智能除草喷药技术，然后通过其庞大的分销商网络销售。数据供应商PitchBook的数据显示，过去十年间，美国74%的风险投资都是通过此类收购“退出”的（见图表2）。而在1980年代，这一比例还几乎为零，有人为此发出了“扼杀式收购”泛滥的警告，即大公司借收购吃掉未来的潜在竞争对手。

这种情况确实存在，但很少见。2021年，当时供职于伦敦商学院的科琳·坎宁安（Colleen Cunningham）及合著者经研究发现，制药公司严重依靠

创业公司来补充研发管线，但药企收购案中只有5%到7%有吃掉竞争对手的嫌疑。在大多数情况下，对于一家创新型新公司来说，并入一家老牌巨头只不过是将自己的突破性成果推向世界的最有效方式。

对缺乏竞争性颠覆的最后一种解释与人口结构有关。“年轻企业通常是由年轻人创建的。”伦敦政治经济学院的约翰·范雷宁（John Van Reenen）指出。1980到2020年间，美国20到35岁的人口占比从26%下降到20%。同期，新成立企业所占比例从12%下降到8%（见图表3）。纽约联储的法提赫·卡拉汉（Fatih Karahan）及合著者在2019年的一项研究中比较了美国各州人口增长和新创企业的变化，得出的结论是，过去40年里新成立公司的减少有60%与人口增速下降有关。

美国新公司的申请数量在疫情暴发的最初几个月急剧下降，随后于2020年底猛增，此后一直明显高于疫情前水平。这种创业激情主要集中在饱受疫情打击的酒店业和零售业，随着时间的推移，特别是随着在疫情期间膨胀起来的家庭储蓄开始缩水，这股热潮可能会见顶。乐观派希望最近对人工智能创业公司的投资热潮能够支撑住这种势头。即便如此，昔日的企业巨人很可能还是会稳坐王座。 ■



Goliath's triumph

America's corporate giants are getting harder to topple

Incumbents from Walmart to General Motors are fighting back against disrupters

ATTEND ANY business conference or open any management book and an encounter with some variation of the same message is almost guaranteed: the pace of change in business is accelerating, and no one is safe from disruption. Recent breakthroughs in artificial intelligence (AI) have left many corporate Goliaths nervously anticipating David's sling, and fearing the same fate as Kodak and Blockbuster, two giants felled by the digital revolution.

“The Innovator’s Dilemma”, a seminal book from 1997 by Clayton Christensen, a management guru, observed that incumbents hesitate to pursue radical innovations that would make their products or services cheaper or more convenient, for fear of denting the profitability of their existing businesses. In the midst of technological upheaval, that creates an opening for upstarts unencumbered by such considerations. Yet America Inc has experienced surprisingly little competitive disruption during the internet age. Incumbents appear to have become more secure, not less. And there is good reason to believe they will remain on their perches.

Consider the Fortune 500, America’s largest firms by revenue, ranging from Walmart to Wells Fargo and accounting for roughly a fifth of employment, half of sales and two-thirds of profits. The Economist has examined the age of each firm, taking into account mergers and spin-offs that make the group look artificially young.

We found that only 52 of the 500 were born after 1990, our yardstick for the internet era. That includes Alphabet, Amazon and Meta, but misses

Apple and Microsoft, the middle-aged tech titans. Only seven of the 500 were created after Apple unveiled the first iPhone in 2007, while 280 predate America's entry into the second world war (see chart 1). In fact, the rate at which new corporate behemoths arise has been slowing. In 1990 there were 66 firms in the Fortune 500 that were 30 years old or younger. Since then the average age has crept up from 75 to 90.

One explanation for this is that the digital revolution has not been all that revolutionary in some parts of the economy, notes Julian Birkinshaw of the London Business School. Communications, entertainment and shopping have been turned on their heads. But extracting oil from the ground and sending electricity down wires look much the same. High-profile flops like WeWork, a much-hyped office-sharing firm now at risk of collapse, and Katerra, which tried and failed to redefine the construction business by using prefabricated building components and fewer middlemen, have discouraged others from trying to disrupt their respective industries.

Another reason is that inertia has slowed the pace of competitive upheaval in many industries, buying time for incumbents to adapt to digital technologies. Although 65% of Americans now bank online, nearly all the banks they use are ancient—the average age of those in the Fortune 500, including JPMorgan Chase and Bank of America, is 138. Fewer than 10% of Americans switched banks last year, according to Kearney, a consultancy. That stickiness has made it difficult for would-be disrupters to build scale before incumbents imitate their innovations. A labyrinthine regulatory system that favours big institutions with well-staffed compliance departments helps. The insurance industry, also dominated by geriatric giants like AIG and MetLife, is much the same.

The pattern is not unique to financial services. Walmart, America's mightiest retailer, almost missed the rise of e-commerce. David Glass, its boss in the 1990s, predicted that online sales would never exceed those of

its single largest retail warehouse, according to a recently published book, “Winner Sells All”, by Jason Del Rey, a journalist. Nonetheless, Walmart’s financial heft and enormous customer base gave it the chance to change course later. Only Amazon now sells more online in America. The recent growth of electric vehicles from Ford and General Motors, America’s two largest carmakers, offers another example. Their bulky balance-sheets have allowed them to spend heavily on reinventing their businesses at a time when raising capital is becoming more difficult for newcomers.

A third explanation for the endurance of America’s incumbents is that their scale creates a momentum of its own around innovation. Joseph Schumpeter, the economist who coined the phrase “creative destruction”, first argued that economic progress was propelled mostly by new entrants, noting in “The Theory of Economic Development” in 1911 that “in general it is not the owner of stage coaches who builds railways”. By the time he published “Capitalism, Socialism and Democracy”, his magnum opus of 1942, he had changed his mind. It was, in fact, big firms—monopolies, even—that drove innovation, thanks to an ability to splash cash on research and development (R&D) and quickly monetise breakthroughs using existing customers and operations, spurred on by a constant fear of being toppled.

America’s tech titans offer the quintessential illustration. Alphabet, Amazon, Apple, Meta and Microsoft invested a combined \$200bn in R&D last year, equivalent to 80% of their combined profits and 30% of all R&D spending by listed American firms. Less obvious examples abound, too. John Deere, America’s largest agricultural-equipment firm, founded in 1837, leads the way in innovations like driverless tractors and clever sprayers that use machine learning to spot and target weeds. Its ambition is to make farming fully autonomous by 2030. After snatching laid-off techies from Silicon Valley it now employs more software engineers than mechanical ones.

Incumbents and newcomers also often play complementary roles in innovation. William Baumol, an economist, wrote in 2002 of a “David-Goliath symbiosis” in which radical breakthroughs generated by independent innovators are then enhanced by established firms. A paper in 2020 by Annette Becker of the Technical University of Munich and co-authors split R&D spending by a sample of firms into more exploratory “research” and more commercially oriented “development”, and found that the relative weight of research fell with firm size. Likewise, a paper in 2018 by Ufuk Akcigit of the University of Chicago and William Kerr of Harvard Business School found that patents generated by big firms were less radical and more focused on incremental improvements to existing products and processes.

That division of labour may help explain why many startups are bought by established firms. John Deere’s acquisition in 2017 of Blue River, for example, gave it the technology behind its clever weed sprayer, which it was then able to sell through its vast network of distributors. Over the past decade 74% of venture-capital “exits” in America were via such acquisitions, according to PitchBook, a data provider (see chart 2). That is up from next to none in the 1980s, leading to warnings of a plague of “killer acquisitions”, with big firms eating their potential future rivals.

Such cases do occur, but are rare. A study in 2021 by Colleen Cunningham, then at the London Business School, and co-authors found that 5-7% of acquisitions by drug companies, which rely heavily on startups to top up pipelines, looked suspect. Most of the time, folding into an established giant is simply the most efficient way for an innovative new firm to bring its breakthroughs to the world.

A final explanation for the lack of competitive disruption relates to demographics. “Young firms are generally built by young people,” notes John Van Reenen of the London School of Economics. Between 1980 and

2020 the share of America's population aged between 20 and 35 fell from 26% to 20%. The rate of new business formation dipped from 12% to 8% in the same period (see chart 3). In a study of 2019 comparing variations in population growth and new business formation across states in America, Fatih Karahan of the Federal Reserve Bank of New York and co-authors concluded that falling population growth accounted for 60% of the decline in the business-entry rate over the past 40 years.

Application rates to start new businesses in America surged in late 2020 after plunging in the early months of the pandemic, and have since remained well above pre-pandemic levels. That entrepreneurial burst has mostly focused on hospitality and retailing, which were hammered by covid, and over time may peak, especially as pandemic-swollen household savings dwindle. Optimists will hope that the recent flurry of investment in AI startups can sustain the momentum. Even if it does, the corporate giants of the past may well remain on top. ■



巴托比

一个良好的职场导师体系的益处无可否认

公司里的良师益友带来的快乐

《指环王》里的甘道夫、《星球大战》里的尤达、还有伊恩·弗莱明（Ian Fleming）早期的詹姆斯·邦德小说里的M，都扮演着导师的角色，为那些还不谙世事的人提供明智的建议和指导。在现实生活中，就像在小说里一样，传授从沧桑岁月（尤达900岁了，甘道夫已经1000多岁了）中得来的智慧的价值日益凸显。即使疫情引发的“大辞职”造成的就业市场动荡已渐平息，让员工保持快乐又忠诚也符合公司的利益。一个好的导师体系可以达到这个目的。

职场导师制一直以来都是一种非正式关系，往往就是和年资更久、级别更高的同事在咖啡机旁聊会儿天或是一起去酒吧。就连最成功的人士也会觉得有只愿意倾听的耳朵是对企业工具库的有益补充。三十多年来，比尔·盖茨一直向另一位亿万富翁巴菲特讨教。另一位科技巨头彼得·蒂尔（Peter Thiel）将法国博学之士、兼职哲学家勒内·基拉尔（René Girard）视为最能给他带来启迪的人之一。

近年来，企业在探寻把这种指导正式化，它能带来明显的回报——培养一种连接感和忠诚度，并且有助于技能的传接和发展。目标是通过分享知识和经验来支持员工，增强他们的信心。最佳情况下，当导师和被指导的人之间建立真正融洽的关系时，这种做法能帮助后者提出新想法，也能帮他们应对问题。

那么企业要如何建立最佳导师体系呢？要使之发挥作用，某种程度的化学反应必不可少，高度尊重被求教者也同样重要，无论双方年龄差距和背景如何。四季酒店的前经理毛里齐奥·奥拉奇奥（Maurizio Orlacchio）将他的职业生涯归功于他与导师的关系，那是一位年长的高管，教会了他如何激励员工以及自我激励。

导师体系应该是自我管理的，由资历较浅的一方主导安排讨论，而这些讨论始终是保密的。最好让员工自己选择最想要和谁讨论他们的职业轨迹，无论他们在公司里的职位高低。接到请求的导师可能会倍感荣幸，但仍然可以拒绝。

如果你想成为一个有分量的导师，不要“不请自来”地去给谁提建议。如果你是被指导方，不要企图解决私人问题（失败的恋爱关系、头皮屑）或让对方帮你付保释金。但是与工作相关的任何事情都应该开放讨论。说“我有点不安，消化不了”和聊你的长期职业前景一样正当合理。

企业越来越认识到与能提供帮助的同事面对面交流的重要性。斯坦福大学的尼古拉斯·布卢姆（Nicholas Bloom）从自疫情暴发以来数百家组织的数据中发现，指导新人是每周让员工回办公室两三天的关键原因。高盛CEO戴维·所罗门（David Solomon）在推动全面返回办公室时也表达了类似的观点。

尽管高盛有这样的政策，居家办公已经成为疫情后的一项常规安排。因此，虚拟指导仍要扮演一定的角色。与任何网上关系一样，以这种方式建立信任和默契将需要更长的时间。无论界限设置得多么清楚，在Zoom上开会时，摄像头会不可避免地扫到些许个人空间。笔者的建议是看起来够整洁干净就好，要忍住，别从冰箱里拿啤酒。面对面时看似自然的事情可不是都适合放到在线会议中。

反向指导也开始流行。有些高管可能也需要简短补习一下对多样性和其他代际差异的理解，和一名初级员工配对可能有帮助。一名经验丰富的首席财务官能从千禧一代员工身上学到些什么还可以探讨，但最佳的指导关系始终是双向的。

无论是共进午餐、喝点东西还是在停车场聊天，如果导师制度能够培养更友好的文化、减少人员流失、促进人才培养，其益处是不可否认的。想象一下尤达云淡风轻的气度和银河般宏大的智慧，先不用管他高深莫测的说话风格。关键是找到一个人，即便不是绝地大师，但至少在你感到工作陷

入困境时可以聊一聊。有时，一起喝杯咖啡的力量可能和挥舞光剑一样强大。 ■



Bartleby

The benefits of a good workplace mentoring scheme are undeniable

The joys of corporate confidantes

GANDALF FROM “The Lord of the Rings”, Yoda in “Star Wars” or M in Ian Fleming’s early James Bond novels all act as mentors, providing sage advice and guidance to the less worldly-wise. In real life, as in fiction, the value of imparting wisdom gained through experience and age (Yoda is 900 years old, Gandalf is in his 1,000s) is becoming ever more important. It is in a company’s interest to keep its employees happy and loyal even if the jobs-market upheavals of the pandemic-induced “great resignation” are fizzling out. A good mentoring scheme can serve this purpose.

Workplace mentoring has long been an informal affair, disguised as a chat by the coffee machine or a trip to a bar with a longer-serving and more senior colleague. Even the most successful find having a receptive ear a useful addition to the corporate armoury. For over 30 years Bill Gates has turned to another billionaire, Warren Buffett, for advice. Peter Thiel, another tech baron, credits René Girard, a French polymath and part-time philosopher, as one of his greatest inspirations.

In recent years businesses have sought to formalise an arrangement with the obvious rewards of nurturing a sense of connection and loyalty, and helping the transfer and development of skills. The aim is to support staff and boost their confidence by sharing knowledge and experience. At their best, when there is genuine rapport between mentor and mentored, such arrangements can help the latter to come up with new ideas and help them cope with problems.

So how do firms build the best mentoring schemes? For them to work, some

degree of chemistry is essential, as is a high regard for the person whose advice is being sought, irrespective of age gaps and backgrounds. Maurizio Orlacchio, a former manager for Four Seasons, a hotels chain, credited his career to his relationship with his mentor, an older executive who taught him how to motivate his employees—and himself.

Schemes should be self-managed with the junior party taking the lead in arranging discussions which are always confidential. It is best to let employees choose the person with whom they would most like to discuss their career trajectory, no matter their position on the corporate ladder. Requested mentors can be flattered but still decline.

If you want to become a valued mentor, do not start by offering unsolicited advice. If you're being mentored, do not look for solutions to personal problems (failing romantic relationships, dandruff) or ask for bail money. But anything else work-related should be open for discussion. "I'm feeling wobbly, this is all too much to take in" is as legitimate as chatting about your long-term career prospects.

Firms are increasingly recognising the importance of face time with helpful colleagues. Nicholas Bloom at Stanford University, using data from hundreds of organisations since the onset of the pandemic, found that the mentoring of recent hires was a key reason to bring employees into the workplace two or three days a week. David Solomon, CEO of Goldman Sachs, has echoed this in his push for a full return to the office.

Despite Goldman's efforts, working from home has become a post-pandemic fixture. So virtual mentoring also still has a role. As with any online relationship, trust and rapport take longer to build. No matter how clearly boundaries are set, there are inevitable glimpses of personal spaces when sessions take place on Zoom with cameras on. Bartleby recommends looking reasonably smart and refraining from getting a beer from the fridge.

What seems natural when meeting face-to-face does not always translate well online.

Reverse mentoring is also in fashion. Matching a junior employee with an executive whose understanding of diversity and other generational divides may need a refresher course could have benefits. There is room to debate how much a seasoned chief financial officer will learn from a millennial but the best mentoring relationships are always a two-way street.

Whether it is lunch, drinks or a chat in the car park, mentoring's benefits are undeniable if it fosters a friendlier culture, staff retention and development of talented employees. Think of Yoda's serene demeanour and galactic wisdom rather than his enigmatic speech patterns. The idea is to find, if not a Jedi master, then at least someone to talk to whenever you feel stuck in your job. Sometimes sharing a coffee can be just as powerful as wielding a lightsabre. ■



电老虎变绿

计算行业能洗心革面降能耗吗？

这个行业消耗的电力与整个英国相当，而且还在上升【深度】

“你首先注意到的是它有多么安静。”芬兰IT科学中心（Finnish IT Centre for Science）的负责人基摩·科斯基（Kimmo Koski）说。他说的是LUMI（芬兰语中“雪”的意思），这是欧洲最强大的超级计算机，位于北极圈以南250公里处的芬兰卡亚尼市（Kajaani）。

LUMI于去年启用，为从气候建模到新药研发的各种领域提供运算。它拥有数万个独立处理器，每秒能够执行高达429万亿次运算，是全世界第三强大的超级计算机。它甚至可以夸耀实现了二氧化碳负排放——它的电力供应来自水力发电，而废热用于为卡亚尼的房屋供暖。

LUMI让人一窥高性能计算（HPC）的未来，无论是在专用超级计算机上还是在支持大部分互联网的云基础设施中。过去十年，在机器学习、基因组测序以及模拟股票市场、核武器和天气等各种场景的技术的推动下，对HPC的需求激增。这种需求可能还会继续上升，因为有多少算力，这些用途就能消耗多少。同样是在过去十年里，训练尖端人工智能模型所需的算力每五个月就翻一番。

这一切都会对环境产生影响。HPC以及更通用的计算正在成为用电大户。国际能源署（IEA）估计，数据中心的用电量占全球总用电量的1.5%至2%，大致相当于整个英国经济的用电量。到2030年，这一比例预计将上升至4%。计算行业对政府减少温室气体排放的承诺心知肚明，正在努力找办法来用更少的资源做更多事，提高其产品的能效。它们的努力涉及三个层面：单个微芯片、由这些芯片构建的计算机，以及计算机所在的数据中心。

先说微芯片。过去80年来，数字计算机的能效有了巨大提升。在第二次世界大战刚结束时单次运算所消耗的电量可以让现代计算机完成大约10万亿

次计算。这样的长足进步在很大程度上是业界努力紧跟摩尔定律的结果——根据摩尔定律，集成电路中排布的元件数量每隔两年就会翻一番。

几十年来，摩尔定律有一个令人欣喜的副作用，那就是随着电路尺寸的缩小，它的功耗也更小了。这个效应被称为登纳德缩放比例定律，得名于当时在IBM工作的科学家罗伯特·登纳德（Robert Dennard），他于1974年写了一篇关于芯片功耗降低的论文。不过在2000年代中期，超微型元件棘手的物理特性让这种尺寸和功耗之间关系开始失效。随着元件尺寸不断缩小，计算机的能效仍在提升，但提升速度已大幅放缓。

这迫使芯片制造商花更大的力气去追求他们在过去顺带就可以降低的功耗。LUMI中的CPU（运行程序并协调计算机其余部分的通用芯片）由美国芯片设计公司AMD制造。除了超级计算机之外，该公司的CPU与其规模更大的竞争对手英特尔的CPU一起，驱动着众多确保互联网运转的数据中心。2010年，随着登纳德缩放比例定律成为历史，AMD将提高能源效率列为“我们的首要任务”，其产品技术架构师塞缪尔·纳夫齐格（Samuel Naffziger）表示。

如今，AMD的芯片使用了一系列方法来试图降低功耗。芯片上布满了传感器，可以根据分配给电路各部分的任务来监控并最大限度地减少它们所接收的电量。其他改进方案的重点是确保芯片上尽可能多的电路在任何时刻都在做有用的工作，因为空闲的电路会白白耗能。AMD希望，通过结合更巧妙的技术和更小的元件，到2025年，其最强大芯片的能效将达到2020年的30倍。

另一种做法是将任务从通用CPU转移到专为更特定的计算任务而设计的专用芯片上。最为人所熟知的专用芯片是“图形处理单元”，即GPU。最初开发GPU是为了在电子游戏中生成更绚丽的图形，但事实证明它在许多可以分解成小块的任务上表现出色，因为它可以同时处理每一个小块。类似的专用芯片越来越多地用于处理联网等任务，而这些任务以前是由CPU来处理的。

这种系统级的调整是可以提高能效的第二个层面。“当你使用成千上万CPU和GPU时，它们的连接方式就决定了超级计算机的能源效率。”慧与（Hewlett Packard Enterprise）高性能计算部门的负责人贾斯汀·霍塔德（Justin Hotard）说，高能效超级计算机是该公司的拿手产品之一。

究竟如何实现最佳连接仍然是一个活跃的研究领域。向计算机中其他位置上的另一个芯片发送信号功耗很大。因此，目标是尽量减少这种情况发生的频率，并在需要发送信号时尽量缩短传送距离。慧与更喜欢采用“蜻蜓拓扑”，这是一种两层系统，其中芯片组在集群内相互连接，集群间又相互连接。这个系统是模块化的，只需添加新节点即可轻松扩展。巴利亚多利德大学（Valladolid University）的计算机科学家弗朗西斯科·安杜哈尔（Francisco Andújar）及其同事在2月发表的一篇论文中表示，经过大量数学分析证明，对于高能效超级计算，蜻蜓拓扑是一种比较接近理想的设计。

提高能效不一定要牺牲性能。Top500.org网站按运算速度和能效发布超级计算机排名。最新的排名于6月发布，LUMI的能效排名全球第七，速度位居第三。美国田纳西州的橡树岭国家实验室（Oak Ridge National Laboratory）的计算机Frontier的运算速度以大优势排在第一，大约是LUMI的四倍。不过Frontier在能效上排名第六。

能够提高能效的最后一个层面是数据中心，这种高科技机房里存放着超级计算机以及驱动互联网运行的更普通的服务器。计算会产生大量热量。尽管效能新近成为一个重点课题，但一个现代CPU或GPU在全速运转时仍可产生500瓦或更多的热量。一个数据中心内有数万个CPU或GPU，也就是要处理几兆瓦的热量。

冷却数据中心也需要能量。衡量数据中心能效的标准指标是电能利用效率（PUE），即数据中心总功耗与用于有用工作的功耗之比。IT咨询公司Uptime Institute称，数据中心的PUE一般为1.58。这意味着大约三分之二的电力用于运行计算机，三分之一用于运行数据中心本身，这其中大部分都用在了冷却系统上。

巧妙的设计可以大大降低这个数字。大多数现有的数据中心依赖空气冷却。液体冷却的热传递效果更好，但需要额外的工程。几家创业公司甚至拿出了将电路板完全浸入专门设计的液体浴中的方案。Frontier的PUE为1.03，这部分归功于它使用了液体冷却。LUMI建在北极圈附近的原因之一就是为了利用亚北极的冷空气。同一数据中心内相邻的另一台计算机用这些不要钱的冷空气冷却，PUE仅为1.02。这意味着它接收的98%的电力都用于有用的计算。“这正在接近可能的极限。”科斯基说。

即使是最好的商业数据中心也达不到这样的水平。例如，谷歌的商业数据中心平均PUE为1.1。Uptime Institute在6月发布的最新数据显示，经过几年的稳步提高之后，全球数据中心的能效自2018年以来一直停滞不前（见图表）。主要原因不在计算机科学而在经济效益。随着计算需求激增，对企业来说让效率较低的老旧基础设施继续运行更长时间更为划算。

目前仅仅是锦上添花的东西可能很快就会成为法律要求。鉴于要实现碳减排目标，美国、英国和欧盟等政府正在考虑制定新规则，强制数据中心提高能效。德国的一项新法律将规定到2027年PUE至少要达到1.5，到2030年要达到1.3。“我们希望LUMI能够展示高性能计算是可以实现净零碳排放的。”科斯基说。那些想要取经的人不妨来一趟芬兰之旅。■



Mean and green

Can computing clean up its act?

The industry consumes as much electricity as Britain—and rising

“WHAT YOU notice first is how silent it is,” says Kimmo Koski, the boss of the Finnish IT Centre for Science. Dr Koski is describing LUMI—Finnish for “snow”—the most powerful supercomputer in Europe, which sits 250km south of the Arctic Circle in the town of Kajaani in Finland.

LUMI, which was inaugurated last year, is used for everything from climate modelling to searching for new drugs. It has tens of thousands of individual processors and is capable of performing up to 429 quadrillion calculations every second. That makes it the third-most-powerful supercomputer in the world. Powered by hydroelectricity, and with its waste heat used to help warm homes in Kajaani, it even boasts negative emissions of carbon dioxide.

LUMI offers a glimpse of the future of high-performance computing (HPC), both on dedicated supercomputers and in the cloud infrastructure that runs much of the internet. Over the past decade the demand for HPC has boomed, driven by technologies like machine learning, genome sequencing and simulations of everything from stockmarkets and nuclear weapons to the weather. It is likely to carry on rising, for such applications will happily consume as much computing power as you can throw at them. Over the same period the amount of computing power required to train a cutting-edge AI model has been doubling every five months.

All this has implications for the environment. HPC—and computing more generally—is becoming a big user of energy. The International Energy Agency reckons data centres account for between 1.5% and 2% of global

electricity consumption, roughly the same as the entire British economy. That is expected to rise to 4% by 2030. With its eye on government pledges to reduce greenhouse-gas emissions, the computing industry is trying to find ways to do more with less and boost the efficiency of its products. The work is happening at three levels: that of individual microchips; of the computers that are built from those chips; and the data centres that, in turn, house the computers.

Start with the microchips themselves. Digital computers have become vastly more efficient over the past 80 years. A modern machine can do around 10trn calculations for the same amount of energy as a single calculation would have consumed in the aftermath of the second world war. Much of that enormous progress was a result of the industry's attempts to stick to Moore's Law—the observation that the number of components that can be crammed onto an integrated circuit doubles every couple of years.

For several decades one happy side-effect of Moore's Law was that, as circuitry shrank, it also became more frugal. That effect is known as Dennard scaling, after Robert Dennard, a scientist then working at IBM who wrote a paper on the subject in 1974. During the mid-2000s, though, the tricky physics of ultra-tiny components meant that relationship began to break down. Computers are still becoming more efficient as their components shrink, but the rate at which they are doing so has slowed sharply.

That has forced chipmakers to work harder in pursuit of gains that they used to get free. The CPUs in LUMI—the general-purpose chips that run programs and co-ordinate the rest of the machine—are made by AMD, an American chip designer. Besides supercomputers its CPUs, alongside those of Intel, its larger rival, power many of the data centres that make the internet work. In 2010, with Dennard scaling confined to the history books, the firm put improving energy efficiency “at the top of our priority list”, says Samuel

Naffziger, the product technology architect at AMD.

These days its chips use an array of tricks to try to keep power consumption down. They are covered with sensors that monitor and minimise the amount of power sent to parts of the circuit depending on the tasks assigned to them. Other improvements have focused on making sure that as much of the chip as possible is doing useful work at any given moment, since idle circuitry wastes power to no purpose. AMD hopes that a combination of even more clever tricks and even smaller components will allow it to boost the efficiency of its most powerful chips 30-fold by 2025, compared with 2020.

Another option is to shift work from general-purpose CPUs to specialised chips designed for a narrower range of mathematical tasks. The best-known are “graphics processing units”, or GPUs. Originally developed to produce snazzier graphics for video games, GPUs have turned out to excel at many tasks that can be broken up into small bits, each of which can then be worked on simultaneously. Similarly specialised chips increasingly handle tasks like networking, which would previously have been left to the CPU to deal with.

Such system-level tweaks are the second scale at which efficiency can be improved. “When you are playing with thousands of CPUs and GPUs, how you connect them up can make or break a supercomputer’s energy efficiency,” says Justin Hotard, who is in charge of high-performance computing at Hewlett Packard Enterprise, a firm that specialises, among other things, in efficient supercomputers.

Exactly how best to wire everything up is still an active area of research. Sending a signal to another chip elsewhere in the computer consumes a great deal of energy. The goal is therefore to minimise how often it happens, and minimise the distance the signal has to travel when it does. HPE prefers

something known as a “dragonfly topology”, a two-layer system in which groups of chips are connected to each other in clusters, and those clusters are wired up to each other in turn. The system is modular, which makes it easy to scale up by simply adding new nodes. And a paper published in February by Francisco Andújar, a computer scientist at Valladolid University, and his colleagues, showed, after a great deal of mathematical analysis, that the dragonfly setup is close to the ideal design for efficient supercomputing.

And efficiency need not come at the cost of performance. Top500.org, a website, publishes rankings of supercomputers by both speed and efficiency. Its most recent, published in June, list LUMI as the seventh-most efficient machine in the world as well as the third-fastest. Frontier, a computer installed at Oak Ridge National Laboratory in Tennessee, is by far the world’s fastest, around four times quicker than LUMI. Nevertheless, when it comes to efficiency, Frontier ranks sixth.

The final scale at which gains can be made is that of the data centre, the high-tech shed in which both supercomputers and the more quotidian servers that power the internet live. Computing produces a great deal of heat. Despite the newfound focus on efficiency, a modern CPU or GPU can produce 500 watts or more of heat at full tilt. With tens of thousands in a single data centre, that means disposing of several megawatts of heat.

Keeping them cool requires energy in turn. The standard measure of a data centre’s efficiency is the power usage effectiveness (PUE), the ratio between the data centre’s overall power consumption and how much of that is used to do useful work. According to the Uptime Institute, a firm of IT advisers, a typical data centre has a PUE of 1.58. That means that about two-thirds of its electricity goes to running its computers while a third goes to running the data centre itself, most of which will be consumed by its cooling systems.

Clever design can push that number much lower. Most existing data centres rely on air cooling. Liquid cooling offers better heat transfer, at the cost of extra engineering effort. Several startups even offer to submerge circuit boards entirely in specially designed liquid baths. Thanks in part to its use of liquid cooling, Frontier boasts a PUE of 1.03. One reason LUMI was built near the Arctic Circle was to take advantage of the cool sub-Arctic air. A neighbouring computer, built in the same facility, makes use of that free cooling to reach a PUE rating of just 1.02. That means 98% of the electricity that comes in gets turned into useful mathematics. “That is closing in on the limits of what is possible,” says Dr Koski.

Even the best commercial data centres fall short of such numbers. Google’s, for instance, have an average PUE value of 1.1. The latest numbers from the Uptime Institute, published in June, show that, after several years of steady improvement, global data-centre efficiency has been stagnant since 2018 (see chart). Economics, rather than computer science, is the main reason. As demand for computing has boomed, it makes sense for firms to keep older, less efficient infrastructure running for longer.

What is presently merely a nice to have may soon become a legal requirement. Mindful of their carbon-reduction targets, the governments of America, Britain and the European Union, among others, are pondering new rules that could force data centres to become more efficient. A new German law would mandate a minimum PUE of 1.5 by 2027, and 1.3 by 2030. “We want LUMI to illustrate how high-performance computing can get across the line on net-zero carbon emissions,” says Dr Koski. Those wanting tips could do worse than book a trip to Finland. ■



热力难招架

气候变化将如何冲击度假

极端天气会影响游客选择出行的目的地和时间

“今天抵达意大利博洛尼亚，现在要去托斯卡纳了。这里的热浪真不得了。这么下去，长远来说这些度假胜地是没有未来的。气候变化正在摧毁南欧。一个时代结束了。”7月初，德国卫生部长卡尔·劳特巴赫（Karl Lauterbach）的这条推文惹得意大利人很恼火。意大利旅游部长丹妮拉·桑坦奇（Daniela Santanchè）尖酸地回击说，她感谢劳特巴赫选择在意大利度假，但意大利政府对气候变化再清楚不过，可持续性正是其旅游管理战略的核心要素之一。

旅游业可不仅仅是意大利经济的重要贡献力量。欧洲是世界上最受游客青睐的地区，2022全球9亿国际游客中有5.85亿去了欧洲。此外，在欧盟，国内度假者在旅游住宿场所的入住夜数超过了外国人。难怪这个行业直接贡献了欧盟GDP的5%，而间接贡献估计超过10%。一些国家严重依赖游客的直接和间接贡献，包括克罗地亚（占该国GDP的26%）、希腊（18.5%）、西班牙（13.6%）和意大利（10%）。

气候变化导致天气越发恶劣，这可能会重创旅游业。今年，南欧经历了一个异常动荡的夏季。7月，意大利西西里岛野火肆虐，极端炎热的天气是原因之一，该岛首府巴勒莫的气温一度攀升至47℃。再往北，伦巴第的雹灾夺去了几条生命。同样在7月，希腊当局不得不从被野火吞没的罗德岛和科孚岛撤离数万名游客。夏季热浪席卷西班牙之后，特内里费岛与野火作战，8月中旬有数千人被迫逃离家园。严重洪涝淹没了奥地利南部、克罗地亚和斯洛文尼亚。

尽管遭遇如此破坏，但随着疫情下的旅行禁令解除后度假者大批归来，意大利的旅游业乃至整个欧洲的旅游业今夏都将创下历史新高。尽管可能面临危险，没什么人取消旅行。据市场研究机构Demoskopika称，这个夏天

将有6800万人在意大利度假，其中约一半来自国外。今年的游客人数甚至可能超过2019年创下的纪录，当时有7.43亿游客从其他国家抵达欧洲各处。根据世界最大的旅游集团德国途易（TUI）的数据，尽管价格上涨，但夏季的预订量比去年同期增长了6%左右。

如果游客担心未来几年气候变化的影响，这种反弹还能持续下去吗？位于韦尔尼格罗德（Wernigerode）的哈茨应用科学大学（Harz University of Applied Sciences）的可持续旅游专家哈拉尔德·蔡司（Harald Zeiss）代表了许多气候观察家的观点，他说欧洲的天气将变得更热、更干燥，未来发生极端天气事件的概率甚至还会更高。除了遭受洪水或火灾的人口会面临可怕的后果，受灾地区依赖旅游业提供收入和就业的人们也可能生计难保。

蔡司预测，经典的地中海海滨“全包式”度假将会经历一段艰难的旅程。他认为，遇上酷热天气的前景尤其将使老人和带孩子出行的人望而却步。位于威廉港（Wilhelmshaven）的雅德应用科技大学（Jade University of Applied Sciences）的另一位旅游专家托斯腾·吉尔斯特盖斯（Torsten Kirstges）认为，在野火仍只是零星发生的情况下，至少未来五年内游客依然会继续涌向南方，即使是在炎热的夏季月份。吉尔斯特盖斯说，尤其是年轻人依旧希望享受阳光的炙烤。

地中海的诱惑仍可能长盛不衰——只要其他地方比不上这里令游客神往。北方的目的地可能会在夏季旅游高峰期迎来需求增长，特别是波罗的海、德国、东欧和斯堪的纳维亚半岛。但这些地方无法取代南方的度假胜地，因为它们不具备接待大规模旅游的条件（反正许多地方也不想有那么多游客）。对于有意前往的游客来说，这里夏天的天气太难预料。但旅游趋势确实是会改变的，尽管比较缓慢。20世纪50年代，德国人最喜欢的度假目的地是穿越边境前往奥地利。直到80年代中期，西班牙才取而代之。专家们一致认为，再过30年，欧洲的旅游业相比现在将是另一番景观。

该行业已加入了企业界做出的广泛承诺，要实现《巴黎气候协定》立下的目标，到2050年实现二氧化碳净零排放。例如，途易希望到2050年自己

的所有业务和供应链都实现气候中和。然而，业内公司为减轻全球变暖效应所做的这类努力并不会产生多少整体影响。更重要的是，旅游业需要去适应气候变化。

途易的首席可持续发展官托马斯·埃勒贝克（Thomas Ellerbeck）表示，短期而言这将是个采取多种应对措施的问题，例如在水资源正变得越发稀缺的地区严格管理水源、建立极端天气事件早预警系统，以及延长度假季。比如他的公司将希腊的预订季延长至11月。吉尔斯特盖斯认为，更多的地中海酒店将安装空调（由太阳能驱动）、饮水机等。游客们或许可以选择早晚出门，避开正午火炉般的高温。

更长远来看，一些人不可避免会从地中海的金色沙滩转向波罗的海的海滩。但对于度假者而言也不全然是坏事，他们要么会发现波罗的海海滩出人意料的美丽，要么可以错开时间南下度假。对于当地居民和那些渴望在相对平静的环境中感受杜布罗夫尼克、威尼斯、巴塞罗那的文化或其他南欧美景的游客来说，熙熙攘攘的人群已成为一种困扰，一些游客改在春季或秋季前往将有助于缓解这一问题。 ■



Too hot to handle

How climate change will hit holidaymaking

Extreme weather will affect where tourists go and when

“ARRIVED IN BOLOGNA, Italy, today, now it’s off to Tuscany. The heatwave is spectacular here. If things continue like this, these holiday destinations will have no future in the long term. Climate change is destroying southern Europe. An era comes to an end.” This tweet in early July by Karl Lauterbach, Germany’s health minister, went down badly in Italy. The country’s minister for tourism, Daniela Santanchè, sourly retorted that she thanked Mr Lauterbach for picking Italy for his holiday, but the Italian government was well aware of climate change and that sustainability was one of the central elements of its strategy for managing tourism.

The industry is not just an important contributor to Italy’s economy. Europe is the planet’s most visited region, welcoming 585m of the world’s 900m international travellers in 2022. On top of this, domestic holiday-makers outstripped foreigners in terms of nights spent in tourist accommodation in the EU. Little wonder then that the sector directly generates 5% of the EU’s GDP and by some estimates indirectly accounts for more than 10%. Some countries rely heavily on travellers’ contributions both direct and indirect, including Croatia (26% of GDP), Greece (18.5%), Spain (13.6%) and Italy (10%).

Changes to the climate that lead to ever-wilder weather could deliver a nasty blow to the tourist industry. This year southern Europe has endured an abnormally turbulent summer. Extreme hot weather in Italy in July contributed to wildfires that ravaged Sicily as the temperature at one time climbed to 47°C in Palermo, the island’s capital. Farther north, hailstorms in Lombardy claimed several lives. Also in July Greek authorities had to

evacuate tens of thousands of tourists from Rhodes and Corfu after wildfires engulfed those islands. After heatwaves scorched Spain over the summer, Tenerife battled fires that forced thousands to flee their homes in mid-August. Heavy floods have deluged southern Austria, Croatia and Slovenia.

Despite the devastation, Italy's tourism industry—and that of Europe as a whole—is set for a record summer this year as holidaymakers return in force after the travel restrictions of the pandemic. Few have cancelled trips despite the dangers that may await them. According to Demoskopika, a market researcher, 68m people will have taken a holiday in Italy this summer, with around half arriving from abroad. Tourist numbers this year may even surpass the record set in 2019, when 743m visitors arrived in European destinations from other countries. According to Germany's TUI, the world's largest travel group, in spite of higher prices summer bookings were around 6% higher than a year ago.

Can the rebound last if tourists are fearful of the effects of climate change in years to come? Harald Zeiss, an expert in sustainable tourism at Harz University of Applied Sciences in Wernigerode, speaks for many climate watchers when he says that Europe's weather will become hotter and drier, and that extreme weather events will become even more likely in the future. Aside from the awful consequences for populations caught up in floods or fires, this also threatens the livelihoods of those who rely on income and employment from tourism in affected areas.

The classic "all-inclusive" package holiday on the beaches of the Med will have a rough ride, predicts Mr Zeiss. He reckons that the prospects of oppressive heat will deter the elderly and those with children in particular. Torsten Kirstges, another tourism expert at Jade University of Applied Sciences in Wilhelmshaven, thinks that while wildfires remain sporadic travellers will continue to flock south, even in the hot summer months, at least for the next five years. Youngsters in particular still want to roast in the

sun, says Mr Kirstges.

The lure of the Mediterranean will probably endure as long as the alternatives do not look as enticing. Northern destinations, in particular the Baltic Sea, Germany, eastern Europe and Scandinavia, may see an increase in demand during the peak summer period. But these destinations cannot replace southern resorts because they are not equipped for mass tourism (which many don't want anyway). For potential visitors the weather is too unpredictable in the summer. But travel trends do change, if slowly. In the 1950s the favourite holiday destination for Germans was a trip across the border to Austria. It was not before the mid-1980s that Spain took over. And experts agree that tourism in Europe in 30 years' time will be different from what it is today.

The industry has joined in with wider promises by businesses to hit the targets of the Paris climate agreement by becoming net-zero emitters of carbon dioxide by 2050. TUI, for instance, wants to be climate-neutral across its operations and supply chain by 2050. Yet such efforts by firms to mitigate the effects of global warming will have little overall impact. More importantly, tourism will need to adapt to climate change.

In the short term, this will be a question of measures such as strict management of water resources where these are becoming increasingly scarce, early-warning systems for extreme weather events and an extension of the holiday seasons, says Thomas Ellerbeck, chief sustainability officer at TUI. His company is, for instance, extending the booking season for Greece until November. Mr Kirstges thinks many more hotels in the Med will install air conditioning (fuelled by solar power), water coolers and the like. Tourists may adapt by going out in the mornings and evenings to avoid the midday furnace.

Longer term, some switching from the golden sands of the Med to the

beaches of the Baltic is inevitable. But there is a silver lining for the holidaymakers who will either discover the unexpected beauty of Baltic beaches or may go south at different times of the year. A shift by some tourists to the spring or autumn will help with the overcrowding which has become a such a nuisance for residents and those visitors eager to imbibe the culture of Dubrovnik, Venice, Barcelona or other marvels of southern Europe in relative peace. ■



经济学人视频

热浪是如何形成的？ - 上

热浪是正常天气的一部分，但它们究竟是如何形成的？



The Economist Film

Heatwaves: The Essentials - part 1

Heatwaves are a normal part of the weather, but how do they form?



找寻黄金

《阿南西的黄金》复盘世界巨骗之一

这本精彩的新书搜集碎片资料，拼凑出一个不太为人所知的骗子如何骗倒众多成功人士的故事【《阿南西的黄金》书评】

《阿南西的黄金：一人骗倒全世界》，耶博卡·伊伯著。布鲁姆斯伯里出版社；400页；29.99美元，20英镑。

从伯尼·麦道夫（Bernie Madoff）到“华尔街之狼”乔丹·贝尔福特（Jordan Belfort）和创办Therano的伊丽莎白·霍尔姆斯（Elizabeth Holmes），骗子们给通常单调的金钱世界添加了色彩。约翰·阿卡·布莱-米耶萨（John Ackah Blay-Miezah）并不像上述几人那样家喻户晓，至少在他的母国加纳之外名气没那么大。但加纳裔英国记者耶博卡·伊伯（Yepoka Yeebo）充分证明了他其实毫不逊色。

从上世纪70年代到90年代的二十年里，凭借满嘴谎言和运气，他编造的一个非同寻常的故事帮助他欺骗了几个洲的数百个（也可能有数千个）投资者。布莱-米耶萨有实力冲击世界头号大骗子的头衔。而他毫无疑问是非洲最大的骗子。

在1966年的一场军事政变中，加纳独立后的第一任领导人克瓦米·恩克鲁玛（Kwame Nkrumah）被推翻，布莱-米耶萨的故事就此拉开帷幕。当时盛传恩克鲁玛把该国的黄金藏匿在了海外。没有人说得清这些黄金到底价值几何：可能是几亿、几十亿，甚至几百亿美元。这些传言可能是无稽之谈，但很多加纳人深信不疑。

布莱-米耶萨出身贫困，但青年时代成功去了美国。在那里，他对经营企业产生了兴趣，并嗅到了一个黄金机会。他在美国、欧洲和亚洲到处转悠——总是住豪华酒店，花的是别人的钱——兜售着他是恩克鲁玛的黄金信托基金托管人的故事。他许诺出资帮助他找回这笔财富的人能从中分得一大笔。当然，从没有人见过这些黄金的踪影。

问题是——就像在各种惊天大骗局中常常叫人不可思议的那样——布莱-米耶萨是怎么能让这谎言维持这么久的。一个答案是他的行骗天分。他擅长财务上的骗术，从支票存款欺诈，到伪造文件。他身型肥胖，衣着考究，是一个总是叼着雪茄的魅力先生，拥有近乎神奇的说服力。伊伯把他比作西非神话中半人半蜘蛛的骗子之神阿南西（Anansi）。布莱-米耶萨深知有一批可信的支持者站台的重要性：被他说服来宣扬他的故事的人当中，有几位加纳高官、瑞士银行家，还有尼克松时期的司法部长约翰·米切尔（John Mitchell）。他还深知好的故事得有让人信服的布景：在伦敦和苏黎世的办公室、精致的介绍册等等。

但要让这些东西起作用少不了贪念：他自己的和别人的。这么多的投资者（为免招惹证券监管机构，布莱-米耶萨喜欢称他们为“支持者”）本应能了解得更清楚些，却都轻信了他的杜撰。在那些不仅同意了投资还大力参与其中的人里，有来自纽约、伦敦和首尔的金融家、企业主和律师。

“他们中一些人几十次、甚至可能几百次地听过他说‘快了’，”伊伯写道，“总是又横生枝节。什么人死了。哪里发生了动荡。”前童星秀兰·邓波儿（Shirley Temple Black）是少数怀疑者之一，她在任美国驻加纳大使时对布莱-米耶提出了质疑，甚至一度发电报给时任国务卿基辛格表达了担忧。

许多投资者只是不愿意承认自己上当罢了。再给阿南西最后一次机会反而让他们没那么难受。从这一点来看，尽管这个骗局大胆妄为，但也和之前之后的众多骗局相差无几。布莱-米耶萨能长时间享受奢华生活，主要归功于沉没成本谬误。最终美国执法机构觉察到了这个骗局，花了好几年才拆解清楚。布莱-米耶回到了加纳，但从未被全面追责，在几年居家监禁后，于1992年死于家中。

在布莱-米耶骗局的背后，是一个拥有得天独厚的自然资源（有黄金、可可，还在不断发现石油）却终年遭受奴隶贩子、殖民者和腐败政客剥削压榨的国家。恩克鲁玛在海外的黄金可能是子虚乌有，但加纳的自然财富是实实在在的。几十年里，加纳一直被贪婪的殖民者、领导人和像布莱-米

耶这样的骗子出卖，这是本书的悲剧核心。

由于许多相关文件在各种政变中被毁，或是被那些想要掩盖自己牵涉其中的人破坏，伊伯需要竭尽全力挖掘资料才能揭示出布莱-米耶骗局的全貌。除了采访过几十个曾与主人公有交集或是被他骗过的人，她还查阅了未出版的回忆录和家族档案，追踪遗失的官方记录，筛查联邦调查局和美国检察官编写的档案。虽姗姗来迟，《阿南西的黄金》为全球巨骗系列增添了可贵的一卷。 ■



Going for gold

“Anansi’s Gold” examines one of the world’s biggest con artists

A riveting new book pieces together how a swindler with a low profile duped so many high-flyers

Anansi’s Gold: The Man Who Swindled the World. By Yepoka Yeebo. Bloomsbury; 400 pages; \$29.99 and £20

FROM Bernie Madoff to Jordan “Wolf of Wall Street” Belfort and Elizabeth “Theranos” Holmes, swindlers bring colour to the often-monochrome world of money. John Ackah Blay-Miezah is no such household name, at least outside his native Ghana. But Yepoka Yeebo, a British-Ghanaian journalist, makes a strong case for why he should be.

For two decades, from the 1970s to the 1990s, he peddled lies and rode his luck, spinning a remarkable story that helped him bilk hundreds (and perhaps thousands) of investors on several continents. Blay-Miezah is a contender for world’s greatest con artist. He is certainly Africa’s.

His story unfolds after the ousting of Kwame Nkrumah, Ghana’s first post-independence leader, by a military coup in 1966. Rumours swirled that Nkrumah had stashed the nation’s gold overseas. No one was quite sure how much the gold was worth: perhaps hundreds of millions, billions or even tens of billions of dollars. The stories were probably nonsense, but many Ghanaians believed them.

Blay-Miezah was born poor but made his way as a young man to America. There he got a taste for enterprise and sensed a golden opportunity. He buzzed around America, Europe and Asia—always staying in swanky hotels, always on someone else’s dime—peddling the story that he had been made custodian of Nkrumah’s trust fund for the gold. He promised that those who

funded his efforts to retrieve the bounty would share handsomely in it. The gold, of course, never appeared.

The question, as so often with big frauds, is how Blay-Miezah kept it going for so long. One answer is his aptitude for deceit. He had a gift for financial sleight-of-hand, from cheque-deposit fraud to document forgery. A portly, sharp-dressed, cigar-chomping charmer, he had almost superhuman powers of persuasion. Ms Yeebo likens him to Anansi, the trickster god, part-man part-spider, from west African mythology. He understood the importance of assembling a cast of credible backers: among those he persuaded to promote his story were several top Ghanaian officials, Swiss bankers and Richard Nixon's former attorney-general, John Mitchell. He understood, too, that a good story needs a convincing set: offices in London and Zurich, glossy brochures, and so on.

But none of it would have been possible without greed: his own and others'. So many investors—whom he preferred to call “supporters”, so as not to fall foul of securities regulators—should have known better but swallowed the fiction. Among those willing not only to invest but to keep ploughing in more were financiers, business owners and lawyers from New York, London and Seoul.

“Some of them had heard dozens, maybe hundreds of ‘soons’,” Ms Yeebo writes. “Something always came up. Someone had died. There had been some unrest.” Shirley Temple Black, the former child star, was one of the few sceptics to raise questions about Blay-Miezah while she served as ambassador to Ghana, at one point even cabling Henry Kissinger, then the secretary of state, with her concerns.

Many of the investors simply could not admit to themselves that they had been scammed. It was less painful to keep giving Anansi one last chance. In this sense the fraud, for all its audacity, was like so many others before and

since. The high life Blay-Miezah enjoyed for so long owed much to the sunk-cost fallacy. After American law-enforcement finally twigged on to the scam, it took years to unravel. Blay-Miezah returned to Ghana but was never fully held to account, dying at his home in 1992 after a few years of house arrest.

The backdrop to Blay-Miezah's shenanigans is a nation blessed with resources (gold, cocoa and, increasingly, oil) but perennially exploited by slave-traders, colonists and corrupt politicians. Nkrumah's offshore gold may have been illusory, but Ghana's natural wealth is real. Its decades-long betrayal by rapacious colonisers, leaders and sharks like Blay-Miezah is the book's central tragedy.

With many of the relevant documents destroyed in coups or by those hoping to cover up their involvement, Ms Yeebo had to dig tenaciously to reveal the full story of Blay-Miezah's exploits. In addition to interviewing dozens of people who crossed paths with or were scammed by him, she drew on unpublished memoirs and family archives, tracked down missing official records and sifted through files compiled by the FBI and American prosecutors. "Anansi's Gold" is a welcome, if belated, addition to the canon on great swindlers. ■



【首文】勿谓言之不预

厄尔尼诺已经开始。必须开始准备

它将给世界大片地区带来混乱天气

加利福尼亚极少像佛罗里达、路易斯安那和得克萨斯等州那样经常性地遭受飓风和暴风雨的袭击。但在8月20日，热带风暴希拉里（Hilary）从南面猛烈进袭该州。创纪录的强降雨倾泻在洛杉矶市中心，淹没了加州干旱的山谷。紧接着，预报就显示，随着一个热穹顶从美国南部大部分地区上空一直盖到五大湖区，天气将从“水煮”变成“烧烤”模式。

今年夏天，几乎每天都会传来世界某个地方出现某种极端天气的新闻。尽管天气总是在打破纪录，但人们开始担忧，当气候进一步变暖将会是什么情形？更令人警觉的是，美国国家海洋和大气管理局（National Oceanographic and Atmospheric Administration）宣布，厄尔尼诺已经到来。这种气候模式每两到七年出现一次，会导致全球气温升高。

因此，今年很有可能成为有记录以来最热的一年；而2024年还会更热，气温将比工业化前水平高出1.4°C。一些热带地区会遭受水灾，而另一些地区会暴发旱灾，带来粮食供应和疾病传播方面令人担忧的后果。和气候变化本身一样，现在就需要为厄尔尼诺即将带来的剧变做准备。

根据目前的预测，这次很可能会是强厄尔尼诺。在2014年至2016年的上一个厄尔尼诺周期，一些受影响最严重的国家遭遇了毁灭性的打击。干旱导致南非的粮食产量降至20年来的最低水平，并在印度尼西亚引发了严重程度史上数一数二的连场野火。与此同时，更加高温多雨的天气加剧了南美洲各地疾病暴发，包括65年来最严重的寨卡病毒感染。

这次厄尔尼诺很可能产生严重影响的一个原因是，它叠加于全球变暖加剧之上。“厄尔尼诺”意为圣婴，因为它往往在圣诞节前后达到高峰。虽然目前它才刚刚开始，但由于凤尾鱼逃离秘鲁沿海海域，它已经导致世界上最大的秘鲁渔场关闭。它还搅乱了全球大米市场，因为印度已经抢先采取行

动，禁止了大部分的粮食出口。

多个人道主义机构已就粮食安全、公共卫生，以及非洲和南美洲大部分地区爆发疟疾、登革热和霍乱等疾病的威胁发出警告。东南亚很可能出现极端炎热和干燥的天气。印尼大范围的火灾可能影响整个亚洲的空气质量。

尽管这些威胁令人恐惧，但在它们来袭之前，还是有可能为其中一些危险做好准备。好在厄尔尼诺是部分可预测的。虽然每次厄尔尼诺不尽相同，但它们的周期性特征帮助揭示了炎热、干燥以及降雨量增加的常见表现形式。相比2014至2016年的厄尔尼诺周期，如今的季节性预报已经可靠得多。这些预报可以指导资金的部署方向，比如用来预先改善水利基础设施，或者在可能遭受暴风雨袭击的地区加固建筑物——而不是等到灾难发生后再行动。在厄尔尼诺到来之前明智合理地加强抗灾能力可以把损失降到最低，也就减少了紧急救援和修缮的费用。

确实已有一些援助机构在利用更准确的预报未雨绸缪了。例如，红十字会与红新月会国际联合会（International Federation of the Red Cross and Red Crescent）目前在17个国家开展预防项目，目标是到2025年将其救灾资金的四分之一用在灾难预防上。世卫组织已经开始与世界气象组织（World Meteorological Organisation）合作，以便能够成功预测最应该把医疗用品和人员配备到哪里。

这只是所需援助的很小一部分。2014年至2017年期间，通过联合国呼吁而筹集到的救灾资金中只有1%提前划拨，尽管五分之一的灾害很容易预测到。据估计，去年全球有1.85亿人受到自然灾害的影响，但只有不到400万人通过预防措施得到了帮助。

麻烦的是，许多将遭受厄尔尼诺最大影响的国家还没有从之前的灾难中恢复过来。其中一些是刚经历了极端干旱和洪灾，另一些则是受困于新冠疫情的后续影响和乌克兰战争导致的粮食价格飙升。这提醒人们应对气候变化的难度之大：重重压力纷至沓来，政府和社会没有足够的喘息时间。但这更加说明了给那些无力自己支付防灾开支的国家提供帮助的必要性。无

论由谁买单，在明知道明天有高几率发生灾难的情况下，今天还想着省下这笔钱，那真是算错了账。 ■



Fair warning

El Niño has started. Preparations must too

It will bring chaotic weather to much of the world

CALIFORNIA RARELY sees the types of hurricanes and storms that routinely pummel Florida, Louisiana and Texas. But on August 20th tropical storm Hilary slammed into it from the south. Unprecedented amounts of rain pelted downtown Los Angeles and flooded the state's arid valleys. Without missing a beat, forecasts then shifted from drenching to baking, as a heat dome fastened itself over much of the southern United States all the way up to the Great Lakes.

Barely a day has gone by this summer without news of some extreme weather somewhere in the world. Although weather is always breaking records, that raises fears of what it will be like when the climate warms further. To add to the alarm, America's National Oceanographic and Atmospheric Administration announced the arrival of El Niño, a climate pattern that shows up every two to seven years and raises global temperatures.

As a consequence, there is a good chance that this will be the hottest year on record; and that 2024 will be hotter still, with temperatures approaching 1.4°C above pre-industrial levels. Some tropical regions will suffer damaging floods, and others will suffer droughts, with worrying consequences for food supplies and the spread of disease. As with climate change itself, the time to prepare for the coming upheaval of El Niño is now.

On current forecasts, this El Niño is likely to be a strong one. The last such cycle was in 2014-16, and was ruinous in the countries it hit hardest. Droughts led South African food production to fall to a 20-year low and

ignited one of Indonesia's worst-ever spates of wildfires. At the same time warmer and wetter weather fuelled disease across South America, including the worst outbreak of infections from the Zika virus in 65 years.

One reason the effects of this El Niño are likely to be severe is that they will be felt on top of more global warming. Although it is only just getting going—El Niños are named after the baby Jesus because they tend to peak around Christmas—it has already contributed to the closure of the world's largest fishery, as anchovies have fled the coastal waters of Peru. It has also rocked the global rice market, as India has pre-emptively banned most exports of its crop.

Humanitarian agencies have warned about the threats to food security and sanitation and from outbreaks of disease including malaria, dengue and cholera in large parts of Africa and South America. South-East Asia is likely to see excessively hot and dry weather. Widespread fires in Indonesia could affect air quality across Asia.

Frightening as these dangers are, it is possible to prepare for some of them before they strike. Helpfully, El Niños offer some predictability. No two are exactly the same, but their cyclical nature reveals patterns of hot and dry and excessively wet weather. Seasonal forecasts are much more reliable than they were in 2014-16. These can help steer funds in order to improve water infrastructure pre-emptively, for example, or to reinforce buildings in regions likely to be hit by storms—rather than after disaster has struck. By wisely building resilience before an El Niño, you can minimise the damage and hence the spending on emergency help and repairs.

Some aid agencies are indeed using better forecasts to start planning ahead. The International Federation of the Red Cross and Red Crescent, for instance, now runs anticipatory programmes in 17 countries, and aims for a quarter of its disaster-relief funding to be spent in advance by 2025. The

World Health Organisation has begun working with the World Meteorological Organisation so that it can successfully predict where best to allocate medical supplies and personnel.

This is just a tiny fraction of the aid that is needed. Only 1% of disaster funding raised through UN appeals between 2014 and 2017 was allocated in advance, despite one in five events being highly predictable. Natural disasters were estimated to have affected 185m people worldwide last year, but fewer than 4m were helped through anticipatory measures.

The trouble is that many of the countries which will bear the brunt of the effects of El Niño are still reeling from previous disasters. Some of those are linked to past episodes of extreme droughts and floods, others to the lingering effects of covid-19 and the spike in food prices caused by the war in Ukraine. It is a reminder of the difficulties of dealing with climate change: stresses come thick and fast without giving governments and societies enough time to recover. Yet that only strengthens the case for helping countries that cannot afford to pay for their own preparations. Whoever foots the bill, it is a false economy to skimp on spending today when there is a known chance of disaster tomorrow. ■



奏乐响起

安谋上市可能会重振IPO市场

尽管经济强韧、股市高涨，但还是鲜有公司上市

无论狂欢有多疯狂，宿醉都很难持续到第二年。然而，在经历了2021年鼎盛的狂欢后，IPO的投资者们仍然头痛未消。数据公司Dealogic称，在长达一年的狂欢中，2021年投资者为全球IPO投入了约6000亿美元。这一数字是2007年金融危机前股市狂奔时的两倍多，也是2000年互联网泡沫膨胀时的近三倍。但随后飙升的通胀、廉价资金的终结以及股市的暴跌让IPO庆典戛然而止。有些地方几乎不再有新公司上市：2022年美国IPO融资同比下降了90%以上。今年至今，阴郁情绪仍在继续（见图表）。

狂欢的乐声可能很快又会响起。8月21日，英国芯片设计公司安谋（Arm）终于提交了一份计划于9月上半月在纳斯达克交易所上市的初步招股说明书。市场对此期待已久。估值可能在600亿至700亿美元之间，将是美国近两年来规模最大的一次上市。

准备上市的不止安谋一家。尽管股市在8月出现波动，但已经持续上涨了将近一年：集合美国大型公司的标普500指数从去年10月的低谷上涨了24%；MSCI覆盖最广泛的全球股票指数也上涨了24%。这样的牛市必然会对非上市公司的老板们产生诱惑。股价上涨了这么多，也许现在是时候向公众投资者出售一批公司股票，换回一笔可观的资本了。

美国银行（Bank of America）的詹姆斯·帕尔默（James Palmer）表示，重要的是，几个月来波动也得到了抑制。如此一来，即将上市的公司也就不至于在启动长达数周的上市流程后却眼见市场暴跌，自己即将发行的股票价值也随之下跌。另一家银行摩根大通的阿洛克·古普特（Aloke Gupte）还要更乐观。他的团队正在帮助一些公司上市。他表示，这些公司最近几周的工作节奏已经“从二挡换到了五挡”。

与此同时，从已完成的上市来看，市场迫切希望更多的公司上市。美容公

司Oddity Tech于7月19日在纳斯达克上市，它的产品开发可能免不了会使用人工智能（AI）。Oddity Tech的股票发行量远远不能满足需求——它出售了价值4.24亿美元的股票，而投资者的订单却超过100亿美元。继安谋的IPO之后，杂货配送集团Instacart、软件公司Databricks以及身份验证公司Socure都很可能跟进上市。

这股稳定的细流要变成一股激流，需要三个有利动向。首先是利率走向变得更清晰。今年上半年，上市的复苏很缓慢，并购等其他交易也一样，一位资深银行家认为主因就是人们对利率走向感到困惑。她认为，由于美联储仍然处在几十年来最快的紧缩周期中，美国一些地方银行摇摇欲坠，此时猜测长期利率最终会走到什么水平和瞎蒙无异。利率除了决定公司的融资成本，还是IPO投资者衡量其潜在回报的终极基准。因此，在不太清楚“无风险利率”会到什么水平的情况下，就不可能有把握地为新股定价。

如今，无论是市场还是经济学家，都越来越倾向于认为美联储的加息已经或者即将结束。不过高利率还会持续多久仍是个未知数，这在很大程度上是由美国经济展现的惊人韧性造成的。主要也是出于这个原因，十年期国债的收益率——可能是投资者最重要的衡量基准——自5月初以来上升了0.8个百分点，达到4.2%。在这个基准开始稳定前，IPO的定价仍然会很困难，因此数量也就很少。

要真正重新掀起上市潮，第二个因素是公司自己的信心增强。“一段时间以来，我一直认为，市场会先于公司做好准备。”美国银行的帕尔默表示。他指出，要成功上市，公司需要向监管机构、投资者和研究分析师等做出一系列保证。公司不仅要提供下一季度、可能还要提供下一年度的财务业绩指引。

只要地缘政治紧张局势（美中之间尤甚）不断加剧，那些严重依赖跨境贸易的公司就会极难提供这样的保证。与此同时，几乎各行各业的公司都会受制于不确定性：通胀将会达到什么水平；世界各大经济体是否已经避免而不仅仅是推迟了衰退。一些公司，比如那些由私募股权基金短期持有的公司，可能别无选择，只能在不确定的迷雾中贸然上市。但那些有选择权

的公司则更有可能等到迷雾消散之时。

新一波IPO潮到来的最后一个（尽管显而易见）条件是，目前准备上市的公司能够成功上市。关键是，这意味着最终它们的发行股价得大致符合投资者被引导的预期，然后在此基础上再上涨，咨询公司安永（EY）的雷切尔·耶林（Rachel Gerring）表示。而2021年许多上市公司的情况恰恰相反，这就为上一次IPO潮敲响了丧钟：如果不能从新股上市带来的股价“暴涨”中获利，那么几乎没有IPO投资者愿意打开自己的支票簿。从这个意义上说，安谋的上市具有象征性的意义。如果它的股价大涨，其他公司会迅速跟进；如果扑街，其他公司可能就会却步。

无论何时现身，下一批新上市公司很可能与2021年那一波大不相同。随着利率触底的好日子一去不复返，投资者将青睐“更安全”的选择。这意味着在投资者看来，大公司胜过小公司；利润胜过收入增长；经验丰富的高管胜过新手；易于复制的商业计划胜过更具投机性的风险项目。摩根大通的古普特认为，现在准备上市的这些公司比2021年时要多样化得多，这正反映了投资者的上述偏好。他表示，上一波IPO潮由科技公司主导，而下一波则有很多会来自工业、能源转型、消费业务和医疗行业。

人们一致认为，像这轮IPO荒之前那样快节奏的公司上市潮不太可能再现。各国央行不再向市场注入大量流动性，过去18个月的加息有可能仍会把许多经济体拽入衰退，而处于几十年来最高位的美国股市可能会崩盘。但古普特表示，“如果不出什么岔子”，应该会有相当数量的公司考虑在2024年上市。因此，现在所有的眼睛都在盯着安谋，看它能否一路平安。





Strike up the band

Arm's flotation could revive the market for IPOs

Despite a resilient economy and buoyant stocks, listings are still thin on the ground

NO MATTER HOW wild the party, it is a rare hangover that lingers into its second year. Yet after a record-smashing rave in 2021, investors in initial public offerings (IPOs) are still nursing sore heads. Over the course of a year-long binge, they ploughed some \$60bn into stockmarket listings around the world in 2021, according to Dealogic, a data firm. That is more than double the figure for 2007, in the mad gallop preceding the financial crisis, and nearly triple that for 2000, as the dotcom bubble swelled. But then soaring inflation, the end of cheap money and cratering markets put paid to the celebrations. In some places flotations all but disappeared: proceeds from American IPOs in 2022 fell by more than 90% compared with the previous year. So far in 2023, the sombre mood has continued (see chart).

The music may soon start up again. On August 21st Arm, a British chip designer, at last filed a preliminary prospectus for a hotly awaited listing on the Nasdaq exchange, expected to take place in the first half of September. A likely valuation of between \$60bn and \$70bn would mark the biggest American float in nearly two years.

It is not just Arm. Notwithstanding an August wobble, stockmarkets have been rising for almost a year: the S&P 500 index of large American firms is up by 24% from a trough in October. MSCI's broadest index of global stocks has also risen by 24%. Such a bull run offers inevitable temptations to the bosses of private firms. With prices having risen so much, perhaps now is the time to sell a chunk of the company's shares to public investors and get a healthy slug of capital in return.

Importantly, says James Palmer of Bank of America, volatility has also been subdued for months. That lowers the likelihood of would-be floaters kicking off a weeks-long listing process only to see the market plunge and the value of their soon-to-be minted shares fall with it. Alok Gupte of JPMorgan Chase, another bank, is more bullish still. The pace of work at firms using his team's help to go public, he says, has "gone from second gear to fifth" in recent weeks.

Meanwhile, the listings that have already taken place suggest a market that is hungry for more. Oddity Tech, a beauty outfit that perhaps inevitably uses artificial intelligence (AI) to develop its products, listed on the Nasdaq on July 19th. It saw demand for its offering vastly outstrip supply. The firm sold \$424m-worth of its shares, while investors placed orders for over \$10bn. After Arm's IPO, Instacart, a grocery-delivery group, Databricks, a software firm, and Socure, an identity-verification company, are all likely to follow up with their own flotations.

If this steady drip is to become a rush, it will require three developments in its favour. The first is a clearer picture of where interest rates are heading. One senior banker cites confusion over this as the main reason that listings, as well as other deals such as mergers and acquisitions, were so slow to return in the first half of 2023. With the Federal Reserve's fastest tightening cycle in decades still under way and a clutch of American regional banks teetering close to collapse, guessing where long-term rates would end up felt like taking a shot in the dark, she argues. As well as determining firms' funding costs, this is the ultimate benchmark against which IPO investors measure their potential returns. And so without much idea of where the "risk-free rate" will settle, pricing a new tranche of shares with any confidence becomes impossible.

There is now a growing sense, both in markets and among economists, that the Fed's rate rises are at or near an end. Yet uncertainty over how

long rates will stay high persists, largely due to the surprising resilience of America's economy. Mostly as a result of this, the yield on ten-year Treasuries—possibly the most important benchmark for investors—has risen by 0.8 percentage points since early May, to 4.2%. Until this measure begins to settle, IPOs will remain hard to price and, as a result, sparse.

A second factor required for listings to resume in earnest is for firms themselves to grow in confidence. "I've thought for some time that market readiness would come before company readiness," says Bank of America's Mr Palmer. A successful flotation, he says, involves the businesses making a series of reassurances: to regulators, investors and research analysts. The firm will offer guidance on its financial performance not just over the next quarter, but probably over the coming year.

For as long as geopolitical tensions, especially between America and China, are running high, companies that rely heavily on cross-border trade will find such reassurances fiendishly hard to offer. Virtually all, meanwhile, are hampered by uncertainty over where inflation will settle and whether the world's big economies have avoided, rather than merely delayed, recessions. Some firms, such as those owned by private-equity funds with limited lifespans, may have few options but to make the jump and list despite the fog of uncertainty. But those with the freedom to choose are more likely to wait until it lifts.

A final, if obvious, requirement for a new IPO boom is that the firms now preparing to float manage to do so successfully. Crucially, says Rachel Gerring of EY, a consultancy, that means their shares end up being sold at around the price investors have been led to expect and then rise from there. That the opposite happened for many of 2021's floaters was the death knell of the previous boom: few IPO investors want to open their chequebooks without benefiting from the share-price "pop" associated with new listings. In this sense, Arm's flotation has acquired totemic importance. Should its

share price leap, others will be quick to follow; should it flop, they may not.

Whenever it materialises, the next cohort of IPOs is likely to look substantially different from the class of 2021. With the heady days of rock-bottom interest rates firmly in the past, investors will prize “safer” prospects. This means big firms over small, profits over revenue growth, seasoned executives over newbies, and easy-to-model business plans over more speculative ventures. JPMorgan’s Mr Gupte sees these preferences reflected in a much more diverse group of companies now preparing to go public than did in 2021. Whereas the last wave was dominated by tech firms, he says, the next will involve many more industrial, energy-transition, consumer-focused and health-care outfits.

All agree that a return to the breakneck pace of dealmaking that preceded the current drought is unlikely. Central banks are no longer flooding markets with liquidity, the rate rises of the past 18 months could yet tip many economies into recession, and an American stockmarket that is at its most expensive in decades could yet crash. But “if nothing upsets the apple cart”, says Mr Gupte, then a reasonable number of firms should be looking to go public in 2024. All eyes on Arm, then, to see if the apple cart can stay on the road. ■



巴托比

一位功成身退的顾问教你对付顾问

如何使唤那些江湖骗子

亲爱的罗宾：经过我们在俱乐部的一番畅谈，你决定委托我为你准备这份报告，我甚感高兴。你身为一家财富500强公司的新任首席执行官，一场令人兴奋又危机四伏的冒险等在前头。此时选择聘请一位管理顾问来指导你前进，我为你的明智叫好。

鉴于我多年的服务贵公司主要竞争对手的经验，我自然是最理想的人选。可惜呀，每个人的一生中总有那么一天，他得金盆洗手，回到他在巴哈马群岛的家中。作为我的告别演出，我已按你的要求，就你该如何应付我的同行草草整理了一些想法。希望我附上的120页ppt对你有用。以下是一个简要的概述。

要对“偷梁换柱”有心理准备：不要被那些能说会道的老江湖蒙骗，他们会出现在你的办公室，言辞恳切地争取你这笔生意。而接下来的工作将主要由聪明机灵但满脸痘痘的二十来岁的小年轻来完成，他们的装备是在一家又一家客户那里反复使用的2乘2矩阵框架。他们会靠加班加点来弥补智慧上的不足。不必为他们难过。他们享受着珍馐美味、奢华酒店和私人司机——付款的是你。

一开始，你会发现他们一点用处都没有，甚至还有害，因为他们会追着你的管理团队没完没了地提问、急不可耐地要数据。最终，他们会用头脑和魄力赢得你的信任——或是被悄无声息地换掉。与此同时，那些头发灰白的资深合伙人会不时造访露个脸。要留心了。

警惕“先签单再扩张”：我们这些顾问都是在神不知鬼不觉中把单子做大的销售大师。如果你雇我们做一个为期两个月的项目，那肯定会花12个月。等到结束时，我们的触手已经伸展开来了。想要新的公司战略，眨眨眼，我们就会削减你的成本，修复你的IT系统，调整你的供应链。

像许多其他老板一样，可能有一天你再也忍不了我们贵得离谱的收费，决定挖走最聪明的顾问直接为自己所用。我们很乐意配合。要宣传咨询的好处，最可靠的传教士还是我们自己人。挖走的人职位越高越好。雇用他们，但别把支票簿拿给他们。

质疑一切：每个自重的顾问都知道，要提大建议得拿出大数字。一般来说，你看到的东西都要除以二。永远不要相信基准；我给的基准大部分都是自己编的。仔细读一读图表底下那些没完没了的注释，最见不得人的秘密往往就埋藏在那儿。对碰巧由你的下属委托撰写的任何咨询报告都要加倍怀疑，尤其是如果当中还建议给这名下属提高预算的话。

绝不背锅：你新官上任，头脑里肯定有很多奇思妙想。其中很多都很糟糕。有些可能会闯大祸。管理顾问提供的有价值的服务之一是充当人盾。确保让你的董事会知道，是他们推荐你设立了糟糕的新产品线，支付了过高的收购价。你一直都有疑虑的，但又相信他们的赫赫声名。同样，你的顾问时不时地也可能踩狗屎捡到个好点子。但那是你先想到的。

尝试“一夫多妻制”：你的顾问会极力说服你建立独家合作关系。他们会大费口舌谈论“长期伙伴关系”。然而，他们追求的是单方面的一夫一妻制。忠诚不是顾问的本性。很有可能他们已经在为你的竞争对手提供建议了，团队之间只隔着薄到不能再薄的保密墙。

你也有样学样，雇用他们的竞争对手。最好就让两队人马坐在你办公室里紧挨着的房间里。咨询顾问极富好胜心，没有什么比看见死对头在你公司的大厅里转悠更能激励他们写更长的报告了。如果无聊，就请两家敌对公司的代表开会吧，且看他们如何争着讨你欢心。

回顾自己的职业生涯，我也并不羞于承认我偶尔也薅过个别公司的羊毛。但我坚持认为我的职业是高尚的。毕竟，“影响力”是我们这一行的口号。（诚然，我一直不太清楚它的含义，但你不能否认它听起来很高大上。）

最后再说一点：对于顾问来说，没有解决不了的大问题，没有不做的小生意。我的经验可以证实这一点。这里奉上给你的帐单，包括各类费用支

出。祝好运。 ■



Bartleby

A retiring consultant's advice on consultants

How to manage the snake-oil salesmen

DEAR ROBIN, I was delighted when you commissioned me to prepare this report for you after our discussion at the club. As a newly appointed chief executive at a Fortune 500 company, a thrilling yet perilous adventure awaits you. I commend your wisdom in choosing to hire a management consultant to guide you on your way.

I, naturally, would have been ideally positioned, given my many years of experience serving your company's principal rival. Alas, the time comes in every man's life when he must hang up his hat and retire to his home in the Bahamas. As my swan song, I have thrown together, as requested, a few thoughts on how to handle my kind. I hope you find the attached 120-page PowerPoint presentation useful. Below you will find a brief summary.

Be ready for the "bait and switch": Do not be fooled by the eloquent veterans who will turn up to your office to plead for your business. The work will mostly be done by clever but pimply 20-somethings, armed with two-by-two matrix frameworks recycled from client to client. What they lack in wisdom will be made up for in long hours. You need not feel sorry for them. They are cocooned in a shell of fancy meals, lavish hotels and private drivers—at your expense.

At first you will find them to be of no use at all—detrimental, even—as they harry your management team with endless questions and urgent requests for data. Eventually, they will win you over with their brains and gumption—or be quietly replaced. Meanwhile, those grey-haired senior partners will pop by from time to time. Beware.

Watch out for “land and expand”: We consultants are masters of the clandestine sale. If you hire us for a two-month project, it will assuredly take 12. By the time it ends, our tentacles will have spread. Ask for a new company strategy, blink, and we will be cutting your costs, fixing your IT systems and tinkering with your supply chain.

Like many other bosses, you may one day tire of our eye-watering rates and decide to poach the cleverest consultants for yourself. We will happily oblige. The most reliable missionary for the merits of consulting is one of our own. The more senior, the better. Hire them, but do not give them the cheque book.

Question everything: Every self-respecting consultant knows that big recommendations demand big numbers. As a rule, divide everything you see by two. Never trust a benchmark; I made up most of mine. And carefully read those endless notes at the bottom of charts. That is often where the dirtiest secrets are buried. Be doubly dubious of any consulting reports your underlings happen to commission, especially when they recommend a bigger budget for said underling.

Take none of the blame: As a freshly minted chief executive, you are undoubtedly brimming with ideas. Many of them are terrible. Some may prove catastrophic. Among the valuable services offered by management consultants is the human shield. Make sure your board knows it was they who recommended the disastrous new product line or the overpriced acquisition. You always had your doubts, but trusted their illustrious reputations. Equally, your consultants may, from time to time, stumble upon a good idea. You thought of it first.

Experiment with polygamy: Your consultants will do their utmost to woo you into exclusivity. There will be much talk of “long-term partnership”. Yet it is a one-sided monogamy they seek. Fidelity is not in a consultant’s

nature. Chances are they are already advising your competitors, with only the thinnest of Chinese walls between teams.

Follow their example and hire their rivals, too. Ideally, sit them in adjacent rooms at your offices. Consultants are fiercely competitive, and nothing will better spur them on to even longer reports than seeing their nemeses wandering the halls of your company. If bored, invite representatives of two warring firms to a meeting and watch them tussle for your favour.

As I look back on my career, I am not too proud to admit that I have occasionally fleeced the odd firm. But I maintain that my profession is a noble one. “Impact”, after all, is our industry’s watchword. (Admittedly, I never was quite clear what it meant, but you cannot deny it sounds lofty.)

One final thought to conclude: there is never a problem too big or small for a consultant. That I can confirm from experience. Your bill, including expenses, is attached. Good luck. ■



速度与疑情

越南的电动车新宠将要失速撞车吗?

上市首日股价暴涨，*VinFast*似乎被严重高估

八月十五日，越南电动汽车制造商*VinFast*在美国纳斯达克证券交易所上市。这真是个相当亮眼的开局：公司股价飙升，将其市值从230亿美元推高到850亿美元。这几乎相当于美国两大汽车制造商福特和通用汽车的总和，也是其母公司Vingroup的七倍。8月16日其市值略有下滑，降至690亿美元。

投资者正竞相购入*VinFast*的股份。这家公司在电动汽车行业中仍名不见经传，但雄心勃勃。今年5月，公司创始人、越南首富范日旺表示希望今年售出五万辆车——去年它的销量是7400辆。虽然目前它的电动车大多在越南销售，但它已经把目光投向了美国市场。7月，*VinFast*在北卡罗来纳州的工厂破土动工。它并且已经开始通过加州的13家经销商销售从越南进口的汽车。

不过测评并不亮眼。汽车业记者凯文·威廉姆斯（Kevin Williams）表示，*VinFast*在加州销售的VF8车型“根本还不适合美国市场”。另一位评论人史蒂文·尤因（Steven Ewing）指出这款车的驾驶体验糟糕，并用“唉呀”作为他的车评标题。它4.6万美元的售价并不比美国电动汽车巨头特斯拉等竞争对手的入门级车型便宜多少。数据分析公司Experian称，今年2月至5月，VF8在美国仅卖出了128辆。

即使*VinFast*实现了今年的高增长目标，其高估值也依然太过夸张。去年它净亏损21亿美元，但它表示最快将在明年年底实现盈亏平衡。咨询公司AlixPartners估计，电动汽车制造商需要每年生产约40万辆车才能开始盈利。即使到了那一步，*VinFast*要赶上行业领先者仍然有很长的路要走。去年，特斯拉卖出了130万辆电动汽车。快速增长的中国汽车制造商比亚迪卖出了190万辆，其中大约一半是纯电动车，另一半是插电式混合动力

车。

由于挂牌交易的股票只占其总股本的1%，VinFast的高市值很容易急剧波动。它的投资者可能踏上了一段颠簸的旅程。 ■



The fast and the dubious

Is Vietnam's EV darling heading for a crash?

After an explosive trading debut, VinFast looks wildly overvalued

ON AUGUST 15TH VinFast, a Vietnamese electric-vehicle (EV) manufacturer, made its trading debut on the Nasdaq, an American stock exchange. It was quite the entrance: the company's share price rocketed, pushing its market capitalisation from \$23bn to \$85bn. That is almost as much as Ford and General Motors, two giant American carmakers, combined, and seven times that of Vingroup, its parent company. On August 16th it fell a little, to \$69bn.

Investors are racing to get a stake in VinFast. The company is still a minnow in the EV business, but has big ambitions. In May Pham Nhat Vuong, the company's founder and Vietnam's richest man, said it hoped to sell 50,000 cars this year, up from 7,400 last. Although most of its vehicles are currently sold in Vietnam, it has its eyes set on the American market. Last month it broke ground on a factory in North Carolina, and has already begun selling imported vehicles in California, where it has 13 dealerships.

The reviews have not been glowing. The VF8 model VinFast is selling in California is "simply not ready for America", says Kevin Williams, an industry journalist. "Yikes," is how Steven Ewing, another reviewer, titled his assessment of the car, citing a poor steering experience. At \$46,000, it is not much, if any, cheaper than the entry-level models offered by rivals like Tesla, America's EV goliath. A mere 128 VF8s were sold in America between February and May, according to Experian, a data-analytics firm.

Even if VinFast achieves its lofty growth targets for the year, its valuation will continue to strain belief. It made a \$2.1bn net loss last year, and has said it will break even, at the earliest, at the end of next year. AlixPartners,

a consultancy, reckons EV makers need to produce around 400,000 cars a year before they start turning a profit. After that, the company would still have a long way to go before it caught up with the industry's leaders. Last year Tesla sold 1.3m EVs. BYD, a fast-growing Chinese carmaker, sold 1.9m, around half fully electric and half plug-in hybrid.

With a mere 1% of its shares put up for trading, VinFast's lofty market valuation is vulnerable to rapid swings. Investors in the company may be in for a bumpy ride. ■



寄生物在起作用

搭病毒便车的微小寄生物有可能增强抗生素耐药性

了解其中机制有助于防感染

使用抗生素防止细菌感染是从剖腹产到化疗等许多现代医学得以实现的基础。这就是细菌对抗生素越来越强的耐药性会如此令人担忧的原因。联合国估计，到2050年耐药细菌感染每年可能会夺走多达一千万人的生命，是目前死亡人数的两倍多。

要攻克这种耐药性，难题之一是科学家对它的起因并不完全了解。它的一个产生路径基本上是随机的：某个细菌的一次偶然突变可能会让某种药物的有效性降低。如果这个细菌在一剂用药后仍然存活，它的后代将遗传同样的耐药性。但从细菌耐药性的扩散速度看，这不可能是全部起因。“我一直觉得还有其他的进化机制。而且可能是更强大的机制。”新加坡国立大学的约翰·陈（John Chen）说。

陈和他的同事们在发表于《细胞》（Cell）杂志的一篇论文中陈述了他们发现的这样一种机制。其核心并不在细菌本身，也不在已知会感染细菌的病毒上，而在更基本的、会利用这些病毒的遗传寄生物上。

众所周知，细菌除可以将基因垂直传递给后代，也可以将之“水平转移”给其他不相关的细菌。有些是通过被称为质粒的小DNA环进行交换的。另一些则通过噬菌体传递。噬菌体是一种专门感染细菌的病毒，当它附着在一种细菌上时，它的DNA迫使这种细菌复制更多的噬菌体直至细菌裂解。有时，细菌DNA的小片段可能被错误地包含在新生噬菌体中。如果这些新生病毒感染了另一种细菌，搭了便车的DNA最终会进入到新宿主的基因组中。但这种“转导”也无法完全解释细菌进化出耐药性的速度。它很少发生，即使发生，也只会转移小片段的DNA。

2018年，陈发现了另一种名为“侧向转导”的机制。当噬菌体不是立即杀死宿主，而是将自己的基因组整合到猎物的基因组中时，就会发生这种情况。

况。当噬菌体复制时，它们从细菌的基因组中读取自己的基因，但有时也会从邻近的细菌DNA中抓取长段拷贝，它们携带这些拷贝来感染新的宿主。

陈认为，通过这种方式，噬菌体最终可能窃取宿主基因组的四分之一。他估算侧向转导比其他机制快数千倍，因此可能是微生物耐药性的主要驱动因素。在现实中，这意味着一种以前没有暴露于抗生素的细菌在几分钟内就能获得产生耐药性所需的基因。

但故事并没有就此结束。陈研究了金黄色葡萄球菌，这种细菌通常是无害的，但偶尔也会引起严重的疾病。其基因组中有一些被称为“致病岛”（或SaPI）的特殊片段，似乎表现得像“遗传寄生物”：不顾其宿主的福祉而自私地大肆自我复制的DNA片段。从某种意义上说，这让它们成为了一种比病毒更原始形式的复制因子。

当作为SaPI宿主的细菌细胞被噬菌体感染时，SaPI可以命令细胞产生一种叫做小转移酶的蛋白质。它类似于进攻的噬菌体用作信号的蛋白质，表明可以开始将其DNA打包到新产生的噬菌体中。这种生化花招可以使得新噬菌体中打包的根本不是它自己的DNA，而是长段的细菌基因组。“它完全取代了噬菌体基因组。”陈说。

如此产生的噬菌体仍然能够感染新的细菌。但此时它们传递的是细菌基因，而不是噬菌体基因——一起作用的也许就是这一点。侧向转导只有在噬菌体将其DNA编织到宿主DNA中时才能发生，但SaPI不需要这一过程就能劫持噬菌体。“我认为这会给我们如何理解细菌基因组的进化带来巨大影响。”科罗拉多大学的布雷克·杜尔科普（Breck Duerkop）说，他没有参与这项研究。

这种机制存在的确切原因尚不清楚。如果SaPI真的是自私的复制因子，那么劫持病毒就给了它们一条传播和延续自己的途径。陈提出了一种可能性，那就是，用新的、有用的基因增强宿主的抵御力从长远来看可能也是在保护寄生物。“如果你的宿主在竞争中输了，你也会死。”他说。因此，

如果噬菌体和SaPI能用最新的基因技术武装其宿主细菌，或许也都能提升自己成功的几率。

毫无疑问，所有这些都会引发进化遗传学家的兴趣。而对公共卫生研究人员来说，这些信息也很有用。一个问题是每种机制各自的重要性如何。而由于SaPI只影响金黄色葡萄球菌，另一个问题将是确定其他细菌是否也有类似的遗传寄生物。最后，噬菌体本身的抗菌特性使得它们正越来越多地被视为抗生素的替代品。了解它们如何可能被比自己更微小的寄生物劫持会是明智之举。■



Parasites at work

Tiny hitchhikers on viruses could promote resistance to antibiotics

Knowing why could help keep infections at bay

FROM CAESAREAN sections to chemotherapy, antibiotics make much of modern medicine possible by keeping bacterial infections at bay. That is why the growing bacterial resistance to those drugs is so worrying. The United Nations estimates that by 2050 infections with drug-proof bacteria could claim up to 10m lives a year, more than double the current toll.

A problem with tackling such resistance is that scientists have an incomplete sense of how it arises. One way is essentially random: a chance mutation in a particular bacterium may make a certain drug less lethal. If that bacterium survives a dose of treatment, its descendants will inherit that same resistance. But the speed at which bacterial drug resistance spreads means that cannot be the whole story. “I always felt there were additional mechanisms of evolution. And probably more powerful ones,” says John Chen at the National University of Singapore.

In a paper in *Cell*, Dr Chen and his colleagues identify one such mechanism. It centres not on the bacteria themselves, nor the viruses that are known to infect them, but on yet more rudimentary genetic parasites that exploit these viruses in turn.

The fact that bacteria can transfer genes horizontally, to other unrelated bugs, as well as vertically to their offspring, is well known. Some are exchanged via small loops of DNA called plasmids. Others are transmitted by bacteriophages, specialised viruses that infect bacteria. When a phage latches on to a bacterium, its DNA forces the bacterium to make more copies of the virus until it bursts. Sometimes, small fragments of bacterial DNA

can be erroneously included with the new viruses. If they infect another bacterium, the hitchhiking DNA can end up integrated into the new host's genome. But such "transductions" cannot fully explain the speed with which bacteria evolve resistance either. It happens rarely, and transfers only small chunks of DNA when it does.

In 2018 Dr Chen identified another mechanism, known as lateral transduction. This happens when phages, rather than killing their hosts immediately, integrate their genomes into those of their prey. When the phages replicate, they read their own genes from the bacteria's genome, but sometimes grab copies of long neighbouring stretches of bacterial DNA too, which they carry to infect new hosts.

Dr Chen reckons that phages could in this way end up stealing up to a quarter of their host's genome. He estimates that lateral transduction is thousands of times faster than other mechanisms, making it a candidate as the chief driver of microbial drug resistance. In practice, this means a bacterium with no previous exposure to antibiotics could acquire the genes necessary for resistance in a matter of minutes.

But the story does not end there. Dr Chen examined *Staphylococcus aureus*, a bacterium that is usually harmless but which can occasionally cause serious illnesses. Particular chunks of its genome, called "pathogenicity islands" (or SaPIs), seem to behave like genetic parasites; bits of DNA that replicate selfishly without regard for the well-being of their host. In one sense, that makes them an even more primitive form of replicator than a virus.

When a bacterial cell playing host to a SaPI is infected by a phage, the SaPIs can command the cell to produce a protein called small transferase. This is similar to the protein that the attacking phage uses as a signal to begin packing its DNA into newly produced phages. That biochemical trick can

cause new phages to be packaged not with viral DNA at all, but with long chunks of bacterial genome. “It completely replaces the phage genome,” says Dr Chen.

The resulting phages are still capable of infecting new bacteria. But when they do, they transfer bacterial genes, not viral ones—which may turn out to be useful. And while lateral transduction can happen only when a phage weaves its DNA into that of its host, SaPIs can hijack phages without that happening. “I think this has huge implications for how we understand the evolution of bacterial genomes,” says Breck Duerkop at the University of Colorado, who was not involved in the research.

Exactly why such a mechanism exists remains unclear. If SaPIs really are selfish replicators, then hijacking viruses gives them a way to spread and perpetuate themselves. Dr Chen raises the possibility that fortifying their hosts with new, useful genes may also protect the parasites in the long run. “If your host gets outcompeted, you also die,” he says. Both phages and SaPIs, therefore, might be more likely to succeed if they can keep their host bacteria armed with the latest genetic technology.

All that will be of interest to evolutionary geneticists, no doubt. But it will be useful information for public-health researchers, too. One question is just how important each mechanism is. And, as SaPIs affect only *S. aureus*, another will be working out whether other bacteria have genetic equivalents. And finally, the antibacterial properties of phages themselves mean that they are increasingly being considered as alternatives to antibiotics. Understanding how they could be hijacked by even tinier parasites would be wise. ■



【首文】谨防许可证王国

要实现经济潜力，印度必须摒弃保护主义

高关税和许可证对发展有害无益

不难看出是什么让许多人为印度经济兴奋叫好。西方公司寻求在中国之外实现供应链多元化，正在该国大举投资。印度对美国来说是如此不可或缺，两国政府甚至说它们之间是“世界上最亲密的伙伴关系之一”，尽管与此同时印度狂购廉价的俄罗斯石油，也加入了反西方论坛。在人口日益老龄化的亚洲，于今年成为世界第一人口大国的印度以年轻的劳动力脱颖而出。近期该国发现了锂矿，这种金属对制造电池至关重要。对采购经理的调查显示，印度经济正以13年来最快的速度增长，而另一边中国却在放缓。然而，尽管拥有所有这些潜力，印度还是存在一个巨大的障碍：它对进口的疑虑。随着世界其他地方背离自由贸易，这种怀疑只会有增无减。

印度有着悠久的保护主义传统，但在上世纪90年代和本世纪初开放国门。它将平均关税从1990年的超过80%削减到2008年的13%左右。之后到了2014年，总理莫迪上台，发起了“印度制造”运动。关税开始上升。今天印度的关税平均约为18%，远高于印尼和泰国等国家。最近，印度也像其他大型经济体一样，重金投资半导体领域，中央政府仅在一家美光（Micron）组装厂上的投入就相当于其高等教育全年预算的四分之一。8月3日它又宣布了最新的贸易破坏措施：印度公司要先获得许可证才能进口个人电脑或平板电脑。

印度政府确信，减少进口是维护安全和创造制造业岗位的必要措施，它尤其希望减少从中国的进口。鉴于与中国的边界争端，印度也和美国一样对中国心存疑虑。但它也羡慕中国长达数十年的高速经济增长，许多印度政策制定者认为这是通过国家主导的重商主义实现的。

然而，印度的战略并没有奏效。2022年，制造业增加值占印度GDP的13.3%，低于2015年的15.6%，是1967年以来的最低水平。一项在本地生产

手机的计划似乎主要还是吸引来了低价值的组装工作。这在一定程度上是因为印度得出的中国经验是错的，当初中国是通过融入制造商的全球供应链而迅速发展——而关税会阻碍这一进程。中国从未像印度那般不信任全球商业，后者把过去十年里达成的两项重大的亚洲贸易协定都拒之门外。

无论如何，遭受危机的中国经济也已开始暴露国家资本主义的局限性。一个更值得效仿的例子是自1970年之后迅速发展的韩国。它补贴制造业出口，但更多是为了争取国际竞争力，而不是自给自足。它意识到限制资本品的流入会产生反作用，因为进口最好的投入品将使本国制造商受益。印度的计算机保护主义会砸了自己的脚，原因之一就是占其出口约四分之一的印度IT服务公司需要大量的处理能力。

在上世纪90年代改革之前，印度以其“许可证统治”（Licence Raj）知名。在此制度之下推行的种种规定导致若没有政府许可就什么事都做不成，由此产生了一个知道如何操弄系统的“获利的内部人士”阶层。如果印度倒退回那段不堪回首的日子，而不是保持开放，那么它将无法利用当前的经济机遇，它的14亿人口将付出代价。 ■



Beware the Licence Raj

To reach its economic potential, India must abandon protectionism

High tariffs and licensing do not help development—they hurt it

IT IS NOT hard to see what enthuses the many evangelists for India's economy. Western companies are investing handsomely in the country as they diversify their supply chains away from China. So indispensable is India to America that their two governments say they are "among the closest partners in the world", even as India guzzles cheap Russian oil and attends anti-Western gabfests. In a greying Asia, India's population—which this year became the world's largest—stands out for its youth. Recently the country discovered reserves of lithium, a metal that is crucial to making batteries. Surveys of purchasing managers suggest the economy is growing at its fastest pace for 13 years, even as China slows. Yet for all this potential, India has an enormous handicap: its suspicion of imports, which is only getting worse as the rest of the world turns away from free trade.

India has a long tradition of protectionism, but in the 1990s and 2000s it opened up. It slashed its average tariff from over 80% in 1990 to about 13% in 2008. Then in 2014 the prime minister, Narendra Modi, came to power and launched the "Make in India" campaign. Tariffs began to rise. Today they average about 18%, well above those of peers like Indonesia and Thailand. Recently, like other big economies, India has thrown cash at semiconductors: central-government spending on just one Micron assembly facility equals a quarter of its entire annual budget for higher education. The latest trade-busting measure, announced on August 3rd, would require Indian companies to get a licence before they could import personal computers or tablets.

India's government is convinced that reducing imports is necessary for its

security and creating manufacturing jobs, and especially hopes to reduce imports from China. Like America, it views China with suspicion, given its border disputes with the country. But it also envies China's decades-long high economic growth, which many Indian policymakers think was achieved with state-led mercantilism.

Yet India's strategy is not working. In 2022 value added in manufacturing accounted for 13.3% of India's GDP, down from 15.6% in 2015 and the lowest since 1967; a scheme to produce mobile phones locally seems mainly to have attracted low-value assembly work. In part this is because India is drawing the wrong lessons from China, which developed rapidly by becoming integrated in manufacturers' global supply chains—a process that tariffs inhibit. China has never been as suspicious of global commerce as India, which has declined to join either of the two big Asian trade deals struck in the past decade.

In any case, China's crisis-struck economy is starting to reveal the limits of state capitalism. A better example to follow is South Korea, which developed rapidly after 1970. It subsidised manufacturing exports but more often aimed for international competitiveness rather than self-sufficiency. It realised that restricting the inflow of capital goods is counter-productive, because importing the best inputs would benefit its manufacturers. One reason India's computer protectionism will prove self-defeating is that the country's IT services firms, which account for about a quarter of its exports, need lots of processing power.

Before the reforms of the 1990s India was known for its "Licence Raj". This imposed rules that made it impossible to get anything done without government permission, creating a class of favoured insiders who knew how to work the system. If India returns to those bad old days rather than opening up, then it will fail to take advantage of its moment of economic opportunity and its 1.4bn people will pay the price. ■



大脱钩

印度公司能否摆脱中国？

莫迪正在试验一系列经济武器

中国和印度的关系实在不算友好。2020年，两国士兵在有争议的边境地区发生冲突，是1967年以来两国之间伤亡最多的一轮对抗——而后在2021和2022年又发生冲突。这使得两个亚洲巨人之间的贸易关系陷入紧张。尽管如此，这种贸易仍然不可或缺，尤其对印度而言。印度消费者依赖廉价的中国商品，印度企业依赖廉价的中国投入品，特别是在未来产业上。印度向中国出售旧经济的产品——甲壳类水产、棉花、花岗岩、钻石、汽油，而中国则向印度出售存储芯片、集成电路和制药原料。结果，贸易变得越来越不平衡。2022年，在两国间价值1170亿美元的商品贸易中，87%是从中国销往印度（见图表）。

印度总理莫迪希望减少对中国的依赖。一个原因是战略上的——在关键进口商品上依赖一个善变的对手会带来风险。另一个原因是商业上的——莫迪试图复制中国民族主义的、出口导向型的增长模式，这意味着要从中国手中抢夺部分生意。近几个月来，莫迪政府加大了在部分经济领域与这个更大邻国脱钩的程度。8月3日，印度宣布对进口笔记本电脑和个人电脑实施新的许可证限制，而这类进口设备主要来自中国。一周后，有报道称印度正在考虑对相机和打印机采取类似措施。

从明面上看，只要符合印度法律，印度对中国企业是开放的。在实践中，印度政府使用一些手段让中国企业在印度日子难过甚至无法生存。其中最直截了当的就是往往以国家安全为名直接禁用中国产品。例如，在2020年边境冲突之后，印度政府禁止了118款中国应用，包括TikTok（热门短视频应用）、微信（超级应用）、Shein（快时尚零售商）以及几乎其他所有获取了印度用户数据的服务。从2022年起至今还有数百个应用因类似的理由被禁。华为和中兴等电信设备制造商也受到了同样待遇，理由是担心其硬件设备会让中国间谍得以监听印度公民。

关税是另一种常用手段。2018年，为了扭转印度手机组装业被中国竞争对手压制的局面，印度政府对进口手机征收20%的关税。2020年，印度政府将玩具（大部分来自中国）的进口关税提高了两倍，达到60%，到今年年初又进一步提高到70%。自2019年以来，印度的玩具进口减少了约四分之三。

印度政府有时会避免官方行动，转而采用更为隐蔽的手段。一种常见的策略是引入官僚摩擦。印度繁琐的官僚程序让官员能够轻易对那些他们不欢迎的企业挑毛病。违反税务规定是最常用的指控，因为这些规定费解难懂，几乎不可能完全遵守。两家智能手机制造商小米和步步高电子（旗下拥有Oppo/一加、真我和Vivo三个流行品牌）正因涉嫌偷逃合计11亿美元的税款而接受调查。8月2日，新闻媒体援引匿名政府官员的话称，中国汽车制造商比亚迪的印度分公司被指控少缴了900万美元的进口部件关税，正在接受调查。

错综复杂的许可制度也让印度当局有更多途径给中国企业设限。2020年4月，印度宣布，来自与其接壤的国家的投资必须拿到特别批准。虽然没有点名，但这里针对的显然是中国。自那以来，在中国提出的435项外国直接投资申请中，印度只批准了不到四分之一。据当地媒体《今日商业》（Business Today）报道，在截至今年3月的上一财年里，印度仅批准了三项中国申请。7月有报道称，比亚迪与印度公司Megha Engineering合资生产电动汽车和电池的项目因安全原因未能获批。

为苹果等公司生产设备的大型中国制造商立讯精密早在2021年便与印度泰米尔纳德邦（Tamil Nadu）签订了协议，但至今仍未在当地开设工厂。据信，延迟的原因是印度中央政府一道不成文的全面禁令，不批准任何中国公司拥有的新生产设施。今年早些时候印度发现了一处可能储量巨大的锂矿（可用于生产电池），8月初，一向拖拉的印度议会迅速通过新法律，放宽了新锂矿的审批程序。各国矿商均可提交申请，但预计中国竞标者将不受待见。

与此同时，印度正运用政策试图在多个市场上取代中国的领先地位。印度

拨款330亿美元的“生产挂钩激励”计划（与销售、投资和产量挂钩的现金补贴）已经确定了14个重点领域，其中许多目前都由中国公司主导。

制药原料就是其中一例，多年来印度制药公司主要从中国采购原料。今年2月，印度政府开始向允诺在国内生产共41种原料的企业提供补贴，将在六年内总共发放20亿美元。Aurobindo、Biocon、Dr Reddy's和Strides等大型制药公司都参与了该计划。另一个例子是电子产品。苹果iPhone的代工厂，如富士康、和硕，以及印度大型企业集团塔塔（Tata），都可以购买中国制造的零部件在印度组装，但前提是它们也要努力培育本地供应商。

在重重障碍面前，一些中国企业不胜其烦，选择作罢。2022年7月，经过两年的努力，包括承诺在印度投资10亿美元后，长城汽车因无法获得当地批准而关闭了它的印度造车项目。有的公司则在努力适应。小米表示将实现全面本地化生产，并将扩大从印度的出口，从现在仅向邻国出口扩大到也面向西方市场。Shein将与印度市值最高的上市公司信实集团

（Reliance）建立合资企业，以重新进入印度市场——信实以善于处理印度的官僚制度和政治关系而闻名。据称中兴正试图找一家印度本土制造商达成生产网络设备的许可协议。到目前为止它还没找到愿意合作者。鉴于印度对中国的疑虑与日俱增，这可能得花些时间了。■



The great untangling

Can India Inc extricate itself from China?

Narendra Modi is testing a wide array of economic weapons

CHINA AND India are not on the friendliest of terms. In 2020 their soldiers clashed along their disputed border in the deadliest confrontation between the two since 1967—then clashed again in 2021 and 2022. That has made trade between the Asian giants a tense affair. Tense but, especially for India, still indispensable. Indian consumers rely on cheap Chinese goods, and Indian companies rely on cheap Chinese inputs, particularly in industries of the future. Whereas India sells China the products of the old economy—crustaceans, cotton, granite, diamonds, petrol—China sends India memory chips, integrated circuits and pharmaceutical ingredients. As a result, trade is becoming ever more lopsided. Of the \$117bn in goods that flowed between the two countries in 2022, 87% came from China (see chart).

India's prime minister, Narendra Modi, wants to reduce this Sino-dependence. One reason is strategic—relying on a mercurial adversary for critical imports carries risks. Another is commercial—Mr Modi is trying to replicate China's nationalistic, export-oriented growth model, which means seizing some business from China. In recent months his government's efforts to decouple parts of the Indian economy from its larger neighbour's have intensified. On August 3rd India announced new licensing restrictions for imported laptops and personal computers—devices that come primarily from China. A week later it was reported that similar measures were being considered for cameras and printers.

Officially, India is open to Chinese business, as long as this conforms with Indian laws. In practice, India's government uses a number of tools to make Chinese firms' life in India difficult or impossible. The bluntest of these

are outright prohibitions on Chinese products, often on grounds related to national security. In the aftermath of the border hostilities in 2020, for example, the government banned 118 Chinese apps, including TikTok (a short-video sensation), WeChat (a super-app), Shein (a fast-fashion retailer) and just about any other service that captured data on Indian users. Hundreds more apps were banned for similar reasons throughout 2022 and this year. Makers of telecoms gear, such as Huawei and ZTE, have received the same treatment, out of fear that their hardware could let Chinese spooks eavesdrop on Indian citizens.

Tariffs are another popular tactic. In 2018, in an effort to reverse the demise of Indian mobile-phone assembly at the hands of Chinese rivals, the government imposed a 20% levy on imported devices. In 2020 it tripled tariffs on toy imports, most of which come from China, to 60%; then, at the start of this year, raised them to 70%. India's toy imports have declined by around three-quarters since 2019.

Sometimes the Indian government eschews official actions in favour of more subtle ones. A common tactic is to introduce bureaucratic friction. India's red tape makes it easy for officials to find fault with businesses that are out of favour. Non-compliance with the tax rules, so impenetrable that it is almost impossible to abide by them all, are a favourite accusation. Two smartphone makers, Xiaomi and BBK Electronics (which owns three popular brands, Oppo/OnePlus, Realme and Vivo), are under investigation for allegedly shortchanging the Indian taxman a combined \$1.1bn. On August 2nd news outlets cited anonymous government officials saying that the Indian arm of BYD, a Chinese carmaker, was under investigation over allegations that it paid \$9m less than it owed in tariffs for parts imported from abroad.

A convoluted licensing regime gives Indian authorities more ways to stymie Chinese business. In April 2020 India declared that investments from

countries sharing a border with it must receive special approvals. No neighbour was named, but the target was clearly China. Since then India has approved less than a quarter of the 435 applications for foreign direct investment from the country. According to Business Today, a local outlet, only three received the thumbs-up in India's last fiscal year, which ended in March. In July reports surfaced that a joint venture between BYD and Megha Engineering, an Indian firm, to build electric vehicles and batteries failed to win approval for security reasons.

Luxshare, a big Chinese manufacturer of devices for, among others, Apple, has yet to open a factory in Tamil Nadu, despite signing an agreement with the state in 2021. The reason for the delay is believed to be an unspoken blanket ban from the central government in Delhi on new facilities owned by Chinese companies. In early August the often slow-moving Indian parliament whisked through a new law easing the approval process for new lithium mines after a potentially large deposit of the metal, used in batteries, was unearthed earlier this year. Miners are welcome to submit applications, but Chinese bidders are expected to be viewed unfavourably.

In parallel, India is using policy to dislodge China as a leader in various markets. India's \$33bn programme of "production-linked incentives" (cash payments tied to sales, investment and output) has identified 14 areas of interest, many of which are dominated by Chinese companies.

One example is pharmaceutical ingredients, which Indian drugmakers have for years mostly procured from China. In February the Indian government started giving handouts worth \$2bn over six years to companies that agree to manufacture 41 of these substances domestically. Big pharmaceutical firms such as Aurobindo, Biocon, Dr Reddy's and Strides are taking part. Another example is electronics. Contract manufacturers of Apple's iPhones, such as Foxconn and Pegatron of Taiwan and Tata, an Indian conglomerate, are allowed to purchase Chinese-made components for assembly in India

provided they make efforts to nurture local suppliers, too.

Some Chinese firms, tired of jumping through all these hoops, are calling it quits. In July 2022, after two years of efforts that included a promise to invest \$1bn in India, Great Wall Motors closed its Indian carmaking operation, unable to secure local approvals. Others are trying to adapt. Xiaomi has said it will localise all its production and expand exports from India, which today go only to neighbouring countries, to Western markets. Shein will re-enter the Indian market through a joint venture with Reliance, India's most valuable listed company, renowned for its ability to navigate Indian bureaucracy and politics. ZTE is said to be attempting to arrange a licensing deal with a domestic manufacturer to make its networking equipment. So far it has found no takers. Given India's growing suspicions of China, that may take a while. ■



在数据花园里挖呀挖呀挖

AI正引发一场数据争夺大战

喂养越来越大的模型需要建模者发挥创造力

不久前，分析人士还在公开猜想人工智能（AI）是否会让Adobe这样一家面向创意人士的软件制造商消亡。DALL-E 2和Midjourney等可以根据文本生成图像的新工具似乎势必会让Adobe的图像编辑产品变得多余。就在4月，财经新闻网站Seeking Alpha还发布了一篇文章，题为《AI是Adobe杀手吗？》（Is AI the Adobe killer?）

事实远非如此。Adobe已经利用其容纳了数亿张照片的数据库创建了自己的AI工具套件Firefly。Adobe高管达纳·拉奥（Dana Rao）表示，自3月发布以来，该软件已经被用来创作了超过10亿张图像。Adobe没有像其竞争对手那样在互联网上挖掘图像，从而避开了目前困扰业界的日益严重的版权纠纷。自Firefly推出以来，Adobe的股价上涨了36%。

从Adobe对其唱衰者的胜利上，可以看到在快速发展的AI工具市场上的争霸战中广泛存在的一个问题。驱动着最新一批“生成式”AI的超大模型离不开海量数据。过去，AI公司往往在未经许可的情况下在互联网上大肆饕餮，现在它们正在寻找新的数据源以维持这种疯狂喂食。与此同时，拥有巨大数据宝库的公司正在琢磨如何能充分从中获利。一场数据抢地战正在展开。

AI模型的两个基本要素是数据集和处理能力——数据集是训练AI模型的基础；处理能力让模型可以识别这些数据集内部以及数据集之间的关系。在某种程度上，这两个要素可以相互替代：摄入更多数据或者提升处理能力都可以改进模型。不过，由于缺乏AI专用芯片，后者正变得愈发困难，于是模型构建者把注意力加倍集中到数据搜寻上。

研究机构Epoch AI认为，对数据的需求增长极其迅猛，可用于训练的高质量文本可能会在2026年前耗尽。谷歌和Meta这两家科技巨头的最新AI模型

可能已经接受了超过一万亿字词的训练——要知道，在线百科全书维基百科总共有约40亿个英语字词。

重要的不仅仅是数据集的大小。数据质量越好，模型就越好。数据创业公司Scale AI的拉塞尔·卡普兰（Russell Kaplan）指出，训练基于文本的模型最好采用文笔上乘、事实准确的长篇文字。模型有了这种高质量的信息输入，就更有可能产生同样高质量的输出。同样，AI聊天机器人在被要求解释自己每一步的思路时会给出更好的答案，这就增加了对教科书之类数据源的需求。专门的信息集也很受重视，因为利用它们可以“微调”模型以满足特定的应用领域。微软在2018年以75亿美元收购了软件代码存储库GitHub，这帮助它开发了一款AI编程工具。

随着对数据需求的增长，数据获取变得越来越困难——如今内容创作者纷纷要求就自己被投喂给了AI模型的作品获得补偿。在美国已经发生了多起状告建模者侵权的案件。包括喜剧演员萨拉·丝沃曼（Sarah Silverman）在内的一些作家正在起诉OpenAI（AI聊天机器人ChatGPT的开发者）和Meta。同样，一些艺术家也在对Stability AI（创建了根据文本生成图像的工具）和Midjourney提起诉讼。

结果是，AI公司为抢先拿下数据源而忙不迭地达成了一连串的交易。7月，OpenAI与新闻机构美联社（Associated Press）签署了一项可以使用其新闻报道档案库的协议。不久前，它还扩大了与图片库服务商Shutterstock（与Meta也有合作协议）的协议。8月8日有报道称，谷歌正在与唱片公司环球音乐（Universal Music）洽谈，以获得授权在AI写歌工具中使用艺术家的声音。目前盛传多家AI实验室正在与英国公共广播公司BBC接触。另一个据称被盯上的目标是学术期刊数字图书馆JSTOR。

信息拥有者正在利用自己业已提升的议价能力。论坛Reddit和备受程序员欢迎的问答网站Stack Overflow都上涨了访问其数据的费用。这两个网站都特别有价值，因为用户会给认可的答案“点赞”，从而帮助模型知道哪些答案最有价值。社交媒体网站推特（现已改名X）已经采取措施，限制机器人从其网站上抓取数据；现在所有想要访问其数据的人都要交费了。它

反复无常的老板马斯克正计划利用这些数据建立自己的AI业务。

这也促使模型构建者努力提高它们已有的输入数据的质量。许多AI实验室雇用大批数据标注员，来执行诸如标注图像或给答案打分等任务。其中一些工作很复杂：一则招聘标注员的广告要求应聘者拥有生命科学专业的硕士或博士学位。但大部分工作都很常规乏味，被外包给了肯尼亚等劳动力成本低廉的地方。

AI公司还通过用户与其工具的交互来收集数据。其中许多工具都有反馈机制，让用户透露哪些输出是有用的。Firefly的“文本到图像”生成器可以让用户从四个方案中选择一个。谷歌的聊天机器人Bard会提供三个答案。用户可以对ChatGPT的答复表示赞成或反对。这些信息可以作为输入回馈给底层模型，形成了创业公司Contextual AI的联合创始人杜威·基拉（Douwe Kiela）所说的“数据飞轮”。他补充说，衡量聊天机器人答案的质量还有一个更有说服力的标志，就是看用户是否将答案文本复制并粘贴到其他地方。这种信息帮助谷歌迅速改进了它的翻译工具。

然而，有一类数据源基本上还未被利用：科技公司的企业客户们的内部信息。许多企业常常在无意中拥有了大量有用的数据，从呼叫中心的通话记录到客户的消费记录。这些信息特别有价值，因为它可以用来微调模型，从而用于特定的商业用途，比如帮助呼叫中心的工作人员回应询问，或者帮助分析师找到提升销售的方法。

不过，想要利用这种丰富的资源并不总是很容易。咨询公司贝恩的罗伊·辛格（Roy Singh）指出，大多数公司过去很少注意到这类庞大但非结构化的数据集，而这些数据集会对训练AI工具最有用。这些数据集往往散布在不同的系统中，或者埋藏在公司的服务器里，而不是在云端。

发掘这类信息将有助于公司定制AI工具，更好地满足自身需求。如今亚马逊和微软这两家科技巨头都提供工具，帮助公司更好地管理它们的非结构化数据集。谷歌也在这么做。数据库公司Snowflake的克里斯蒂安·克莱曼（Christian Kleinerman）表示，随着客户希望“打破数据孤岛”，这项业务

正在蓬勃发展。创业公司纷纷跑步进场。今年4月，专注于AI的数据库公司Weaviate融资5000万美元，估值达到两亿美元。仅仅一周后，其竞争对手PineCone融资一亿美元，估值达到7.5亿美元。8月初，另一家数据库创业公司Neon在又一轮融资中获得了4600万美元。数据争夺战才刚刚开始。 ■



Digging for digits

AI is setting off a great scramble for data

Feeding ever-larger models is requiring makers to get creative

NOT SO LONG ago analysts were openly wondering whether artificial intelligence (AI) would be the death of Adobe, a maker of software for creative types. New tools like DALL-E 2 and Midjourney, which conjure up pictures from text, seemed set to render Adobe's image-editing offerings redundant. As recently as April, Seeking Alpha, a financial-news site, published an article headlined "Is AI the Adobe killer?"

Far from it. Adobe has used its database of hundreds of millions of stock photos to build its own suite of AI tools, dubbed Firefly. Since its release in March the software has been used to create over 1bn images, says Dana Rao, a company executive. By avoiding mining the internet for images, as rivals did, Adobe has skirted the deepening dispute over copyright that now dogs the industry. The firm's share price has risen by 36% since Firefly was launched.

Adobe's triumph over the doomsters illustrates a wider point about the contest for dominance in the fast-developing market for AI tools. The supersize models powering the latest wave of so-called "generative" AI rely on oodles of data. Having already helped themselves to much of the internet, often without permission, AI firms are now seeking out new data sources to sustain the feeding frenzy. Meanwhile, companies with vast troves of the stuff are weighing up how best to profit from it. A data land grab is under way.

The two essential ingredients for an AI model are datasets, on which the system is trained, and processing power, through which the model detects

relationships within and among those datasets. Those two ingredients are, to an extent, substitutes: a model can be improved either by ingesting more data or adding more processing power. The latter, however, is becoming difficult owing to a shortage of specialist AI chips, leading model-builders to be doubly focused on seeking out data.

Demand for data is growing so fast that the stock of high-quality text available for training may be exhausted by 2026, reckons Epoch AI, a research outfit. The latest AI models from Google and Meta, two tech giants, are likely trained on over 1trn words. By comparison, the sum total of English words on Wikipedia, an online encyclopedia, is about 4bn.

It is not only the size of datasets that counts. The better the data, the better the model. Text-based models are ideally trained on long-form, well-written, factually accurate writing, notes Russell Kaplan of Scale AI, a data startup. Models fed this information are more likely to produce similarly high-quality output. Likewise, AI chatbots give better answers when asked to explain their working step by step, increasing demand for sources like textbooks. Specialised information sets are also prized, as they allow models to be “fine-tuned” for more niche applications. Microsoft’s purchase of GitHub, a repository for software code, for \$7.5bn in 2018 helped it develop a code-writing AI tool.

As demand for data grows, accessing it is getting trickier, with content creators now demanding compensation for material that has been ingested into AI models. A number of copyright-infringement cases have already been brought against model-builders in America. A group of authors, including Sarah Silverman, a comedian, are suing OpenAI, maker of ChatGPT, an AI chatbot, and Meta. A group of artists are similarly suing Stability AI, which builds text-to-image tools, and Midjourney.

The upshot has been a flurry of dealmaking as AI companies race to secure

data sources. In July OpenAI inked a deal with Associated Press, a news agency, to access its archive of stories. It has also recently expanded an agreement with Shutterstock, a provider of stock photography, with which Meta has a deal, too. On August 8th it was reported that Google was in discussions with Universal Music, a record label, to license artists' voices to feed a songwriting AI tool. Rumours swirl about AI labs approaching the BBC, Britain's public broadcaster. Another supposed target is JSTOR, a digital library of academic journals.

Holders of information are taking advantage of their greater bargaining power. Reddit, a discussion forum, and Stack Overflow, a question-and-answer site popular with coders, have increased the cost of access to their data. Both websites are particularly valuable because users "upvote" preferred answers, helping models know which are most relevant. Twitter (now known as X), a social-media site, has put in place measures to limit the ability of bots to scrape the site and now charges anyone who wishes to access its data. Elon Musk, its mercurial owner, is planning to build his own AI business using the data.

As a consequence, model-builders are working hard to improve the quality of the inputs they already have. Many AI labs employ armies of data annotators to perform tasks such as labelling images and rating answers. Some of that work is complex; an advert for one such job seeks applicants with a master's degree or doctorate in life sciences. But much of it is mundane, and is being outsourced to places such as Kenya where labour is cheap.

AI firms are also gathering data through users' interactions with their tools. Many of these have a feedback mechanism, where users indicate which outputs are useful. Firefly's text-to-image generator allows users to pick from one of four options. Bard, Google's chatbot, proposes three answers. Users can give ChatGPT a thumbs-up or thumbs-down to its responses.

That information can be fed back as an input into the underlying model, forming what Douwe Kiela, co-founder of Contextual AI, a startup, calls the “data flywheel”. A stronger signal still of the quality of a chatbot’s answers is whether users copy the text and paste it elsewhere, he adds. That information helped Google rapidly improve its translation tool.

There is, however, one source of data that remains largely untapped: the information that exists within the walls of the tech firms’ corporate customers. Many businesses possess, often unwittingly, vast amounts of useful data, from call-centre transcripts to customer spending records. Such information is especially valuable because it can be used to fine-tune models for specific business purposes, such as helping call-centre workers answer queries or analysts spot ways to boost sales.

Yet making use of that rich resource is not always straightforward. Roy Singh of Bain, a consultancy, notes that most firms have historically paid little attention to the types of vast but unstructured datasets that would prove most useful for training AI tools. Often these are spread across various systems, buried in company servers rather than in the cloud.

Unlocking that information would help companies customise AI tools to serve their needs better. Amazon and Microsoft, two tech giants, now offer tools to help companies improve management of their unstructured datasets, as does Google. Christian Kleinerman of Snowflake, a database firm, says that business is booming as clients look to “tear down data silos”. Startups are piling in. In April Weaviate, an AI-focused database business, raised \$50m at a valuation of \$200m. Barely a week later PineCone, a rival, raised \$100m at a \$750m valuation. Earlier this month Neon, another database startup, raised an additional \$46m in funding. The scramble for data is only just getting started. ■



经济学人视频

预告 | 热浪是怎样形成的？

一个热天如何变成持续热浪？气候变化又是如何影响这个过程的？



The Economist Film

Heatwaves: The Essentials - trailer

What turns a hot day into a heatwave? And how is that process being affected by climate change?



一镜照今古

薄荷、蜡、有毒植物：文艺复兴时期意大利的美容秘诀

一本关于化妆品历史的新书，轻快有趣，又能引起共鸣【《文艺复兴女性的美丽秘史：美容、化妆和女性创造力》书评】

《文艺复兴女性的美丽秘史：美容、化妆和女性创造力》，吉尔·伯克著。Profile出版社；336页；25英镑。飞马出版社将于1月在美国出版；28.95美元。

用“25岁或30岁以下”健康红发男子的三升血液可以修复问题肌肤。吃荨麻是面颊红润的秘诀。由大理石、小麦和一种有毒的泻根植物制成的糊状物可以美白皮肤。在文艺复兴时期的意大利，大多数美容产品的成分在现代人看来匪夷所思，或傻大胆。

但在《文艺复兴女性的美丽秘史》（How to be a Renaissance Woman）一书中，化妆是了解社会和女性经历的一种工具。这本书生动地讲述了16世纪和17世纪意大利美容文化的新历史。男人们控制着金融和政府。女性注重外表是因为“她们必须如此”，而不是因为她们肤浅无聊，爱丁堡大学的教授吉尔·伯克（Jill Burke）写道。美貌与权力相互交织，动人的外表带来更好的婚姻前景和社会地位。

美容产品可不只是些华而不实的东西。它们既可以是武器，也可以是盾牌。当时的婚姻手册建议殴打规训妻子，而化妆品配方书籍中就有如何用野生薄荷叶来掩盖面部受击后的“死血”的技巧。罗马女子乔凡娜·德格兰迪斯（Giovanna de Grandis）与其他四名女子一起被处以绞刑，原因是她们出售一种伪装成祛斑产品的毒药，导致46名男子死亡。（伯克认为这些男人可能都有家暴行为。）一位显贵猜测格兰迪斯的药剂可能杀死了500名男子，而他们的死因被误认为是鼠疫。

如今化妆品是一门大生意，2022年价值高达4300亿美元，但它们却常常被认为是不足挂齿的小玩意。“我们对我们的头发、脸和身体做些什么反

映并影响着我们的社会生活。”伯克认为。学术纯正主义者可能不太接受在他们看来是随意闲聊的“轻历史”写法，但伯克的所有结论都源自一手资料（其中许多是她自己从意大利语文献翻译而来的）。

她参考的大部分资料以前都没有被深入研究过，比如乔瓦尼·马里内洛（Giovanni Marinello）于1562年在威尼斯出版的《女士装容》（The Ornaments of Ladies）。其中“女性的身体被描述成永远无法完工的项目”，伯克在书中写道。马里内洛向读者许诺诗人和画家笔下的体形，如提香（Titian）的《乌尔比诺的维纳斯》（Venus of Urbino）中的女性裸体。他提供了1400种秘方来改善各种问题，如妊娠纹（女士“最好能在产后消除妊娠纹，让腹部呈现应有的状态”）、白头发（可能会让有“少夫”的女性特别烦恼）和松垮赘肉（他建议整夜用蜡包裹有这种问题的部位）。

当时视觉文化迅速演变。全身镜和印刷书籍这些文艺复兴时期的技术塑造了对女性特质的看法。社交媒体和照片编辑应用等21世纪的创新同样塑造了当下的观点。社交媒体用户看到肉毒杆菌除皱后的面容和经Photoshop精修的身材。伯克认为，单点透视和自然主义在绘画中的流行意味着文艺复兴时期的女性同样受到了“雕塑、绘画和印刷品中不断涌现的新写实裸体女神形象”的轰炸。

一些女性做出了反击。当时金发在艺术中被理想化，漂染大为流行。但以笔法细腻的花卉和昆虫而闻名的画家乔凡娜·加佐尼（Giovanna Garzoni）在十几岁时画了一幅自我宣传的肖像画，把自己描画成有一头蓬乱棕发的希腊太阳神阿波罗。阿尔泰米西娅·真蒂莱斯基（Artemisia Gentileschi）曾宣称“只要我活着，就能掌控自己的存在”，她在自画像上用一缕缕不服贴的黑发来映衬自己的面庞。在伯克看来，女性艺术家选择这样自我呈现是玩一把当时的刻板印象，那时认为有一头深色蓬乱头发的女人有着“内在想象力……忧郁的创造力和‘男性’气质”。无论是用化妆刷还是画笔，女性想要掌控世界对她们的看法和记忆。 ■



A mirror on our times and theirs

Mint, wax, poisonous plants: beauty tips from Renaissance Italy

A new book tells the rollicking and relatable history of cosmetics

How to be a Renaissance Woman: The Untold History of Beauty and Female Creativity. By Jill Burke. Profile; 336 pages; £25. To be published in America by Pegasus in January; \$28.95

THREE LITRES of blood from a healthy red-headed man “no older than 25 or 30” could fix bad skin. Eating nettles was a trick for rosier cheeks. A paste made from marble, wheat and bryony, a poisonous plant, could whiten skin. Most beauty products in Renaissance Italy were made from ingredients that seem strange or foolhardy to modern eyes.

But in “How to be a Renaissance Woman”, a lively new history of beauty culture in 16th- and 17th-century Italy, make-up is a tool to understand society and the female experience. Men controlled finance and government. Women cared about their appearances because “they had to”, not because they were frivolous, argues Jill Burke, a professor at the University of Edinburgh. Beauty and power intertwined: an attractive appearance offered better marriage prospects and social status.

Beauty products were no mere frippery. They could be both weapons and shields. Marriage manuals of the day recommended wife-beating, and cosmetic recipe-books shared tips on how to hide “dead blood” from blows to the face using wild mint leaves. Giovanna de Grandis, a woman from Rome, was hung alongside four other women for selling a poison disguised as a blemish remover that killed 46 men. (Ms Burke thinks the men may have been abusing their wives.) One dignitary guessed that 500 men could have been killed by de Grandis’s toxic mixture, their deaths mistaken for

plague fatalities.

Cosmetics are a big business—worth \$430bn in 2022—but all too often they are dismissed as trivial. “What we do with our hair, face and body reflects and affects our social world,” Ms Burke argues. Academic purists may balk at what they perceive as a chatty “history-lite” approach, but Ms Burke draws all her conclusions from primary sources (many of which she translated from the Italian herself).

Most of her sources have not been studied in great depth before, like Giovanni Marinello’s “The Ornaments of Ladies”, published in Venice in 1562. In it “women’s bodies are presented as forever-unfinished projects”, writes Ms Burke. Marinello promised readers the kind of physique described by poets and painters, such as Titian’s female nude “Venus of Urbino”. He offered 1,400 recipes to improve imperfections such as stretch marks (ladies would “do well” to “remove this defect after the birth and make your belly look like it should”); grey hair (women with “younger husbands” might be especially concerned); and extra flab (he suggested wrapping the troublesome area in wax overnight).

Visual culture was evolving rapidly. The Renaissance era’s technologies—the full-length mirror and the printed book—shaped views of femininity. So too have 21st-century innovations: social media and photo-editing apps. Social-media users see Botox-smoothed features and photoshopped bodies. In the same way, argues Ms Burke, the popularity of single-point perspective and naturalism in drawing meant Renaissance women were bombarded with “endless images of newly realistic naked goddesses being churned out in sculptures, painting and prints”.

Some women pushed back. Blond hair was idealised in art, and bleaching was common. But as a teenager, the painter Giovanna Garzoni, famous for her meticulous flowers and insects, depicted herself in a self-promotional

portrait as Apollo, the Greek god of the sun, with tousled brown hair. Artemisia Gentileschi, who once proclaimed “as long as I live I will have control over my being”, painted herself with wayward strands of black hair framing her face. In Ms Burke’s view female artists chose to present themselves like this to toy with the stereotypes that equated unruly dark hair with “interior imagination...melancholy creativity and a ‘masculine’ temperament”. Whether with a make-up brush or a paintbrush, women wanted to control how the world would see and remember them. ■



山谷外的景色

抛开科技大热不谈，美国商业健康与否？

人工智能之外的经济领域大多出人意料地好

十个月前，经济衰退的忧惧还笼罩着美国企业界。当时通胀肆虐，利润低迷，美联储不断“拧紧螺丝”。但结果，通胀缓和了下来，就业市场依然吃紧，衰退不再是定局。一种难以捉摸的“软着陆”前景加上人工智能（AI）有望提高生产率而激起的喧嚣，令投资者的情绪为之一振。今年，追踪大公司的标普500指数上涨了近五分之一。

市场尤其看好几家大型科技公司和汽车制造商。根据我们的早期AI采用者指数（考虑了AI相关专利、投资和招聘等因素，见图表1），它们也在标普500指数中最痴迷AI的公司之列。它们现时的表现也很好：在即将结束的最新财报季中，所有公司都公布了可观的第二季度业绩。但是，受科技炒作影响更小的广大美国经济部门的健康状况又如何呢？在这个部分，情形要更复杂，但归根结底是令人放心的。

先说坏消息。有一些面对“AI的未来”准备最不充分的企业目前日子难过。医疗类企业看起来很虚弱：瑞银（UBS）估计，与去年相比，它们的利润猛跌近30%（见图表2）。连锁药店CVS Health（在我们的AI指数中排名第218位）在收益下降37%后正在裁减5000个职位。能源公司在2023年第二季度的收益较上一年下降一半，当时俄罗斯入侵乌克兰推高了石油和天然气价格。由于其他大宗商品价格也在下跌——部分原因是中国经济增长缓慢，需求疲软——原材料公司的利润下降了30%。

因此，数据供应商FactSet认为，标普500指数成分股公司的总体收益据估计在第二季度同比下滑了5%。这是自新冠疫情初期以来的最大降幅。

不过，痛楚集中在少数几个行业。深入挖掘后可以发现，大部分非AI经济部门看起来出人意料地稳健。据估计，资本品制造商（如卡特彼勒和雷神公司，在我们的排名中分别位列第204和第340）在第二季度收入总体增

长超过8%，利润增长则是这个数字的两倍——可能要部分归功于拜登对产业政策的偏好。就连石油和天然气巨头的表现也比总体数据所显示的要好。它们当中规模最大的埃克森美孚（排名第236位）实现了近80亿美元的净利润——同比下降56%，但除了2022年创纪录的业绩外，这仍然是该公司近十年来最高的第二季度数字。

最明显地体现了这种韧性的，可能是那些自身运势与美国消费者的境况息息相关的企业，而美国消费者眼下手头仍十分宽绰。据瑞银称，食品和家庭用品等基本用品销售商的利润同比增长了5%。非基本消费品供应商的收益猛增了40%。8月1日，咖啡店巨头星巴克（在我们的AI指数中排名第116位）报告其季度营业利润为16亿美元，增长了22%。次日，卖番茄酱和焗豆的卡夫亨氏（排名第253位）表示公司营业利润达到14亿美元，是一年前的2.5倍。

消费品公司牢牢把持了定价权。例如，根据劳工统计局的数据，糖果商对巧克力的定价较去年上涨了11%。好时（第331位）抵消了不断上涨的可可价格——而且还有得赚。其营业利润增长了23%，达到5.61亿美元。百事公司（第245位）仅在第二季度就将软饮料和零食的价格提高了15%。它的营业利润激增四分之三，至37亿美元。该公司目前预计今年的销售额将增长10%，净利润将增长12%，而此前的预测分别为8%和9%。

美国人不只把钱花在甜食和可乐上。航空旅行正在迅速复苏，尤其是国际旅行。美国航空（在我们的AI指数中排名第266位）、达美航空（第193位）和联合航空（第183位）上季度的净利润总计为42亿美元，是2015年以来的最高水平。酒店里挤满了出游和出差的旅客。连锁酒店希尔顿（排名在下游的第420位）表示，其每间可用客房的收入（业界首选的衡量标准）同比增长了12%。

这波财运能持续多久？消费者正在逐渐消耗掉他们在疫情期间攒下的储蓄，当时他们收到了政府发放的刺激支票，却没处花掉这些钱。根据旧金山联储的数据，在2021年8月至今年5月期间，美国家庭花掉的这部分储蓄超过1.5万亿美元。

按照这一速度，美国家庭将在今年年底前“败完”剩余的约5000亿美元。尽管失业率仍旧接近历史低位（7月份为3.5%），但工资增长已经放缓。咨询公司牛津经济研究院（Oxford Economics）称，在最高法院驳回了拜登免去部分学生债务的计划后，10月份恢复偿还学生贷款可能会导致消费者支出每月减少多达90亿美元。

如果不断上升的利率最终抑制了需求，企业将更难继续提高价格，导致利润率更加脆弱。更高的利率也会打击那些资产负债表薄弱的企业。今年上半年，信用评级机构标普全球（S&P Global）覆盖的公司有340家宣布破产，是自2010年以来的最高数字。可能还会有更多的公司遭遇类似的命运，尤其是经济衰退最终来袭的话。

这种前景并非全无可能。高盛银行认为，未来12个月美国经济衰退的可能性为20%。另一家银行花旗集团预计，经济将在2024年初下滑。如果这真的发生，即使是那些对AI最友好的公司也不会毫发无损。■



The view beyond the Valley

Beyond the tech hype, how healthy is American business?

Most parts of the non-AI economy are doing surprisingly well

TEN MONTHS ago the spectre of recession haunted corporate America. Inflation was rampant, profits were depressed and the Federal Reserve was tightening the screws. Instead, inflation has moderated, the jobs market remains tight and recession is no longer a certainty. The prospect of an elusive “soft landing” has combined with hype over the productivity-boosting promise of artificial intelligence (AI) to give investors a fillip. This year the S&P 500 index of big firms is up by nearly a fifth.

Markets are especially bullish about a few large technology companies and carmakers. These are among the S&P 500’s most AI-obsessed members, according to our early-adopters index (which takes into account factors such as AI-related patents, investments and hiring, see chart 1). They have done well in the here and now, too: all reported respectable second-quarter results in the latest earnings season, which wraps up soon. But what about the health of the broad swathes of the American economy that are less affected by all the tech hype? Here the picture is more complex, but ultimately reassuring.

Start with the bad news. Some of the businesses least prepared for an AI future are suffering in the present. Health-care companies look sickly: UBS, a bank, estimates that their profits slumped by nearly 30% compared with last year (see chart 2). CVS Health, a chain of chemists (ranked 218th in our AI index), is slashing 5,000 jobs after its earnings sank by 37%. Energy firms made half as much money in the second quarter of 2023 as they did a year earlier, when Russia invaded Ukraine, pushing up oil and gas prices. With other commodity prices also down, in part owing to weak demand from a

sluggishly growing China, materials firms' profits fell by 30%.

As a result, overall earnings for S&P 500 firms are estimated to have slid by 5% in the second quarter, year on year, reckons FactSet, a data provider. That is the biggest decline since early in the pandemic.

Yet the pain has been concentrated in a handful of sectors. Dig deeper, and much of the non-AI economy looks surprisingly robust. Capital-goods manufacturers, such as Caterpillar and Raytheon (which come in at 204th and 340th in our ranking), are reckoned to have collectively increased their revenues by more than 8% in the second quarter, and their profits by twice as much—perhaps thanks in part to President Joe Biden's taste for industrial policy. Even the oil-and-gas giants are doing better than the headline numbers suggest. The largest of them, ExxonMobil (ranked 236th), made nearly \$8bn in net profit—down by 56% year on year but, bar that record-breaking result in 2022, still its highest second-quarter figure in nearly a decade.

The resilience is perhaps most obvious for businesses with fortunes tied to the condition of the American consumer, who remains in rude health. Pedlars of staples, such as foodstuffs and household goods, saw their profits rise by 5% year on year, according to UBS. For purveyors of non-staple consumer goods, earnings shot up by 40%. On August 1st Starbucks, a coffee-shop colossus (ranked 116th in our AI index), reported a quarterly operating profit of \$1.6bn, up by 22%. The next day Kraft Heinz, a seller of ketchup and baked beans (ranked 253rd), said it made \$1.4bn in operating profit, two and a half times what it did a year ago.

Consumer-goods firms have held on to pricing power. Confectioners, for example, are charging 11% more for chocolates than they did last year, according to the Bureau of Labour Statistics. Hershey (331st) has offset the rising cost of cocoa—and then some. Its operating profit rose by 23%, to

\$561m. PepsiCo (245th) lifted prices of its soft drinks and snacks by 15% in the second quarter alone. Its operating profit bubbled up by three-quarters, to \$3.7bn. It now expects to increase sales by 10% and net profit by 12% this year, up from an earlier forecast of 8% and 9%, respectively.

Americans aren't just spending on sweets and cola. Air travel is recovering rapidly, particularly for international trips. American Airlines (266th in our AI index), Delta Air Lines (193rd) and United Airlines (183rd) collectively reported net profits of \$4.2bn last quarter, the most since 2015. Hotels are inundated with leisure and business travellers. Hilton (a chain ranked a lowly 420th) said that its revenue per available room, a preferred industry measure, was up by 12%, year on year.

How long can the bonanza last? Shoppers are gradually drawing down the savings they accumulated during the pandemic, when they received stimulus cheques from the government but lacked ways to spend them. Between August 2021 and May this year, households spent over \$1.5trn of these savings, according to the Federal Reserve Bank of San Francisco.

At that rate they will burn through the \$500bn or so they still have before the end of the year. Although unemployment remains near historic lows, at 3.5% in July, wage growth has slowed. The resumption of student-loan repayments in October, after the Supreme Court struck down Mr Biden's plan to cancel some student debts altogether, could see consumer spending fall by as much as \$9bn a month, according to Oxford Economics, a consultancy.

If rising interest rates eventually curb demand, firms will find it harder to continue raising prices, leaving margins more vulnerable. Higher rates will also knock businesses with weak balance-sheets. In the first half of this year 340 companies covered by S&P Global, a credit-rating agency, declared bankruptcy, the highest number since 2010. More could suffer a similar fate,

especially if a recession does hit.

That eventuality is not completely out of the question. Goldman Sachs, a bank, thinks there is a 20% chance of a recession in America in the next 12 months. Citigroup, another lender, expects a downturn at the start of 2024. If that happens, not even the AI-friendliest firms will emerge completely unscathed. ■



自然资源

拉丁美洲如何可能成为大宗商品霸主

它绝不能浪费下一次大宗商品繁荣的机会

五个世纪以来，拉丁美洲及其20亿公顷的土地一直是世界粮食、燃料和金属的重要来源。这里先是被殖民者掠夺黄金、白银、棉花和蔗糖，后来又向欧洲和美国供应橡胶和石油。现在，拉丁美洲面临着成为21世纪大宗商品霸主的机会。这一次，它必须利用这个机会促进本地发展。

向清洁能源的过渡将引发未来几十年里对大量建造太阳能和风能园区、输电线和电动汽车所需的金属的需求。拉丁美洲拥有五种关键金属全球储量的五分之一以上。它已经主导了绿色技术中无处不在的铜的开采，还拥有全球近60%的已知锂资源，而锂被用在所有主要的电动汽车电池类型中。它还拥有丰富的银、锡和镍资源。由于最近发现了石油，到2030年，它可以满足全球5%到10%的石油需求，即使绿色转型出现停滞，它也能从中受益。

在世界变得越来越环保的同时，人口也将越来越多。到2050年，要养活的人口可能将从现在的80亿增加到近100亿。这将刺激对拉丁美洲大量生产的碳水化合物、蛋白质和美食的需求。拉美的玉米、牛肉、家禽和蔗糖供应量已占全球的30%，大豆供应量占全球的60%。世界上每十杯阿拉比卡咖啡中有八杯是用该地区的咖啡豆制成的。到2032年，该地区的粮食净出口额将超过1000亿美元，在全世界遥遥领先。

该地区作为贸易伙伴的吸引力将因超级大国间的竞争而更加突出。随着西方国家争相寻求中国之外的多元化发展，他们希望与拉丁美洲这个大体上中立、和平的地区达成更多交易。财大气粗的竞争对手们也对其财富虎视眈眈，一场新的大博弈正在上演：就在上个月，巴西矿业公司淡水河谷以30亿美元的价格将其绿色金属部门13%的股份出售给沙特拥有的实体；中国拨出14亿美元专款在玻利维亚发展锂生产；欧洲承诺向拉美绿色项目投

资450亿欧元。

问题在于，拉美与大宗商品的关系从来都不怎么美满。过去对利益的争夺引发了政变、不平等和民粹主义。委内瑞拉暴君乌戈·查韦斯（Hugo Chávez）浪费了国家的石油繁荣，挥霍无度却对该行业投资不足，并在其中塞满了亲信。石油暴利导致了哥伦比亚和厄瓜多尔过早的去工业化。随着出口收入激增，国内货币也随之飙升，扼杀了其他出口产业，并将该地区的命运与动荡的市场捆绑在一起。拉丁美洲经历了无数次繁荣和萧条。当地经济呈现一边倒的趋势：平均而言，拉美国家80%的出口是原材料出口。

要想在这一次做得更好，拉美国家必须做好几件事。首先，它们必须确保繁荣确实到来。目前，政治阻碍了这一进程。随着左翼分子和民粹主义者掌权，该地区许多国家通过了或威胁要通过提高税收、将储备国有化或将外国投资拒之门外的法律。政府希望最大限度地提高其收益，这是天经地义的，尤其是考虑到它们过去经常被掠夺。但是，如果它们索取过度，或者不断改变主意，储备就不会很快被开采出来。

与居住在矿区附近的社区分享开采成果也至关重要。当地居民抱怨开采危及他们的生计。今年，占全球供应量2%的秘鲁铜矿因抗议活动停工数月。这些社区经常被国家政府忽视；矿业公司惯常卷入丑闻或破坏当地环境。除非两者都采取更多措施来缓解不满情绪，否则进展仍将岌岌可危。当地老板经常为金钱展开争夺战，但钱不能解决所有问题。

而且政府应该明智地花钱。在价格高涨时，政府应将部分意外之财存入“应急基金”，以便在经济困难时支撑国家预算。政府不应砸钱从零开始建设尖端电池工厂，而应投资于促进新产业兴起的基础领域：教育、卫生、基础设施和研究。据世界银行估计，到2030年，巴西的基础设施建设资金缺口会接近8000亿美元，占每年GDP的3.7%。拉丁美洲有一个走出资源陷阱的历史性机遇。它应该抓住这个机会。 ■



Natural resources

How Latin America could be a commodities superpower

It must not squander the opportunity of the next commodity boom

OVER FIVE centuries Latin America and its 2bn hectares of land have been a vital source of food, fuel and metals for the world. First looted by colonisers for gold, silver, cotton and sugar, it later supplied rubber and oil to Europe and the United States. Now Latin America faces a chance to become the 21st century's commodity superpower. This time, it must use that chance to boost development at home.

The transition to clean energy will spark decades of demand for the metals needed to multiply solar and wind parks, power lines and electric cars. Latin America holds more than a fifth of the global reserves for five critical metals. It already dominates the mining of copper, pervasive across green technologies, and holds nearly 60% of the world's known resources of lithium, used in all main e-vehicle battery types. It is also rich in silver, tin and nickel. And it will benefit even if the green transition sputters, thanks to recent discoveries of oil that could see it quench 5-10% of the global demand by 2030.

As the world goes greener it will also become more populous. By 2050 it may have nearly 10bn mouths to feed, up from 8bn now. That will fuel demand for the carbs, proteins and delicacies that Latin America produces aplenty. It already supplies more than 30% of the world's corn, beef, poultry and sugar, and 60% of the world's soyabeans. Eight out of ten cups of the world's Arabica coffee are made from the region's beans. By 2032 its net food exports may exceed \$100bn, the largest in the world by far.

The region's draw as a trading partner will be accentuated by superpower

rivalries. As the West scrambles to diversify away from China, it wants more deals with Latin America, a largely neutral and peaceful region. As monied rivals also eye its riches, a new great game is under way: just last month Vale, a Brazilian mining company, sold 13% of its green-metal arm to Saudi-owned entities for \$3bn; China earmarked \$1.4bn to develop lithium production in Bolivia; and Europe pledged to invest €45bn in Latin American green projects.

The problem is that Latin America's affair with commodities has rarely been happy. Past struggles over the spoils have catalysed coups, inequality and populism. Hugo Chávez, a Venezuelan despot, squandered his country's oil boom, spending lavishly while underinvesting in the industry and stuffing it with cronies. Oil windfalls in Colombia and Ecuador led to premature deindustrialisation. As export receipts have surged, so have domestic currencies, strangling other export industries and tying the region's fate to a volatile market. Latin America has endured countless booms and busts. Local economies are lopsided: on average, 80% of its countries' exports comes from the export of raw materials.

To do better this time round, Latin American countries must get several things right. First they need to make sure the boom does indeed take place. At present, politics is holding it back. As left-wingers and populists have gained power, many countries in the region have passed or threatened laws that would raise taxes, nationalise reserves or shut out foreign investment. It is right and proper that governments want to maximise their rents, especially given how often they have been robbed in the past. But if they seek to take too much, or keep changing their minds, their reserves will not soon be tapped.

Sharing the bounty with communities that live near mines is also crucial. Locals complain that extraction endangers their livelihoods. This year protests stopped work for months at a Peruvian copper mine accounting

for 2% of the world's supply. Those communities are frequently ignored by national governments; mining firms have too often been involved in scandals or ruined the local environment. Unless both do more to alleviate grievances, progress will remain precarious. Money, often fought over by local bosses, cannot solve it all.

And governments should spend their money wisely. When prices are high they should stash some of the windfall in rainy-day funds that they can tap into to prop up state budgets when times get tough. Instead of splashing cash in a bid to build cutting-edge battery factories from scratch, governments should invest in the basics that enable new industries to emerge: education, health, infrastructure and research. The World Bank estimates that Brazil's infrastructure-financing gap until 2030 is almost \$800bn, 3.7% of GDP each year. Latin America has a historic chance to grow out of its resource trap. It should seize it. ■



先进制造

能在电脑上设计的，就能由机器人造出来

强大的新软件改写了大规模生产的规则【深度】

在靠近南北卡交界的一家工厂里，史丹利百得（Stanley Black & Decker）正在组装无绳电钻。装在盒子里的电钻半成品随传送带移动，一个机械臂对它们拍照和扫描，检查有无缺陷。另一个机器臂将电机装入电钻内。第三个机器臂装上螺丝并拧紧。整条生产线由一个软件控制，仅需七人管理，每小时可生产130台无绳电动工具。它所取代的中国装配线最多需要40名工人，每小时产量一般不超过100台。

“三十年后我们会笑话自己这一代人，居然还要手工组装产品。”Bright Machines的老板利奥尔·苏珊（Lior Susan）预言。这家总部位于旧金山的公司给这间工厂安装了软件。倒不是电钻的设计或各道制造工序发生了什么变化。而是现在可以通过软件中编码的指令直接驱动自动化机器来完成工作，这些指令实际上是从中国工厂工人的大脑中复制过来的，而他们那会儿基本上是手工作业。

这种制造方式类似于半导体行业采用的模式，即使用软件设计芯片，而软件又直接连接到制造芯片的自动化硬件。对于这家位于米尔堡（Fort Mill）的工厂，以及开始采用这种软件定义制造系统的其他公司来说，这种模式可以更快地设计和投产更加精密复杂的产品，也许能让未来的工厂彻底改观。所有这一切都有望大大节省成本。

要理解其中的原因，不妨想象一下制造一种新的动力工具的简略过程。设计团队提出了一个新功能，例如更耐用的电池。他们绘制出新产品当中需要改变的每个元素，从电池仓到电路。这是一项复杂的工作，主要是因为对一个组件的微小改动可能会对另一个组件产生很大影响，继而引发连锁反应。

然后，将设计 “扔给隔壁”负责生产的人。有时是第三方工厂，通常在中

国。工程师、设计师和生产人员交流信息并碰头，制作一系列产品原型，并根据过程中的成功或失败经验不断调整设计。一些细微之处，例如电动螺丝刀很难触碰到某个螺丝而无法将其正确拧紧，可能会导致回到绘图板上重新设计——如今的绘图板主要是计算机辅助设计（CAD）程序。

最终，所有的问题都解决后（希望如此），新产品就可以投产了。然而，一路走来的一些更微小的细节还是有可能藏在组装原型的工人的脑子里。毕竟，人类思维极为灵活，经常会想出各种变通的办法。

这种流程已经沿用了几十年，但它从根本上说是不确定和混乱的。设计师没有把握预判工厂能否比较顺利地实现某些要求。结果，设计团队可能会故意在某些功能上含糊其辞一点，搁置一些创新的点子，因为担心工厂会说做不到或者成本过高。

当硬件由软件而非人类控制时，一切都不同了。设计师在构想新产品时有了很大的把握它是可以用机器批量制造的。这是因为生产线上的各种限制因素——甚至像螺丝的位置放在哪儿这样的细枝末节——都已编码在CAD程序中。而这些程序又直接连接到控制工厂机器的软件上。因此，如果一项设计能在数字模拟中成功运行，那么它也很有可能在生产线上“跑起来”。

这种制造硬件与CAD软件的紧密集成已经给半导体制造带来了福音，让庞大的机器得以将仅几纳米（十亿分之一米）宽的电路蚀刻到硅片上。苹果、英伟达（Nvidia）或高通（Qualcomm）等公司的芯片设计人员使用专用程序（主要来自Cadence和Synopsys这两家公司）来绘制电路。然后，设计文档被直接发送给台积电等代工厂进行生产。

“在这些工具出现之前，人们是用手工绘制集成电路的。”哈佛商学院的史兆威（Willy Shih）说。他完全无法想象今天如何用手工方式来设计芯片，比如苹果的包含了1140亿个晶体管的M1芯片。只有在使用软件而让人类可以把注意力从细节转向功能的系统中，才有可能完成这样复杂的制造。

史丹利百得还没有把它的CAD工具和Bright Machines的系统充分整合来设计全新产品。但双方的想法是这一步也会很快发生。“Cadence和Synopsys为半导体所做的，就是我们要对产品设计做的事。”Bright Machines的苏珊表示。

有的公司已经开始这样设计产品了。VulcanForms是一家代工厂，但生产的是金属件而不是芯片。它的工厂在马萨诸塞州北部的一个旧飞机库里，由计算机控制的庞大机器将十万瓦特的不可见激光聚焦到金属粉末槽中。粉末一层一层熔化并熔接成错综复杂的形状，最终制成尺寸精确到百分之一厘米的部件。成品可以是军用无人机的引擎部件，也可以是完美成型的人工髋关节。这是一种增材制造，也就是人们常说的3D打印。

VulcanForms的机器由CAD软件驱动，可以生产直径最多达半米左右的任何金属部件。

“熟悉了VulcanForms的工序后，我可以预见一些可预测的模式，与半导体领域的一些经验非常类似。”美国芯片制造商Analog Devices的创始人、同时也是VulcanForms董事的雷·斯塔塔（Ray Stata）说。他表示，在芯片制造中，用软件连接设计方和制造方的做法极大地提升了效率和规模经济。

VulcanForms使用的是nTopology开发的软件。这让不懂激光操作的人也能设计物件交由代工厂生产。VulcanForms的首席技术官约翰·哈特（John Hart）说，如此生产出的部件可以达到以前无法比拟的性能水平，因为它们具有以其他任何方式都无法实现的复杂几何结构。还可以大批量制造物件，例如在一个粉末槽里制作1000个脊柱植入物。运用增材制造，产品还可以一次性整体制成，无需由多个部件组装而成。这就减少了材料用量，因为这样的部件往往更轻。此外还降低了组装成本。

“软件定义制造”会给企业面临的一些重大贸易和政治挑战带来影响。对那些越发对依赖中国制造商感到不安的企业来说，它可以让生产回流成为一种更可行的选择。苏珊用军事术语解释道：“制造是一种武器。当我们把设计文档交给中国时，就等于把这种武器的源代码交给了我们的敌人。”

制造业岗位也会受到影响。虽然自动化通常意味着车间里的装配工人减少，但它也会创造出一些新工作。需要有技术人员给生产系统编程和做维护，而在办公室里，成功的公司很可能会增加设计、营销和销售人员。不过这些工作要求具备不同的技能，因此再培训必不可少。

史兆威也指出，不仅仅是机床和工艺，工厂整体都开始受到软件的控制。他以德国工业巨头西门子的子公司Tecnomatix为例：设计师可以在其软件中构建整个工厂，这样就可以先在虚拟环境（即“数字孪生体”）中模拟新产品的生产过程，然后才开始在对应的实体环境中开始制造。

如果说制造业的未来要追随半导体的方向，那么还有一段路要走。生产机械产品与蚀刻没有活动部件的精密电路不是一回事。首先，机械部件的最终用途五花八门，产品的标准化程度要低得多。“我们在机械结构方面才刚刚起步。”斯塔塔表示，“用增材制造将各种材料组合在一起的整个过程还处于非常早期的阶段。由此带来的灵活性和可能性令人难以置信。”

然而，其中一些影响已经开始清晰显现。产品的性能和精度可以大大提高，达到过去依靠人力生产根本无法企及的水平。在二维图纸上设计虑及工人作业需要的厂房将成为过去。由软件设计的工厂将是更密集、复杂度大为提高的三维空间，充斥着高效率、高度自动化的机器集群。

这些未来工厂里可能没什么人迹，只有少数技术人员在照管。但是，既然生产中的错综复杂之处也都交给了软件来搞定，这些工厂将更容易为新产品的开发者和设计者所用。这应该能让他们放飞想象力到新的高度。■



Advanced manufacturing

If it can be designed on a computer, it can be built by robots

Powerful new software rewrites the rule of mass production

IN A FACTORY on the Carolinas' border, Stanley Black & Decker is assembling cordless electric drills. As part-finished drills travel in boxes along a conveyor belt, a robotic arm photographs and scans them for defects. Another robot nestles electric motors into the drills' casings. A third one places and tightens screws. A single piece of software oversees the entire production line, which is capable of pumping out 130 cordless power tools every hour under the supervision of just seven humans. The assembly line it replaced in China needed up to 40 workers and rarely produced more than 100 an hour.

“Thirty years from now we will laugh at our generation of humans, putting products together by hand,” predicts Lior Susan, the boss of Bright Machines, a San Francisco-based company that installed the plant’s software. It is not that the design of the electric drills or the various steps involved in making them have changed. Rather, it is the way the automated machines doing the work are being driven by instructions that have been encoded into software having been in effect copied from the brains of Chinese factory workers, who mostly did the job manually.

Making things this way resembles a model used by the semiconductor industry, where chips are designed using software that directly links to the automated hardware which fabricates them. For the Fort Mill plant, and other firms starting to employ such software-defined manufacturing systems, it promises to transform the factory of the future by allowing more-sophisticated products to be designed and put into production more quickly. All of which promises big cost savings.

To understand why, consider a simplified version of how a new power tool is made. A team of designers come up with a fresh feature, say a longer-lasting battery. They map out every element of the new product, from the battery compartment to the circuitry, that needs to be changed as a result. It is complex work, not least because a small change to one component can have a big impact on another, and so on.

The design is then “thrown over the wall” to the people responsible for making it. Sometimes that is a third-party factory, often in China. Engineers, designers and production staff exchange information and meet up, constantly tweaking the design in response to the various successes or failures involved in making a series of prototypes. Little things, such as a screw that cannot be tightened correctly because it is hard to reach with an electric screwdriver, might result in a return to the drawing board—which nowadays is mostly a computer-aided-design (CAD) program.

Eventually, all the kinks are ironed out (hopefully) and the new product is ready for production. The finer details of how all this was achieved, however, are likely to remain locked up in the minds of the workers assembling the prototypes. Humans are, after all, incredibly flexible and often come up with workarounds.

This process has been employed for decades, yet is inherently uncertain and messy. Designers cannot predict with any confidence what things the factory can or cannot easily accommodate. As a consequence, the design team may purposely leave some features a bit vague, and be put off innovative ideas for fear of being told it cannot be made or is impossibly costly.

When the hardware is controlled by software, rather than by humans, all this changes. Designers can dream up new products with a far greater certainty that they are manufacturable. This is because the constraints of

the production line—even fiddly details like the positioning of screws—are encoded in their CAD programs. Those programs, in turn, are directly connected to the software which controls the machines in the factory. So, if a design works in a digital simulation, there is a good chance it will also “run” on the production line.

This tight integration of manufacturing hardware and CAD software has been a boon in semiconductor manufacturing, where vast machines etch circuits into silicon just a few nanometres (billions of a metre) wide. Chip designers with firms such as Apple, Nvidia or Qualcomm use specialised programs, largely produced by two companies, Cadence and Synopsys, to sketch out circuits. The design files are then sent directly to silicon foundries, such as TSMC, in Taiwan, for production.

“Until the advent of those tools, people were laying out integrated circuits by hand,” says Willy Shih of Harvard Business School. Mr Shih imagines the impossibility of attempting to do that today with, for instance, Apple’s M1 chip, which contains 114bn transistors. Producing such complexity is only possible in a system where software allows humans to ignore the detail and focus on function.

Stanley Black & Decker has not yet turned its CAD tools loose on Bright Machines’ system to design new products. But the idea is that they soon will. “What Cadence and Synopsys did to semiconductors is what we will do to product design,” says Bright Machines’ Mr Susan.

Some companies have already started designing products this way. VulcanForms is a foundry, but one that makes metal components rather than chips. It operates out of a former aircraft hangar in northern Massachusetts, where its vast computer-controlled machines focus 100,000 watts of invisible laser light onto a bed of powdered metal. The powder melts and fuses into intricate patterns, layer by layer, until a component

with dimensions specified to within a hundredth of a centimetre emerges. It could be part of the engine in a military drone, or a perfectly formed hip-replacement joint. This is a type of additive manufacturing, more popularly known as 3D-printing. VulcanForms' machines are driven by CAD software and can produce any metal component with a diameter up to about half a metre.

"When I became familiar with what VulcanForms was doing, I could see predictable patterns that mirrored some of the learning with semiconductors," says Ray Stata, the founder of Analog Devices, an American chipmaker, and a member of the foundry's board. In chipmaking, he says, the software linking designer and manufacturer has produced huge gains in efficiency and economies of scale.

VulcanForms uses software made by nTopology. This lets people without the skills required to operate lasers, to design objects for production by the foundry. It can result in components with previously unmatched levels of performance, because they can be produced as complex geometric structures which are impossible to manufacture any other way, says John Hart, chief technology officer of VulcanForms. Objects can be created at high volumes, such as forging 1,000 spinal implants from a single powder bed. With additive manufacturing, products can also be produced in one go, as single components, rather than being assembled from individual parts. This reduces the amount of material required as the parts tend to be lighter. It also cuts down on assembly costs.

Software-defined manufacturing has an impact on some of the big trade and political challenges faced by companies. For firms that are increasingly uncomfortable with relying on Chinese manufacturers, it can make reshoring production a more viable option. Mr Susan puts it in martial terms: "Manufacturing is a weapon. When we give design files to China, we give the source code of that weapon to our enemy."

There will be implications for manufacturing jobs. Although automation usually means a reduction in the number of people assembling things on the shop floor, it also creates some jobs. Technicians are required to program and maintain production systems, and in offices successful companies are likely to boost the numbers working in design, marketing and sales. These jobs, though, require different skills so retraining will be necessary.

Mr Shih also notes that factories themselves, not just the machine tools and processes within them, are coming under the thrall of software. He cites Tecnomatix, a subsidiary of Siemens, a German industrial giant, whose software lets designers lay out an entire factory so that the making of new products can be simulated in a virtual environment, known as a digital twin, before manufacture begins in its physical counterpart.

If the future of manufacturing is following semiconductors, then there is still some way to go. Producing mechanical objects is not the same as etching elaborate circuits that have no moving parts. For a start, things are far less standardised, with components having all sorts of end uses. “We’re just at the beginning with mechanical structures,” says Mr Stata. “The whole process of putting materials together in an additive method is in its very early stages. The flexibility and possibility that opens up is mind-boggling.”

Yet some of the implications are becoming apparent. Products could reach a level of performance and precision which is simply unachievable when their production is limited by human hands. Laying out a factory floor in two dimensions to accommodate human workers will become a thing of the past. Factories designed by software will be denser, much more complex three-dimensional places, full of clusters of highly productive, highly automated machinery.

These factories of the future may be almost deserted places, attended to by a

handful of technicians. But with software also taking care of the intricacies of production, they will be easier to use by people developing and designing new products. That should free their imaginations to soar to new levels. ■



【首文】需要替换

为什么在足球中性别差异是要紧事

男女差异可不只是头发长短，哪怕在球场上

在从1921年到1971的半个世纪里，在英格兰管理足球运动的英格兰足球总会（Football Association）禁止在它下属的球场里举行女足比赛。“这项运动，”它表态说，“不那么适合女性。”

把这说给球迷们听吧。今年在澳大利亚和新西兰举办的女足世界杯在8月20日迎来决赛，对阵双方是西班牙和英格兰，后者是现任欧洲冠军。决赛前夕已经售出180万张门票，打破了2015年在加拿大销售130万张的纪录。电视观众人数可能会是之前10亿人次纪录的两倍。比赛的水平也全面提高。

到目前为止，为女子足球争取重视的努力就是争取与男子足球平等。从资金和曝光率来衡量，这还有很长的路要走。自上届世界杯以来，虽然女足的奖金已经提高了两倍多，但仍只有男足奖金的25%。俱乐部的工资差距天差地别。一个原因是，女子运动总体只占英国2022年电视体育转播的13%，占美国2019年转播的5%。

但是在球场本身，这项运动是严格平等的。女足的赛场尺寸、足球大小、比赛规则都和男足一样。然而在体育运动中，这种平等并不总是个好主意。

长期以来，女权主义者提出，女人可不是留长发的男人。说得没错。把男性作为“人类默认值”的欠考虑的假定使得从药品、手机，到防刺背心和气囊等种种东西的设计都对女性使用者不便或危险。

类似的主张对许多体育运动也适用，而这反倒又是女子体育之所以自成一类的原因。总体而言，女子的体形小于男子，即便在精英运动员中也是一样。一篇论文计算认为，与体形匹配的话，女子足球场的大小应是现在的

三分之二。球门应该稍小一些，足球也应该更小更轻。研究人员指出，认为女子要使用和男子同样大小的球场，实则是要她们做一种不同于男子足球的、难度更大的运动。

另一个担心是受伤的风险。还在不久前，制作一双女子足球鞋差不多就是做一双男子球鞋而后涂装成粉色。不用在意女性的脚有着不同的形状和结构。也不用在意按男性体重设计的鞋钉对体重更轻的女性来说抓地力可能太强了。那么也不用在意这是不是会增加膝盖受伤的风险，而女性似乎更容易膝盖受伤。但还不只是膝盖的问题。2018年的一项研究发现，反复顶头球对女性大脑的损害似乎大于男性。在美式橄榄球和英式橄榄球运动员中已经发现了脑损伤的情况，运动管理机构有责任考虑使用更轻的球。

不可否认，这些改变会引发争议。当国际橄榄球理事会（World Rugby）决定测试一只为女性更小的手掌而设计的更小的橄榄球时，球员出现了意见分歧。一些人欢迎她们眼里的一个障碍就此消除。另一些人则担心，任何一种看似优待的改变都可能损害这项女子运动的声誉。

这种风险确实存在，但有可能被夸大了。很多其他运动都考虑了男女的身体差异。在田径运动中，女性的跨栏栏架更低，铁饼更轻。篮球使用了更小的球，排球使用了更低的球网。在体育运动中，男女应该像在任何其他行业中一样得到平等对待。但男女的身体是不一样的，假装看不到这一点对谁都没有好处。■



Substitution required

Why sex differences matter in football

Women are not simply men with long hair, even on the pitch

FOR HALF a century, between 1921 and 1971, the Football Association, which governs the sport in England, forbade women from playing on FA-affiliated pitches. “The game”, it opined, “is quite unsuitable for females.”

Tell that to the fans. The women’s World Cup, held this year in Australia and New Zealand, is gearing up for a final on August 20th between Spain and England, the reigning European champions. So far, more than 1.8m tickets have been sold, breaking the previous record of 1.3m in Canada in 2015. The television audience is likely to be double the previous record of 1bn. The level of play is higher across the board.

The struggle for women’s football to be taken seriously has, so far, meant fighting for equality with the men’s game. In terms of money and exposure, it still has a long way to go. Although women’s prize money has more than tripled since the previous World Cup, it is still only 25% of men’s hauls. The disparity in club wages is cavernous. One reason is that women’s sport in general accounted for just 13% of TV sports coverage in Britain in 2022, and 5% in America in 2019.

But on the field itself, football is scrupulously equal. Women play on the same-size pitch, with the same-size ball and the same rules as men. And yet in sport that sort of equality is not always a good idea.

Feminists have long argued, correctly, that women are not just men with long hair. The unthinking assumption that men are the “default human” means that everything from drugs and smartphones to stab vests and airbags has been designed in ways that are inconvenient or dangerous for

their female users.

Similar arguments apply to many sports, an irony given that they are the reason why women's sport even exists as a separate category. Women's bodies are smaller, on average, than men's, even among elite athletes. One paper calculates that a pitch scaled for them would be two-thirds as big as it is now. Goals would be slightly smaller and the ball would be smaller and lighter. Expecting women to play on the same-size pitch as men, the researchers point out, means asking them to play a game that is different from the one the men play—and harder.

Another worry is the risk of injury. Until recently, making a women's football boot meant little more than taking a men's one and colouring it pink. Never mind the different shape and structure of women's feet. Never mind that studs designed for a man's weight might provide too much grip for a lighter woman. And never mind how that might increase the risk of knee injuries, to which women seem more prone. But it is not just knees. A 2018 study found that repeatedly heading a football seemed to harm women's brains more than men's. Having seen brain damage among American football and rugby players, the sport's authorities have a duty to consider using a lighter ball.

Admittedly, such changes would be controversial. When World Rugby, the international governing body for rugby union, decided to test a smaller ball designed for women's smaller hands, players were split. Some welcomed the removal of what they saw as a handicap. Others worried that anything which looked like a concession risked undermining the prestige of the women's game.

That is a real risk, but it can be overstated. Plenty of other sports accommodate the physical differences between the sexes. In athletics, women's hurdles are lower and discs are lighter. Basketball uses a

smaller ball; volleyball a lower net. Men and women should be treated equally in sport as in any other walk of life. But they are not physically the same, and it does no one any favours to pretend that they are. ■



机器梦想

面对人工智能，你的雇主（很可能）尚无准备

这对你的收入和整体经济都不是好消息【深度】

要想了解人工智能（AI）对经济可能造成的影响，不妨看看拖拉机的例子。对于到底是谁发明了这种不起眼的机器，历史学家众说纷纭。有人说它是英国工程师理查德·特里维西克（Richard Trevithick）在1812年的创造。另一些人认为，1890年代初在美国南达科他州工作的约翰·弗勒利希（John Froelich）更有资格得到这项荣誉。还有人指出，在20世纪初以前都没什么人用“拖拉机”这个词。不过，大家一致认为，拖拉机花了很长一段时间才真正普及。1920年，只有4%的美国农场有一辆。即使到了1950年代，有拖拉机的农场也还不到一半。

眼下人们正在热烈讨论AI对就业、生产率和生活质量的影响。这项技术令人惊叹。但它对经济的影响不会立即显现，而需要等到除硅谷等科技中心以外的千百万家公司都开始采用它那一天。这种采用将远不只是偶尔用一下聊天机器人，而是会涉及企业架构及其内部数据的全面重组。“对于长期增长而言，技术进步的扩散可说和创新一样重要。”芝加哥大学的南希·斯托基（Nancy Stokey）说。

日本和法国的例子说明了技术扩散的重要性。日本具有杰出的创新力，年人均专利申请量仅次于韩国。二维码、锂离子电池和3D打印技术都可说出自日本研究人员之手。但日本在经济中传播新技术的表现糟糕。东京的生产率远高于全国其他地区。现金仍是主流支付方式。到2010年代末，只有47%的大公司用电脑管理供应链，而新西兰为95%。根据我们的分析，与其创新能力所应带来的效益相比，日本的财富少了40%左右。

法国恰恰相反。虽然它在创新方面表现平平，但传播知识的能力却极为出色。18世纪，法国间谍窃取了英国海军的工程机密。20世纪初，路易·雷诺（Louis Renault）去美国拜访亨利·福特（Henry Ford），学到了汽车工

业的一些诀窍。前不久，谷歌和Meta的前AI专家在巴黎创立了Mistral AI。法国也很擅长将新技术从首都传播到周边地区。如今，法国头部和腰部企业之间的生产率差距还不到英国的一半。

在19和20世纪，新技术传播的速度越来越快，世界各地的商业变得越来越接近法国模式。两位经济学家迭戈·科明（Diego Comin）和马蒂·梅斯蒂里（Martí Mestieri）发现，有证据表明“在过去200年里，不同国家在技术采用上的差距已经缩小”。电力比拖拉机更快地席卷了整个经济。仅仅用了二三十年的时间，个人电脑在办公室的普及率就超过了50%。互联网的普及还要更快。总的来说，技术扩散帮助推动了20世纪的生产率增长。

然而，自2005年左右以来，世界开始变得更像日本模式。诚然，消费者接受科技的速度之快前所未见。据估计，社交媒体应用TikTok的用户数从零增长到一亿只用了一年。ChatGPT曾是历史上增长最快的应用，但7月推特的竞争对手Threads在推出后刷新了纪录。但公司却越来越谨慎。在过去二十年里，各种各样令人兴奋的创新进入了市场。即便如此，根据最新的官方估计，在2020年只有1.6%的美国公司部署了机器学习。在美国制造业里，只有6.7%的公司使用3D打印。只有25%的业务工作流在云端进行，这个数字过去五年几乎没有变化。

耸人听闻的故事比比皆是。2017年，三分之一的日本地区性银行仍在使用COBOL这种比人类登上月球还要早十年出现的编程语言。去年，英国进口了价值超过2000万英镑（2400万美元）的软盘、迷你光盘和磁带。发达国家五分之一的公司甚至没有网站。政府往往表现最为糟糕——例如仍在坚持使用纸质表格。我们估计，全球官僚机构每年在纸张和打印上的支出为60亿美元，按实值计算大致与1990年代中期的支出相当。

结果就形成了一种“双层”经济。积极拥抱科技的公司正从竞争中脱颖而出。2010年，英国最具生产效率的公司的人均商品和服务产出（以今天的货币计算）为98,000英镑，到2019年已上升至108,500英镑。生产效率最低下的公司的人均产出并没有增加。在1990年代的加拿大，前沿企业的生产率增速比非前沿企业高出约40%，而从2000到2015年变成了高两倍。咨

询公司麦肯锡的蒂姆·科勒（Tim Koller）及其同事在一本书中根据资本回报率对美国公司进行了排名，发现2017年75分位公司的回报率比中位数公司高出20个百分点——是2000年差距的两倍。一些公司通过购买新技术获得了巨大收益，许多公司却一无所获。

虽然这里的经济学原理可能听起来很抽象，但在现实世界中的后果并不让人陌生。只能将就用旧技术的人很受累，薪水也受拖累。自1990年代以来，英国生产率最低的10%的公司经通胀调整后的平均工资略有下降——而生产率最高的公司的平均工资同期内大幅上涨。鲁汶大学（KU Leuven）的扬·德洛克（Jan De Loecker）及其同事认为，“工人之间不平等的扩大主要源自公司之间平均工资差距的扩大”。那么，到底是哪里出了问题？

有三种可能性可以解释技术扩散程度降低：新技术的特性、竞争乏力和监管增加。西北大学的罗伯特·戈登（Robert Gordon）认为，19和20世纪的“伟大发明”对生产率的影响远远大于更近期的发明。问题在于，随着技术进步变得更加渐进式，技术扩散也放缓了，因为促使企业升级技术的动力和竞争压力都减少了。电力带来了光明和驱动机器的能量。相比之下，只有在最密集的业务场景才会用到云计算。像机器学习这类更加新颖的创新可能更难应用，需要更多高技能工人和更好的管理。

自步入21世纪以来，各个富裕国家的商业活力都在下降。人口老化。新公司数量减少。员工跳槽的频率降低。这些全都导致了技术扩散放慢，因为劳动者在经济体中流动时会传播技术和商业实践。

在由政府经营或严格管控的行业，技术变革速度缓慢。正如乔治华盛顿大学的丁恩（Jeffrey Ding）所指出的，中央计划制度下的苏联取得了世界一流的创新——例如诞生了斯普特尼克（Sputnik）人造卫星——但根本没有扩散。缺乏竞争压力，也就缺乏改善的动力。政客的公共政策目标（例如就业最大化）往往有违对效率的追求。如今，西方经济有很大一部分属于高度监管的行业：包括建筑、教育、医疗和公用事业在内的这些部门占了美国GDP的四分之一。

AI能否打破常规，比其他近期技术更快地在整个经济中扩散？有这种可能。因为几乎任何公司都可以轻松构想出AI的用例。不再需要行政管理！一个工具就可以帮我报税！新冠疫情也可能为西方经济体注入了一些活力。目前新公司成立的速度为近十年之最，工人跳槽也更加频繁了。乔治梅森大学的泰勒·考恩（Tyler Cowen）补充说，实力较弱的公司从AI中获益的空间更大，可能更有动力采用AI。

AI也可以被整合到现有的工具中。许多（可能是大部分）程序员已经每天都在使用这项技术，因为它已经通过Github的Copilot集成到了日常的编程工具中。Google Docs和微软Word等文字处理软件很快将推出数十项AI功能。

另一方面，当企业围绕新技术全面重组时——例如根据内部数据来适配AI模型——新型AI才能带来最大的效益。这耗时费钱，最重要的是，还需要竞争动力。收集数据的过程很繁琐，运行最好的模型也很昂贵——在最新版本的ChatGPT上，复杂的单次查询可能要花费1到2美元。一小时运行20次查询的话，耗费的成本已经超过美国的时薪中位数了。

这些成本会降下来，但要让AI技术变得足够便宜以便大规模部署可能还要等待多年。担心隐私和安全的企业老板经常对本刊表示，他们不愿意发送自己的数据来改进在外部某处运行的模型。对小企业的调查结果并不令人鼓舞。网络托管公司GoDaddy的一项调查显示，大约四成美国小企业对AI工具不感兴趣。这项技术毫无疑问是革命性的。但企业准备好迎接一场革命了吗？ ■



Machine dreams

Your employer is (probably) unprepared for artificial intelligence

That is bad news for your earnings—and the broader economy

TO UNDERSTAND THE impact that artificial intelligence may have on the economy, consider the tractor. Historians disagree about who invented the humble machine. Some say it was Richard Trevithick, a British engineer, in 1812. Others argue that John Froelich, working in South Dakota in the early 1890s, has a better claim. Still others point out that few people used the word “tractor” until the start of the 20th century. All agree, though, that the tractor took a long time to make a mark. In 1920 just 4% of American farms had one. Even by the 1950s less than half had tractors.

Speculation about the consequences of AI—for jobs, productivity and quality of life—is at fever pitch. The technology is awe-inspiring. And yet AI’s economic impact will be muted unless millions of firms beyond tech centres like Silicon Valley adopt it. That would mean far more than using the occasional chatbot. Instead, it would involve the full-scale reorganisation of businesses, as well as their in-house data. “The diffusion of technological improvements”, argues Nancy Stokey of the University of Chicago, “is arguably as critical as innovation for long-run growth.”

The importance of diffusion is illustrated by Japan and France. Japan is unusually innovative, producing on a per-person basis more patents a year than any country bar South Korea. Japanese researchers can take credit for the invention of the QR code, the lithium-ion battery and 3D printing. But the country does a poor job of spreading new tech across its economy. Tokyo is far more productive than the rest of the country. Cash still dominates. In the late 2010s only 47% of large firms used computers to manage supply chains, compared with 95% in New Zealand. According to our analysis,

Japan is roughly 40% poorer than would be expected based on its innovation.

France is the opposite. Although its record on innovation is average, it is excellent at spreading knowledge. In the 18th century French spies stole engineering secrets from Britain's navy. In the early 20th century Louis Renault visited Henry Ford in America, learning the secrets of the car industry. More recently, former AI experts at Google and Meta founded Mistral AI in Paris. France also tends to do a good job of spreading new tech from the capital to its periphery. Today the productivity gap in France between a top and a middling firm is less than half as big as in Britain.

During the 19th and 20th centuries businesses around the world became more French, with new technologies diffusing ever faster. Diego Comin and Martí Mestieri, two economists, find evidence that “cross-country differences in adoption lags have narrowed over the last 200 years.” Electricity swept across the economy faster than tractors. It took just a couple of decades for personal computing in the office to cross the 50% adoption threshold. The internet spread even faster. Overall, the diffusion of technology helped propel productivity growth during the 20th century.

Since the mid-2000s, however, the world has been turning Japanese. True, consumers adopt tech faster than ever. According to one estimate TikTok, a social-media app, went from zero to 100m users in a year. ChatGPT was the fastest-growing app in history until Threads, a rival to Twitter, launched last month. But firms are increasingly cautious. In the past two decades all sorts of mind-blowing innovations have come to market. Even so, according to the latest official estimates, in 2020 just 1.6% of American firms employed machine learning. In America's manufacturing sector just 6.7% of companies use 3D printing. Only 25% of business workflows are on the cloud, a number that has not budged in half a decade.

Horror stories abound. In 2017 a third of Japanese regional banks still used COBOL, a programming language invented a decade before man landed on the moon. Last year Britain imported more than £20m-(\$24m-) worth of floppy disks, MiniDiscs and cassettes. A fifth of rich-world firms do not even have a website. Governments are often the worst offenders—insisting, for instance, on paper forms. We estimate that bureaucracies across the world spend \$6bn a year on paper and printing, about as much in real terms as in the mid-1990s.

The result is a two-tier economy. Firms that embrace tech are pulling away from the competition. In 2010 the average worker at Britain's most productive firms produced goods and services worth £98,000 (in today's money), which had risen to £108,500 by 2019. Those at the worst firms saw no rise. In Canada in the 1990s frontier firms' productivity growth was about 40% higher than non-frontier firms. From 2000 to 2015 it was three times as high. A book by Tim Koller of McKinsey, a consultancy, and colleagues finds that, after ranking American firms according to their return on invested capital, the 75th percentile had a return 20 percentage points higher than the median in 2017—double the gap in 2000. Some companies see huge gains from buying new tech; many see none at all.

Although the economics can sound abstract, the real-world consequences are familiar. People stuck using old technologies suffer, along with their salaries. In Britain, average wages at the least productive 10% of firms have fallen slightly since the 1990s when adjusted for inflation—even as average wages at the best firms have risen strongly. According to Jan De Loecker of KU Leuven and colleagues, “the majority of inequality growth across workers is due to increasing average wage differences between firms”. What, then, has gone wrong?

Three possibilities explain lower diffusion: the nature of new technology, sluggish competition, and growing regulation. Robert Gordon of

Northwestern University has argued that the “great inventions” of the 19th and 20th centuries had a far bigger impact on productivity than more recent ones. The problem is that as technological progress becomes more incremental, diffusion also slows, since companies have less incentive and face less competitive pressure to upgrade. Electricity provided light and energy to power machines. Cloud computing, by contrast, is needed only for the most intensive operations. Newer innovations, like machine learning, may be trickier to use, requiring more skilled workers and better management.

Business dynamism fell across the rich world in the first decades of the 21st century. Populations aged. Fewer new firms were set up. Workers moved companies less frequently. All this reduced diffusion, since workers spread tech and business practices as they move across the economy.

In industries run or heavily managed by the government, technological change happens slowly. As Jeffrey Ding of George Washington University notes, in the centrally planned Soviet Union innovation was world-beating—think of Sputnik—but diffusion was non-existent. The absence of competitive pressure blunted incentives to improve. Politicians often have public-policy goals, such as maximising employment, that are inconsistent with efficiency. Heavily regulated industries make up a big chunk of Western economies today: such sectors, including construction, education, health care and utilities, account for a quarter of American GDP.

Could AI break the mould, diffusing across the economy faster than other recent technologies? Perhaps. For almost any firm it is easy to dream up a use-case. No more administration! A tool to file my taxes! Covid-19 may have also injected a dose of dynamism into Western economies. New firms are being set up at the fastest pace in a decade, and workers are swapping jobs more often. Tyler Cowen of George Mason University adds that weaker firms may have a particular incentive to adopt AI, because they have more to gain.

AI can also be incorporated into existing tools. Many coders—maybe most—already use the technology on a daily basis owing to its integration in everyday coding instruments through Github's Copilot. Word processors, including Google Docs and Microsoft Word, will soon roll out dozens of AI features.

On the other hand, the most significant benefits from new forms of AI will come when firms entirely reorganise themselves around the new technology; by adapting AI models for in-house data, for example. That will take time, money and, crucially, a competitive drive. Gathering data is tiresome and running the best models expensive—a single complex query on the latest version of ChatGPT can cost \$1-2. Run 20 in an hour and you have passed the median hourly American wage.

These costs will fall, but it could take years for the technology to become sufficiently cheap for mass deployment. Bosses, worried about privacy and security, regularly tell *The Economist* that they are unwilling to send their data to modify models that live elsewhere. Surveys of small businesses are not encouraging. One, by GoDaddy, a web-hosting company, suggests that around 40% of those in America are uninterested in AI tools. The technology is undoubtedly revolutionary. But are businesses ready for a revolution? ■



【首文】体育产业

沙特闯入全球体坛

体育是一门充满活力、资本密集的生意，不是博物馆展览

今年夏天体育迷们屡屡大跌眼镜。卡洛斯·阿尔卡拉斯（Carlos Alcaraz）赢得温网冠军，结束了德约科维奇（Novak Djokovic）、费德勒（Roger Federer）和纳达尔（Rafael Nadal）三巨头多年来对网坛的统治。在高尔夫领域，美国公开赛和英国公开赛冷门迭报，夺冠的是赛前预测胜率不超过1%的黑马。8月6日，在瑞典队打进制胜点球后，已经多年难求一败的美国女足惨遭世界杯淘汰。这粒进球仅越过球门线几毫米。

不过，最大的冲击发生在赛场外——沙特阿拉伯突然闯进了体育产业。该国受石油美元提振，并且在它事实上的统治者、37岁的穆罕默德·本·萨勒曼（MBS）的领导下急于重塑自身，已经在球员、球队和联赛上砸下100亿美元，颠覆了高尔夫和足球圈。这让西方球迷、活动人士和政客们感到不安，他们视之为对侵犯人权行为的“体育洗白”，抱怨这是对体育运动神圣奖杯的亵渎。

本刊不是萨勒曼的拉拉队，但这种“球迷宣泄”也经不起推敲。西方与沙特阿拉伯贸易广泛，这些体育交易不会让它糟糕的人权记录变得更糟，目前也不清楚该国能够或将会垄断并毁掉任何一项全球性体育运动。在一个动荡的世界中，许多球迷视自己支持的球队为自豪和稳定的源泉。但许多人忘记了体育也是一种正在被颠覆的产业。它需要对新资本和新想法敞开。

对体育界大举撒钱久已有之，无论出自媒体大亨还是俄罗斯寡头之手。即使按这些标准，沙特目前的动作也是巨大的。在足球运动上，它签下了本泽马等世界顶级球员，让他们到改制后的沙特国内联赛中踢球。它控股英格兰俱乐部纽卡斯尔联队，并可能申办2030年世界杯。在高尔夫运动中，一项由沙特资助的联赛正在与美国男子职业高尔夫球巡回赛（PGA Tour）合并。沙特还赞助一级方程式赛车（F1），签下了摔跤和拳击交易，此外

也在瞄准冬季运动和电子竞技。

不要把这一切想象成阿拉伯王室选购吸睛赛马的现代版。沙特的计划是由国家支持的、更加系统化的。它把体育视为石油收入再投资的一种方式，还可通过创建更大规模的服务业和提振旅游业来促进国内改革。萨勒曼是一个反复无常的铁腕领袖，但他也在施行某些自由化，包括妇女权利的自由。全球化、消费主义、体育文化的传播可能有助于沙特改变社会规范，摆脱严苛的宗教保守主义。

沙特这波投资潮也反映出流入体育界的机构资本激增。自2020年初以来，私募股权部署的现金已超过1000亿美元。美国的棒球、篮球、曲棍球和橄榄球联赛拥有带来可靠现金流的品牌（部分原因是它们是自我监管的卡特尔）。欧洲的足球队因为有可能降级而风险更高，但鉴于其球迷基数之庞大，有时价值被低估。其他主权买家也很活跃。去年主办世界杯的卡塔尔收购了法国俱乐部巴黎圣日耳曼，入股了华盛顿奇才篮球队。彭博社估计，欧洲前98家足球俱乐部中有17家目前有主权国家或机构资本的支持。

这些新投资者中有许多都将数字颠覆视为一种机遇。随着观众放弃传统电视，在美国“切断”捆绑体育节目的有线电视套餐，赛事收入岌岌可危。这对老牌媒体公司是一场噩梦：迪士尼正在寻找投资者入股ESPN这个庞大但日渐衰落的体育电视网。对于灵活的团队和品牌所有者来说，数字颠覆有望直接覆盖受众，提供更沉浸的互动式体验。

粉丝们常常担心变化会毁掉他们心爱的东西。然而，体育运动不仅仅是运动员之间的竞争，也是观众争夺战，而竞争性的娱乐形式也不会原地踏步。意甲就是一个警告，提醒人们如果改革得太慢会发生什么。它的收入在下跌，球队表现不佳且多数在亏损。欧洲足球每年的运营成本超过70亿美元（不包括球员工资），未能实现收支平衡。它可以从新鲜的资金中受益。

此外，颠覆可以带来改进，从而吸引新粉丝。英超于1991年脱离了原来的国家联赛，如今已成为世界上最成功的赛事之一。印度板球超级联赛（印

超）于2008年推出，吸引了千百万人观看这项运动。F1在奈飞的节目《疾速争胜》（Drive to Survive）和直接面向消费者的流媒体中找到了更年轻的观众群体。谁知道苹果公司投资25亿美元以流媒体直播美职联（MLS）足球赛事、卡塔尔注资在全球有2500万玩家的笼式网球（Padel）会带来什么结果？

那么，颠覆的理由已经很清楚了。但沙特还面临另外两个反对意见。首先，它是一个国家行为体，并非以利润驱动，而拥有巨大资源。体育运动需要竞争的平衡，所以如果一个老板买下了所有最好的球员，他们组成的球队理论上就可以战无不胜，那么这项运动赛事就差不多玩完了。需要警惕这种风险。然而，尽管几十年来资本疯狂涌入，却不曾有哪支球队能独霸足坛。沙特在球员身上的支出仅相当于欧洲足球年度运营成本的6%。它的“叛军”新联赛则引发了高尔夫世界的大地震。

第二个反对意见是沙特在人权方面的恶劣记录，包括谋杀记者贾迈勒·卡舒吉（Jamal Khashoggi）的事件。俄罗斯等西方的对手面临制裁，包括体育业。但沙特不在此列。2022年，美国和欧洲与沙特达成了1400亿美元的贸易，其中包括石油和武器——两者都比推球入洞更具战略敏感性。而尽管一些俱乐部所有者获得了影响力，控制体育资产似乎并没有蒙蔽西方的公众或其政府。就连为了讨好英国精英而收购切尔西的寡头罗曼·阿布拉莫维奇（Roman Abramovich）也没能逃脱制裁。正如卡塔尔在2022年世界杯期间引发有关同性恋和劳工权益的批评一样，主办赛事有时会带来更多审视。

基于国家安全、福祉或道德上的理由，全球范围内受到限制的活动清单正在不断扩大，例如半导体、社交媒体、能源和武器。把体育添加到这份清单中是一个乌龙球。■



The business of sport

Saudi Arabia's rush into global sports

Sports is a dynamic, capital-intensive business, not a museum exhibit

SPORTS FANS have seen plenty of surprises this summer. Carlos Alcaraz won Wimbledon, ending years of domination of tennis by the trio of Novak Djokovic, Roger Federer and Rafael Nadal. In golf the victors of the US Open and Britain's Open were outsiders who were given odds of winning of 1% or less. On August 6th the all-conquering US women's football team crashed out of the World Cup after Sweden scored a winning penalty. The ball crossed the goal line by only a few millimetres.

Yet the biggest shock has been off the field, as Saudi Arabia has barged into the sports industry. Pumped up on petrodollars and desperate to reinvent itself under Muhammad bin Salman (MBS), its 37-year-old de facto ruler, it has spent \$10bn on players, teams and leagues, upending golf and football. That has upset Western fans, activists and politicians, who see it as “sportswashing” human-rights abuses, and complain about the desecration of the hallowed trophies of sport.

The Economist is no cheerleader for MBS, but this sports-venting does not bear scrutiny. The West trades widely with Saudi Arabia, the deals will not make its bad human-rights record worse, and it is not clear that the country could or would monopolise and destroy any global sport. In a turbulent world many fans see their teams as a source of pride and stability. But many forget that sport is also a business that is being disrupted. It needs to be open to new capital and fresh ideas.

Sport has long seen investment splurges, whether by media tycoons or Russian oligarchs. Even by those standards the Saudi effort is big. In football

it is paying for some of the world's top players, including Karim Benzema, to play in a revamped domestic league. It controls Newcastle United, an English club, and may bid for the World Cup in 2030. In golf a Saudi-bankrolled tournament is merging with the PGA Tour, America's men's circuit. The kingdom sponsors Formula 1, has deals in wrestling and boxing and is eyeing winter sports and e-sports.

Do not imagine that this is a modern version of Arab royals buying racehorses that catch their eye. Saudi Arabia's plan is state-backed and more systematic than that. The kingdom views sport as a way to reinvest oil revenues and catalyse reform at home by creating a bigger services industry and boosting tourism. MBS is a volatile strongman, but he is also overseeing some liberalisation, including of women's rights. The spread of a globalised, consumerist, sporting culture may help Saudi Arabia shift social norms away from austere religious conservatism.

The Saudi spree mirrors a surge in institutional capital flows into sport. Since early 2020 over \$100bn of private-equity cash has been deployed. America's baseball, basketball, hockey and football leagues contain brands with reliable cashflows (partly because these are self-regulating cartels). Europe's soccer teams, which may be relegated, are riskier but sometimes undervalued given their big fan bases. Other sovereign buyers are active. Qatar, which hosted last year's World Cup, has Paris St Germain, a French club, and a stake in the Washington Wizards, a basketball team. Bloomberg reckons 17 of Europe's top 98 soccer clubs are now backed by sovereigns or institutional capital.

Many of these new investors see digital disruption as an opportunity. Revenues are in jeopardy, as viewers abandon traditional television, and in America "cut the cord" on cable packages that bundle sports. For old media firms this is a nightmare: Disney is looking for an investor to take a stake in ESPN, its huge, declining sports network. For nimble owners of teams and

brands, digital disruption holds the promise of reaching audiences directly, with a more immersive, interactive experience.

Fans often fear change will ruin something that they love. However, sport is not just a competition between players, but also for an audience—and rival forms of entertainment do not stand still. Italy's Serie A football league is a warning of what happens if reform is too slow. Its revenues are falling, its teams are underperforming and they are mostly lossmaking. European football costs over \$7bn a year to run, excluding players' wages, and does not break even. It can benefit from fresh money.

Besides, disruption can lead to improvements that bring in new fans. England's Premier League broke off from the rest of the game in 1991 and is now one of the world's most successful tournaments. India's Premier League, launched in 2008, drew millions to Indian cricket. Formula 1 has found a younger audience in the Netflix show, "Drive to Survive" and direct-to-consumer streaming. Who knows what will come from Apple's \$2.5bn investment in streaming MLS, America's soccer league; or Qatar's backing of Padel, a rival to tennis, with 25m players.

The case for disruption, then, is clear. However, Saudi Arabia faces two other objections. The first is that it is a state actor that is not motivated by profits and has vast resources. Sport requires a competitive balance, so if an owner buys all the best players their team can in theory win all the time and the game suffers. This risk needs to be watched. However, despite decades of crazy money, no team has managed to dominate football. Saudi Arabia's spending on players is worth only 6% of European football's annual operating costs. Its rebel league shook-up golf.

The second objection is Saudi Arabia's rotten record on human rights, including the murder of Jamal Khashoggi, a journalist. Foes of the West like Russia face sanctions, which include sport. Yet the kingdom is not in

this category. America and Europe did \$140bn of trade with Saudi Arabia in 2022, including in oil and weapons—both more strategically sensitive than putting. And although some club owners gain influence, controlling sports assets does not seem to blind the Western public or their governments. Even Roman Abramovich, an oligarch who bought Chelsea to court Britain's elite, has not escaped sanctions. As Qatar found with gay and labour rights in the 2022 World Cup, sponsorship can sometimes bring more scrutiny.

An ever-expanding list of activities are restricted around the world on grounds of national security, well-being or morality: think of semiconductors, social media, and energy and arms. Adding sport to the list is an own goal. ■



满电冲刺

中国是如何成为汽车出口大国的

这要部分归功于它在电动汽车领域的主导地位

汽车爱好者往往分为两个阵营：一个膜拜德国汽车工程的性能和速度；一个认为日本汽车更优秀，欣赏其可靠性和性价比。

几十年来，这两个国家一直在争夺世界最大汽车出口国的领跑位置。但它们的统治地位即将终结。中国本已是世界最大的汽车制造国，以目前的势头看，它在出口上也将赶超竞争对手。

仅仅几年前，中国汽车制造商驶进海外市场的速度还停滞不前。2015年，中国每年出口汽车不到37.5万辆，少于印度，大致相当于德国和日本一个月的出口量。但到了2020年前后，中国换挡提速。2021年，中国出口了近160万辆汽车。到2022年达到270万辆。2023年的国际销量势必进一步增长。海关数据显示，今年前6个月中国已出口了近200万辆汽车，也就是每天超过1万辆。

中国新兴的汽车工业过去主要向贫穷国家出口，但现在许多西方消费者也开始购买中国制造的汽车。2023年上半年中国对澳大利亚的出口量同比增长了两倍，超过10万辆；对西班牙的销量增长了16倍，达到近7万辆。不过其中许多汽车都是西方品牌。2022年出口的汽车中大约有十分之一来自美国电动汽车品牌特斯拉。原本是英国品牌的名爵和瑞典车商沃尔沃现在都归中国公司所有。它们的车型也在中国出口海外的汽车中占了很大一部分。

中国擅长制造电动汽车是出口激增的原因之一。尽管中国制造实力强大，但从未掌握内燃机技术，因为内燃机有数以百计的活动部件，组装复杂。电池动力汽车的机械构造更简单、更容易制造，其兴起帮助中国迎头赶上。2009年至2019年间，政府对电动汽车技术的投资估计达6760亿元，让中国占得首发车位。如今，电池动力汽车在中国的汽车销量和出口量中分

别占五分之一和三分之一。在日本和德国，电动汽车分别仅占汽车出口的4%和20%。

战争也加速了中国对俄罗斯的出口。2022年2月俄罗斯入侵乌克兰后，大多数西方汽车制造商停止了在该国的业务。它们的退出让中国竞争对手抢占了市场份额。2023年上半年，俄罗斯进口了近30万辆中国汽车，价值45亿美元，比2022年增长了五倍。根据分析公司Autostat的数据，7月，中国汽车占俄罗斯汽车进口的近80%。

中国出口的强劲势头似乎不太可能在短期内放缓。咨询公司AlixPartners估计，到2030年，中国品牌汽车的海外销量可能将达到900万辆，是2022年日本出口量的两倍。尽管这些本土品牌在西方仍然相对不为人知，但在巴西等新兴市场很受欢迎。这些汽车往往价格便宜，中国制造的汽车成本平均约为德国制造的40%。

不过前方仍有减速路障。中国的电动汽车制造商可能赢得了高销量，但没几家在赚钱。整个行业靠政府补贴支撑，在销售增长放缓后，政府最近又出台了新的补贴政策。但政府可能不会永远补贴下去。

图表来源：联合国商品贸易统计数据库；政府统计数据 ■



Charging ahead

How China became a car-exporting juggernaut

Its dominance in electric vehicles is partly to thank

CAR ENTHUSIASTS tend to fall into one of two camps: those who fawn over the power and speed of German automotive engineering; and those who think Japanese cars are superior, admiring their reliability and value for money.

For decades the two countries have jostled for position as the world's leading car exporter. But the pair's dominance is coming to an end. Already the world's largest car manufacturer, China is on track to overtake its rivals in exports, too.

Until just a few years ago, attempts by Chinese carmakers to expand into foreign markets had stalled. In 2015 China exported under 375,000 cars a year, fewer than India, and about as many as Germany and Japan shipped in a single month. But in around 2020, the country changed gears. In 2021 China exported nearly 1.6m cars. By 2022 it hit 2.7m. International sales are set to rev up further in 2023. Customs data show that the country shipped nearly 2m cars in the first six months of the year, or more than 10,000 a day.

China's nascent auto industry mainly exported to poor countries, but now many Western consumers are buying Chinese-made cars for the first time. Exports to Australia tripled year on year in the first half of 2023, to more than 100,000 cars; sales to Spain rose 17-fold to nearly 70,000 vehicles. But many of these cars are Western-branded. Roughly a tenth of vehicles exported in 2022 came from Tesla, an American electric-car brand. MG, which started as a British marque, and Volvo, a Swedish carmaker, are now owned by Chinese companies. Their models also make up a large chunk of the cars

sent overseas.

The country's expertise in electric vehicles (EVs) is partly responsible for the surge in exports. For all its manufacturing might, China never mastered internal-combustion engines, which have hundreds of moving parts and are tricky to assemble. The arrival of battery-powered vehicles, which are mechanically simpler and easier to build, helped China catch up. State investment in the EV technology, an estimated 676bn yuan (\$100bn) between 2009 and 2019, put the country in pole position. Today battery-powered vehicles account for a fifth of car sales in China and a third of exports. In Japan and Germany only 4% and 20% of exports, respectively, are electric.

War has also turbocharged Chinese exports to Russia. After the invasion of Ukraine in February 2022 most Western carmakers ceased their Russian operations. Their exit allowed their Chinese rivals to capture market share. In the first half of 2023 Russia imported nearly 300,000 Chinese cars worth \$4.5bn, a six-fold increase on 2022. In July Chinese cars accounted for nearly 80% of imports, according to Autostat, an analytics firm.

China's export juggernaut looks unlikely to slow soon. AlixPartners, a consultancy, estimates that foreign sales of Chinese-branded cars could reach 9m vehicles by 2030, double Japan's exports in 2022. Although these homegrown brands are still relatively unknown in the West, the cars, which tend to be cheap—on average Chinese-made vehicles cost roughly 40% as much as German-made ones—are popular in emerging markets such as Brazil.

There are still speed bumps ahead. Chinese EV-makers may be chalking up big sales, yet few are making money. The industry is propped up by state subsidies, recently renewed after slowing sales growth. But subsidies may not last forever. ■

Chart sources: UN Comtrade; government statistics ■



自由交流

马斯克的计划可能会妨碍推特经济学

这个现在更名为X的网站对研究人员极为有用

伊隆·马斯克一点都不喜欢美联储。过去一年里，因为加息，这位X（不久前还叫做推特）的所有者至少对美联储发起了十几次猛烈抨击。例如，去年12月，他在推特上表示，美联储这轮快速加息可能被后人铭记为“史上最具破坏性的”一次。但美联储在对待X时可没有复刻马斯克对它的蔑视态度。相反，美联储的研究人员相当喜欢这个网站，将其视为令人信服的经济晴雨表。

这让X处在一个奇特的位置。它作为一门生意的价值仍然存疑，因此马斯克一直在忙着改造它，改造内容包括（但不限于）公司名称。但X对经济的价值却完全是另一回事。该公司可以充当一个能及时反应基本趋势和市场情绪的指标。

关于如何解读来自Facebook和Reddit等社交媒体网站的经济信号，研究文献有很多，而且还在增加。然而，即使网络信息和评论浩如烟海，马斯克的平台仍然鹤立鸡群。其他网站根本无法在体量和频率上与之匹敌。推特用户在2013年时的每秒发帖量已超过5700个。而用户群规模更大的Instagram在2016年时每秒发帖量只有1000个。美联储最近发表的三篇论文探讨了推特的经济贡献。

首先，它能够预测市场。从推文中搜集到的情绪在预示股价和债券收益率的短期走势时似乎效果都很好。在一篇论文中，弗朗西斯科·巴斯克斯-格兰德（Francisco Vazquez-Grande）等经济学家筛选了2007年至2023年4月期间发布的440万条与金融相关的推文，创建了“推特金融情绪指数”（Twitter Financial Sentiment Index）。他们用机器学习模型来衡量每条推文的情绪，比如谈论股票大涨的消息应该算是积极情绪，而马斯克对美联储的讥讽想来会被算作负面情绪。

他们发现，该指数与公司债券利差（公司债券和政府债券收益率之间的差异，通常随着投资者变得悲观而扩大）密切相关。推文不仅可以追踪金融动态，甚至还可以对它们做出预示。股市开盘前的隔夜指数会与第二天的股票回报率相吻合。克拉拉·维嘉（Clara Vega）及同事的另一篇论文发现，推特上的推文情绪也与美国国债收益率密切相关。事实上，比起从美联储自己的官方公告中搜集的情绪指标，推文的相关性还更强些。

其次，推特可以衡量经济状况。特别是有关失业的推文似乎提供了有关劳动力市场的及时信息。托马兹·盖纳（Tomaz Cajner）与共同作者构建了另一个机器学习模型，来分析带有“失业”或“解雇通知书”等关键词的推文。他们据此衡量出的失业情况与2015年至2023年的官方就业数据相吻合。这种相关性可能用处很大，因为大多数政府统计数据都有滞后性，而推文却立即可得。例如，通过推特来预测应该能比官方早十天发现2020年疫情最严重时就业市场开始崩溃。

美联储的论文还发现了推文的第三个作用——充当货币政策的某种风向标。维嘉和同事发现，在公布货币政策决定的当天，用推特来预测决定相比用债券收益率的波动更为准确。另外，推特情绪指数很适合预测加息等紧缩政策带来的冲击。在这些举措公布的前夕，推文往往会变得消极。

（对于老用户来说，推特上风向突转已经见怪不怪。）

没有人会认为X本身在兴风作浪。推文反映的实则是已经在金融市场中广泛蔓延的感受。尽管如此，大量的推文确实提供了另一种衡量这种情绪的方法。如果假以时日这种方法被证明有效，它将非常有价值。

除美联储之外，一些分析师还发现了推文的其他潜在应用。据卡内基梅隆大学卡塔尔分校的奥古斯丁·因达科（Agustín Indaco）计算得出，仅推文数量就可以解释约四分之三的GDP跨国差异。因此，推文与夜间灯光卫星图类似，可能是观察经济健康状况的另一种方式，让人无需过分依赖姗姗来迟的官方统计数据。这一指标用在较贫穷的国家可能效果最好，因为社交媒体上的大量发帖可以反映电信水平和智能手机使用状况。

如果X在经济上这么有用，为什么它没能赚到更多钱呢？那些论文并没有试图探讨推特为何难以盈利，尽管它的功用显而易见——它不仅是一种经济工具，也是一个分享信息、观点、笑话等内容的平台。马斯克说它是“共有的数字城市广场”，也算是说到点子上了。从经济角度来看，问题在于城市广场与公园和清洁水一样属于公共品的范畴。尽管公共品可以由私人所有，但众所周知，要从中获取利润非常困难，因为其特性就决定了很难让人们为它们提供的种种好处付费。

马斯克正在竭尽全力改善X的财务表现，为每月支付8美元获得蓝V认证的用户提供额外特权。现在，付费用户的多种福利之一是他们发布的推文可获得额外推广，可以更频繁地出现在其他推特用户的信息流中。然而，这样做有得有失。付费用户的推文可能会一步步淹没那些不愿订阅的用户发布的更可靠、更明智的推文。随着时间的推移，一个更看重付费而非可信度的网站将折损其作为城市广场的功能，进而也会影响作为经济指标的作用。X的财务收益可能会是美联储经济学家的损失。■



Free exchange

Elon Musk's plans could hinder Twitternomics

The site now known as X is extremely helpful to researchers

ELON MUSK is no fan of the Federal Reserve. At least a dozen times over the past year the owner of X (a firm until recently known as Twitter) has savaged America's central bank for raising interest rates. Last December, for instance, he tweeted that its hikes might go down as the "most damaging ever". But Mr Musk's disdain for the Fed is not mirrored by the Fed's attitude towards X. On the contrary, the central bank's researchers rather like the website, treating it as a compelling barometer of the economy.

This puts X in a peculiar position. Its value as a business remains dubious, which is why Mr Musk has been scrambling to remake it, with changes including (but not limited to) the company's name. But its value to the economy is a different story altogether. The firm can serve as a timely indicator of both fundamental trends and market sentiment.

There is a large, growing literature on how to decode economic signals from social-media sites, ranging from Facebook to Reddit. Yet even in the sea of online information and commentary, Mr Musk's stands out. Others simply cannot match its volume and frequency. By 2013 Twitter users were already producing more than 5,700 posts in a second. By 2016 Instagram's larger user base was producing only 1,000. Three papers recently published by the Fed explore the platform's economic contributions.

The first is as a predictor of markets. Sentiment gleaned from tweets seems to be rather good at presaging short-term movements in both share prices and bond yields. In one paper a group of economists including Francisco Vazquez-Grande sifted 4.4m finance-related tweets posted between 2007

and April 2023 to create a Twitter Financial Sentiment Index. They used a machine-learning model to measure each tweet's sentiments: a message about stocks going to the Moon would be positive; Mr Musk's quips about the Fed would presumably count as negative.

The index, they find, correlates tightly with corporate-bond spreads (the difference between yields on corporate and government bonds, which usually widens as investors turn pessimistic). More than merely shadowing financial movements, posts can even foreshadow them. The overnight index before the stockmarket's open dovetails with the coming day's equity returns. A separate paper by Clara Vega and colleagues finds that the website's sentiment also closely tracks Treasury yields. Indeed, the correlation is stronger with tweets than with sentiment measures gleaned from the Fed's own official communications.

A second use of tweets is as a gauge of economic conditions. Posts about job losses in particular seem to offer timely information about the labour market. Tomaz Cajner and co-authors construct a separate machine-learning model to digest posts with keywords such as "lost job" or "pink slip". Their measure of job losses mirrors official data on employment levels from 2015 to 2023. This correlation is potentially powerful because most government statistics appear with a lag, whereas the tweets are available immediately. Twitter, for example, would have provided a ten-day advantage in detecting the collapse in employment at the height of the covid-19 pandemic in 2020.

The Fed papers also see a third use for tweets: as a bellwether of sorts for monetary policy. Ms Vega and colleagues find that the social-media site fares better than changes in bond yields in predicting monetary-policy decisions on the day of their announcement. The Twitter sentiment index, meanwhile, is good at anticipating shocks from tighter policy such as rate increases. Tweets tend to turn sour just ahead of these moves. (That the

website wastes no time in turning bitter will come as little surprise to regular users.)

No one is about to ascribe powers of causation to X. The social-media posts instead reflect broader feelings that are already coursing through financial markets. Still, the cornucopia of tweets does provide an additional way of measuring such sentiment, which, if proved valid over time, would be highly valuable.

Beyond the Fed, some analysts are also finding other potential applications. Agustín Indaco of Carnegie Mellon University in Qatar calculates that the volume of tweeting alone can account for about three-quarters of cross-country variation in GDP. Rather like satellite images of night lights, tweets may therefore be a way of observing economic health without relying so heavily on tardy official statistics. This metric may work best in poorer countries, where heavy posting on social media would be a proxy for the state of telecommunications and use of smartphones.

If X is so economically useful, why is it not more lucrative? The various papers do not venture so far as to examine the gulf between Twitter's struggle for profitability and its evident utility—not just as an economic tool but as a platform for sharing information, opinions, jokes and more. Mr Musk was onto something when he described the firm as a “common digital town square”. The problem in economic terms is that a town square falls into the category of public goods such as parks and clean water. Although public goods can be privately owned, it is notoriously hard to extract profits from them given that, by definition, it is difficult to charge people for all the benefits they confer.

Mr Musk is doing his darnedest to shift the economic equation at X by giving additional privileges to users who pay \$8 a month for the site's blue-check verification. Tweets by users who cough up now receive extra

promotion, among other benefits, showing up more often in the feeds of other people on the website. That, however, sets up a trade-off. Paid-for tweets may start crowding out better-informed posts from users who would rather not subscribe to the website. Over time, a website that prioritises payment over credibility will function less well as a town square and, by extension, as an economic indicator. The gain to X's finances would be a loss to the Fed's economists. ■



任芯片高飞

美国芯片制造业复兴的真相如何？

《芯片法案》一周年，半导体公司五味杂陈

美国芯片制造商占据全球半导体销售的三分之一。它们设计了世界上最复杂的微处理器，驱动着智能手机、数据中心以及越来越多的人工智能（AI）模型。然而，无论是美国的芯片制造商还是它们的亚洲代工厂，都没有在美国本土生产任何一片这样的尖端芯片。鉴于芯片在现代经济中的核心地位——以及在AI时代对战争的重要作用，华盛顿的政策制定者对这种情况感到担忧。为此他们制定了《芯片法案》（CHIPS Act），试图通过提供500亿美元的一揽子补贴、税收减免和其他优惠措施，把先进芯片制造带回美国。该法案在去年8月9日由总统拜登签署成为法律。

表面上看，该法案似乎产生了效果。自2020年该法案首次提出以来，芯片制造商宣布在美国的投资已超过2000亿美元。如果一切按计划进行，到2025年，全球18%的尖端芯片（见图表1）将出自美国本土的芯片工厂（行话叫晶圆厂）。代工巨头台积电正斥资400亿美元在亚利桑那州兴建两家晶圆厂。韩国三星将在得克萨斯州投资170亿美元。美国的芯片制造领军者英特尔将斥资400亿美元，在亚利桑那州和俄亥俄州兴建四座晶圆厂。在《芯片法案》迎来诞生一周年、同时也是拜登政府准备开始发放补贴之际，如今已鲜有共识的民主党人和共和党人认为这是两党的共同胜利。

然而，任何必胜的论调恐怕都喊得过早。相比亚洲的晶圆厂，美国的尖端晶圆厂不仅建设速度慢、运营成本高，规模也相对较小。让情况更复杂的是，正当芯片制造商在美国大举投资之际，市场对芯片的需求似乎正在降温，至少短期内是这样。这可能会影响芯片行业的长期盈利能力。

智库安全与新兴技术中心（Centre for Security and Emerging Technology）估计，在中国大陆和台湾，建设一座新工厂大概要650天。而在美国，制造商必须设法应付一大堆错综复杂的联邦、州和地方政府的法规，这把平

均建设期拉长到900天。建设成本通常约占一座新晶圆厂资本支出的一半，而这部分成本在美国有可能比在亚洲高出40%。

一部分增加的成本可以用《芯片法案》的补贴来支付。但是还有年营运开支这一块，在美国也比在亚洲高出30%，部分原因是美国的用工成本更高。而且前提是能招到人。7月，因为招不到足够的具有半导体行业经验的员工，台积电将其在亚利桑那州的第一家晶圆厂的投产时间延后到2025年，比原计划推迟了一年。

计划在美国建造的晶圆厂规模相对较小，这进一步影响了经济效益。晶圆厂生产的芯片越多，单位成本就越低。在亚利桑那州，台积电计划每月生产五万片晶圆，相当于该公司所说的两座“大型”晶圆厂的产量。而在台湾本土，台积电经营着四座“超大型”晶圆厂，每座每月至少生产十万片晶圆（此外还有许多“大型”晶圆厂）。台积电创始人张忠谋提醒称在美国制造的芯片会更贵。

台积电现任CEO魏哲家暗示，台积电会消化这些增加的成本。他之所以能承受得起这么做，是因为台积电将继续把大部分的芯片生产放在成本更低的台湾，而不是美国。三星也是如此，它将把近90%的资本预算花在韩国国内。就连英特尔对晶圆厂的投资也是国内国外一样多（见图表2）。结果就是，即使所有的投资计划都得以实现，美国生产的尖端芯片也只能满足其国内三分之一的需求。苹果将继续从台湾为iPhone采购高端处理器。美国新兴的AI产业综合体十有八九也会如此。

新法案也可能产生意想不到的后果。美国禁止接受其补助的芯片公司在中国扩大晶圆厂产能。此举可能导致像台积电和三星这样拥有大量中国客户的公司不愿加大对美国晶圆厂的投资。它还在促使中国芯片制造商投资生产不那么高端的半导体。这些制造商希望，把很多老一代芯片加在一起，至少可以部分完成那些用少量高端芯片就能做到的事情。

根据行业组织国际半导体产业协会（SEMI）的数据，2019年，中国制造了全球五分之一的“后缘”芯片，这些芯片应用于从洗衣机到汽车和飞机的

各种产品。到2025年，中国后缘芯片的产量将超过全世界的三分之一。⁷ 7月，荷兰后缘芯片制造商恩智浦半导体（NXP Semiconductor）警告称，中国公司的供应过剩正给价格带来下行压力。从长远来看，这可能会伤害到高成本的西方生产商，甚至会让其中一些关门大吉。7月，美国商务部长吉娜·雷蒙多（Gina Raimondo）承认，中国对后缘芯片的专注“是我们需要考虑的问题”。

最难预测的是《芯片法案》对半导体行业众所周知的盛衰周期的影响。通常情况下，芯片制造商会提高产能。而目前的情况正好相反。新冠疫情期间的芯片短缺已经成为过去，取而代之的是供过于求，因为消费者对万物数字化的无尽需求似乎终究还是得到了满足。台积电第二季度的销售额同比下降了10%，它目前预计2023年全年销售额也会有类似幅度的下降。英特尔第二季度的收入下降了15%。三星将收入和利润下降归咎于芯片供过于求。

芯片公司的高管们指出，芯片行业前景依然乐观。他们认为需求势必会在某个时候复苏，这可能是对的。然而，目前“库存调整”（大白话就是减少供应过剩）花费的时间比预期的要长。而等库存最终调整过来，恢复过来的行业可能也没那么赚钱了。自2021年初以来，英特尔、三星和台积电的总市值已经损失了三分之一，接近5000亿美元。或许还需要再等上几个周年，才能正确评估《芯片法案》对美国经济安全的影响，但投资者已经在做出他们的判断了。 ■



Let the chips rise where they may

How real is America's chipmaking renaissance?

As the CHIPS Act turns one, semiconductor firms have mixed feelings

AMERICAN CHIPMAKERS account for a third of global semiconductor sales. They design the world's most sophisticated microprocessors, which power smartphones, data centres and, increasingly, artificial-intelligence (AI) models. But neither the American firms nor their Asian contract manufacturers make any such leading-edge chips in America. Given chips' centrality to modern economies—and, in the age of AI, to war-fighting—that worries policymakers in Washington. Their answer was the CHIPS Act, a \$50bn package of subsidies, tax credits and other sweeteners to bring advanced chipmaking back to America, which President Joe Biden signed into law on August 9th 2022.

On the surface, the law appears to be having an impact. Since 2020, when it was first floated, chipmakers have announced more than \$200bn-worth of investments in America. If all goes to plan, by 2025 American chip factories (fabs, in the lingo) will be churning out 18% of the world's leading-edge chips (see chart 1). TSMC, a Taiwanese manufacturing behemoth, is splurging \$40bn on two fabs in Arizona. Samsung of South Korea is investing \$17bn in Texas. Intel, America's chipmaking champion, will spend \$40bn on four fabs in Arizona and Ohio. As the CHIPS Act celebrates its first birthday, and as the administration prepares to start doling out the money, both Democrats and Republicans, who agree on little else these days, regard it as a bipartisan triumph.

Any triumphalism may, however, be premature. Leading-edge fabs being built in America are slower to erect, costlier to run and smaller than those in Asia. Complicating matters further, the chipmakers' American investment

binge comes at a time when demand for their wares appears to be cooling, at least in the short term. That could have consequences for the industry's long-term profitability.

The Centre for Security and Emerging Technology, a think-tank, estimates that in China and Taiwan companies put up a new plant in about 650 days. In America, manufacturers must navigate a thicket of federal, state and local-government regulations, stretching average construction time to 900 days. Construction, which makes up around half of the capital spending on a new fab, can cost 40% more in America than it does in Asia.

Some of that extra cost can be defrayed by the CHIPS Act's handouts. However, that still leaves annual operating expenses, which are 30% higher in America than in Asia, in part owing to higher wages for American workers. If those workers can be found at all: in July TSMC delayed the launch of its first fab in Arizona by a year, to 2025, because it could not find enough staff with semiconductor industry experience.

The planned American projects' smallish size further undermines the economics. The more chips a fab makes, the lower the unit cost. In Arizona, TSMC plans to make 50,000 wafers a month—equivalent to two “mega-fabs”, as the company calls them. Back home in Taiwan, TSMC operates four “giga-fabs”, each producing at least 100,000 wafers a month (in addition to numerous mega-fabs). Morris Chang, TSMC's founder, has warned that chips made in America will be more expensive.

C.C. Wei, the current chief executive of TSMC, has hinted that the company will absorb these higher costs. He can afford to do this because TSMC will continue to make the lion's share of its chips more cheaply at home, not in America. The same is true of Samsung, which will spend nearly 90% of its capital budget in South Korea. Even Intel is investing as much in foreign fabs as in American ones (see chart 2). As a result, if all the planned

investments materialise, America will produce enough cutting-edge chips to meet only about a third of domestic demand. Apple will keep sourcing high-end processors for its iPhones from Taiwan. So, in all likelihood, will America's nascent AI-industrial complex.

The law may have unintended consequences, too. Chip firms that accept state aid are barred from expanding fab capacity in China. This may put firms like TSMC and Samsung, which have plenty of Chinese customers, off investing more in American fabs. It is also leading Chinese chipmakers to invest in producing less fancy semiconductors. The hope is that lots of older-generation chips can do at least some of what fewer fancier ones are capable of.

According to SEMI, an industry group, in 2019 China made a fifth of "trailing-edge" chips, which go into everything from washing machines to cars and aircraft. By 2025 it will produce more than a third. In July NXP Semiconductor, a Dutch maker of trailing-edge chips, warned that excess supply from China is putting downward pressure on prices. In the long run, this could hurt high-cost Western producers—or even drive some of them out of business. In July Gina Raimondo, America's commerce secretary, acknowledged that China's focus on the trailing edge "is a problem that we need to be thinking about".

Hardest to predict is the CHIPS Act's effect on the semiconductor industry's notorious boom-and-bust cycle. Usually chipmakers would be boosting capacity at a time of rising demand. Right now the opposite is true. Pandemic-era chip shortages have been replaced by a glut, now that consumers' insatiable appetite for all things digital seems, after all, to be sated. TSMC's sales declined by 10% in the second quarter, year on year, and the firm now expects a similar drop for the whole of 2023. Intel's revenue was down by 15% in the same period. Samsung blamed a chips glut for its falling revenues and profits.

Chip executives point out that prospects for their industry remain rosy. They are probably right that demand is bound to revive at some point. Yet “inventory adjustments” (reducing oversupply, in plain English) are taking longer than expected. And when inventories finally adjust, the business that emerges may be less lucrative. Since early 2021 Intel, Samsung and TSMC have lost a third of their combined market value, or nearly half a trillion dollars. A few more anniversaries may be needed before the CHIPS Act’s impact on American economic security can be properly evaluated. Investors are already making up their minds. ■



巴托比

权力的黑暗面与光明面

老板们不可忽视权力的影响

权力是企业生活中的现实存在。它也影响行为。研究表明，权力让人更不容易接受他人的建议，即使对方是自己行业里的专家。权力让人更可能去满足自己的生理需求。在伦敦大学学院的安娜·吉诺特（Ana Guinote）进行的测试中，有权有势者相比更弱小者更可能选择巧克力等诱人的食物，而对小萝卜等更有营养的零食不屑一顾。在交谈中，位居高位的人往往自我陶醉：他们认为自己的故事比对话者的更加鼓舞人心。

他们更不容易从别人的视角看问题。在一个著名的实验中，研究人员要求一组人回忆自己位居人上的时刻，而要求另一组人回忆自己屈居人下之时，然后让两组人都在自己额头上画一个大写的“E”。在那些被提示自己拥有权力的受试者当中，从自己的目视角度来画“E”的比率是另一组的三倍，这样的“E”在其他人看来是写反了的。

权力甚至会让人觉得自己个子更高。在另一项实验中，被诱导而自觉强有力的人相比不那么有权的人更可能高估自己（相对于一根杆子）的身高，也更容易在游戏中为自己选择一个高个子化身。

这里的因果关系很难厘清：那些掠走小吃盘里的巧克力而留下小萝卜的支配型人格可能本就更有机会晋升。但是，拥有权力本身似乎也在悄悄强化权力，让人更容易为所欲为、自私自利。

权力也会影响那些地位较低的人。在2016年发表的一项研究中，加州大学圣地亚哥分校的克里斯托弗·奥维斯（Christopher Oveis）与合著者研究了地位对笑声的影响。研究人员记录了美国一所大学的兄弟会成员（有新人也有老人）之间相互逗趣的情形。地位高的成员相比地位低的笑得更大声更肆意——他们是大主教，可不是兄弟。

权力与这个时代格格不入。高绩效的团队有赖协作和坦诚，而不是畏缩和顺从。谦逊越来越被推崇为高管的一项品质。在招聘过程中，一些面试官会观察一个人用的是“我”还是“我们”，从这一细微之处来判断他们以自我为中心的程度。

也有整个的行业因努力抵消权力影响的做法而为人称道。航空业以一种名为“机组资源管理”的培训技巧受到赞扬，这种培训鼓励在驾驶舱中的互动无需那么层级分明。从军队到医院，在其他指挥链特别明确的工作场所也可以看到类似的思路。

但权力仍会惹来批评。等级会自然而然地浮现，且有充足的理由：如果每个人都有话事权，往往什么事也办不成。埃默里大学的奥兹坎·考克（Ozgecan Kocak）及其同事今年发表的一项研究发现，与首领明确的组织相比，扁平化的组织更有可能花太多时间探索各种选择。实际上老板是不是很懂行并不特别要紧；只要有人行使权威就意味着团队可以更快地就一项决策凝聚力量。

权力除了可用于牟取私利，也能用来实现高尚目标：如果无法付诸实践，有绝妙的想法是毫无用处的。斯坦福商学院最受欢迎的课程之一“通往权力之路”（Paths to Power）具有少见的实用性。魅力十足的教授杰弗里·普费弗（Jeffrey Pfeffer）宣扬打破规则、表现愤怒、“策略性虚报”（也就是撒谎）以及许多其他反主流文化的特质在奋力攀登权力顶峰道路上的价值。

你不必信奉这一套也能认可权力的重要性。公司喜欢谦逊和团队协作的理念，但它们本身也是封建式的构造，依赖野心、急切以及大量不断的盲目自信。最优秀的管理者非常清楚自己的权力如何在整个组织中产生影响。他们会注意在会议中不急于表明自己的观点；不知道答案时，他们会承认自己不知道。但他们也知道何时该停止与人商量，而开始发号施令。在一定限度内，说“我不知道”释放出一种并非以我为尊的包容的信号；超过了这个限度，那就只会传达出自己不知道了。 ■



Bartleby

The dark and bright sides of power

Bosses cannot afford to be oblivious to the effects of authority

POWER IS A fact of corporate life. It also affects behaviour. Research suggests power makes people less likely to take the advice of others, even if those others are experts in their fields. It makes them more likely to gratify their physical needs. In a test conducted by Ana Guinote of University College London, powerful people were likelier than less powerful folk to choose tempting food, like chocolate, and ignore worthier snacks like radishes. In conversations, the powerful are bewitched by themselves: they rate their own stories as more inspiring than interlocutors'.

They struggle to see things from the perspective of others. In one famous experiment, some people were asked to recall a time they held power over someone else and others a time when another person was in a more powerful position than them; both groups were then asked to draw a capital “E” on their own foreheads. Subjects primed to think of themselves as powerful were three times more likely to draw the “E” as though they were looking at it themselves, making it appear backwards to anyone else.

Power even makes people think they are taller. In another experiment, those coaxed to think of themselves as powerful were more likely to overestimate their own height relative to a pole, and to pick a loftier avatar to represent them in a game, than less potent counterparts.

Cause and effect are hard to unravel here: the dominant types who snaffle the chocolate and leave the radishes may also be more likely to climb the ladder. But possessing power seems itself to put a thumb on the scales, towards more entitled and self-serving behaviour.

Power also affects those lower down the pecking order. In a study published in 2016, Christopher Oveis of the University of California, San Diego, and his co-authors looked at how status affects laughter. The researchers recorded members of a fraternity house in an American university, some new joiners and some old hands, teasing each other. Higher-status participants laughed more loudly and with less inhibition than lower-status ones—primates, not mates.

Power is out of sync with the times. High-performing teams depend on collaboration and candour, not cringing and compliance. Humility is increasingly prized as an attribute of senior executives. In hiring processes some interviewers will look for use of the word “I” rather than “we” as a small marker of how egocentric people really are.

Entire industries are feted for the way they try to counteract the effects of power. The aviation industry is celebrated for a training technique called “crew resource management” that is designed to encourage a less hierarchical set of interactions in the cockpit. Similar kinds of thinking are visible in other workplaces that have especially clear chains of command, from the army to hospitals.

Still, power can also get a bad press. Hierarchies emerge organically, and with good reason: precious little gets done when everyone is in charge. Research published this year by Ozgecan Kocak of Emory University and her colleagues found that flatter organisations are likelier to spend too much time exploring options than ones where someone is clearly in charge. It doesn’t particularly matter if the boss knows what they are talking about; the mere fact that authority is being wielded means a team converges more quickly on a decision.

Power is an instrument for achieving noble ends as well as selfish ones: it is no use having brilliant ideas without the means to put them into practice.

One of the most popular classes at Stanford Graduate School of Business is a refreshingly functional one called “Paths to Power”. It is taught by Jeffrey Pfeffer, a charming man who preaches the value of rule-breaking, displays of anger, “strategic misrepresentation” (ie, lying) and many other countercultural qualities in order to get to the top.

You don't have to believe that to appreciate the importance of power. Companies like the idea of humility and teamwork but they are also feudal structures that depend on ambition, impatience and gallons of unwarranted self-confidence. The best managers are well aware of how their own power sends ripples across the organisation. They take care not to signal their opinions too early in meetings; they admit when they don't know the answer to something. But they also know when to stop consulting and start commanding. Up to a certain point, saying “I don't know” sends a signal of low-ego inclusivity; beyond it, it is just a signal of not knowing. ■



【首文】代价高，危险大

拜登的中国策略不管用

供应链正变得更加缠结和不透明

八月九日，美国总统拜登亮出了美国对华经济战的最新一件武器。新法规将监管私营部门的对外投资，禁止在最敏感的技术上对中国投资。世界上最强大的资本主义捍卫者动用这样的限制来对抗一个日益强硬和构成威胁的竞争对手的崛起，这是其经济政策发生深远转变的一个最新信号。

几十年来，美国为贸易和资本的全球化喝彩鼓劲，它们带来了效率提升、为消费者降低了成本的巨大好处。但在一个危险的世界里，单单效率已经不够了。在美国以及所有西方国家，中国的崛起正在让其他目标上升到显要地位。官员们想要保护国家安全，为此而要限制中国获得可能增强其军事实力的尖端技术，还想在那些一直由中国牢牢掌控的领域里另外打造供应链，这都可以理解。

结果就是一连串针对中国的关税、投资审查和出口管制措施，首先发难的是前任总统特朗普，现在是拜登。美国财政部长耶伦出访了德里和河内，宣扬“友岸外包”的好处，示意公司老板们撤离中国是明智之举。这背后的思路是，尽管这些“去风险”措施会降低效率，但若只局限于敏感产品就能限制损失。而且付出一些额外成本是值得的，因为美国会更安全。

这种新思路的后果现在正变得清晰。不幸的是，它既没有带来韧性，也没有带来安全。供应链在想方设法对付和适应新规则的过程中已变得更加纠缠混乱和不透明。而且，如果仔细观察会发现，美国在关键投入品上对中国的依赖照旧。更让人担忧的是，这些政策产生了适得其反的效果，还把美国的盟友往中国那边推了一把。

这一切可能出人意料，因为乍看起来，这些新政策像是大获全胜。中美间的直接经济联系正在萎缩。2018年，美国从一批“低成本”亚洲国家的进口有三分之二来自中国，去年则刚刚过半。作为替代，美国转向了印度、墨

西哥和东南亚。

投资流动也在调整。2016年，中国企业在美的投资达到了惊人的480亿美元；六年过去，这一数字萎缩到只有31亿美元。二十五年来，中国头一次掉出了中国美国商会大多数成员企业的前三大投资目的地。在过去二十年的大部分时间里，亚洲新增的外商投资项目中的大部分都去了中国。去年中国吸引到的这类项目少于印度和越南。

不过，深挖下去就会发现，美国对中国的依赖根本没变。美国可能确乎把自己的需求从中国转向了其他国家，但那些地方的生产现在比以往更依赖中国的投入品。例如，随着东南亚对美国的出口增长，它从中国进口的中间投入品急剧增长。墨西哥是另一个从美国的去风险措施中得益的国家，在过去五年里，它从中国进口的汽车零部件翻了一番。国际货币基金组织发布的研究显示，即使在美国最急于和中国脱钩的先进制造部门，那些大举进入美国市场的国家也是和中国的产业联系最紧密的国家。供应链变得更错综复杂，贸易成本变得更高。但中国的支配力并未减弱。

这是怎么回事？在最极端的案例中，中国产品干脆就被重新包装，通过第三国输往美国。2022年底，美国商务部发现东南亚的四家主要太阳能供应商只是对中国产品做了一点加工，让它们不再被认定为中国产品，实际就是为了规避对中国产品的关税。在其他领域，如稀土金属，中国提供的投入品依然难以替代。

不过更多时候，这种机制是良性的。自由市场不过是在适应变化，以找到最划算的方法向消费者供应商品。在很多情况下，凭借庞大的劳动力和高效的物流，中国仍然是最划算的供应国。美国的新规则能够改变它自己与中国的贸易路径，但无法让整个供应链摆脱中国的影响。

因此，脱钩在很大程度上是虚假的。从拜登的角度看，更糟糕是，他的做法还在深化中国和其他出口国之间的经济联系。结果反而使得这些国家的利益与美国的利益相悖。即使是那些对中国日益强硬感到担忧的国家，它们与这个亚洲最大经济体的商业联系也在加深。很多东南亚国家在2020年

11月和中国签订了《区域全面经济伙伴关系协定》（Regional Comprehensive Economic Partnership），恰是为近年来蓬勃发展的中间产品贸易打造了某种单一市场。

对众多较贫穷国家来说，接收中国的投资和中间产品、向美国出口制成品是就业和繁荣的来源。它们有时视美国为不可靠的伙伴，原因之一是美国不愿支持新贸易协定。如果要在中美之间选边站，它们未必站在山姆大叔这边。

这些都为美国官员上了重要一课。他们说想用“小院高墙”来精准防范中国。但如果对关税和限制措施的利弊没有清楚的认识，每一次安全恐慌都可能让院子更大、围墙更高。到目前为止，这样做的好处虚无缥缈，成本却高于预期，更显出精准聚焦的必要性。

而且，聚焦越精准，美国就越可能说服贸易伙伴在真正重要的领域减少对中国的依赖。做不到这一点，去风险将把世界变得更危险，而非更安全。 ■



Costly and dangerous

Joe Biden's China strategy is not working

Supply chains are becoming more tangled and opaque

ON AUGUST 9TH President Joe Biden unveiled his latest weapon in America's economic war with China. New rules will police investments made abroad by the private sector, and those into the most sensitive technologies in China will be banned. The use of such curbs by the world's strongest champion of capitalism is the latest sign of the profound shift in America's economic policy as it contends with the rise of an increasingly assertive and threatening rival.

For decades America cheered on the globalisation of trade and capital, which brought vast benefits in terms of enhanced efficiency and lower costs for consumers. But in a dangerous world, efficiency alone is no longer enough. In America, and across the West, China's rise is bringing other aims to the fore. Understandably, officials want to protect national security, by limiting China's access to cutting-edge technology that could enhance its military might, and to build alternative supply chains in areas where China maintains a vice-like grip.

The result is a sprawl of tariffs, investment reviews and export controls aimed at China, first under the previous president, Donald Trump, and now Mr Biden. Janet Yellen, America's treasury secretary, has travelled to Delhi and Hanoi to tout the benefits of "friendshoring", signalling to company bosses that shifting away from China would be wise. Although such "de-risking" measures would lower efficiency, the thinking goes, sticking to sensitive products would limit the damage. And the extra cost would be worth it, because America would be safer.

The consequences of this new thinking are now becoming clear. Unfortunately, it is bringing neither resilience nor security. Supply chains have become more tangled and opaque as they have adapted to the new rules. And, if you look closely, it becomes clear that America's reliance on Chinese critical inputs remains. More worrying, the policy has had the perverse effect of pushing America's allies closer to China.

All this may come as a surprise, because, at first glance, the new policies look like a smashing success. Direct economic links between China and America are shrivelling. In 2018 two-thirds of American imports from a group of "low-cost" Asian countries came from China; last year just over half did. Instead, America has turned towards India, Mexico and South-East Asia.

Investment flows are adjusting, too. In 2016 Chinese firms invested a staggering \$48bn in America; six years on, the figure had shrunk to a mere \$3.1bn. For the first time in a quarter of a century, China is no longer one of the top three investment destinations for most members of the American Chamber of Commerce in China. For the best part of two decades, China claimed the lion's share of new foreign-investment projects in Asia. Last year it received less than India or Vietnam.

Dig deeper, though, and you find that America's reliance on China remains intact. America may be redirecting its demand from China to other countries. But production in those places now relies more on Chinese inputs than ever. As South-East Asia's exports to America have risen, for instance, its imports of intermediate inputs from China have exploded. China's exports of car parts to Mexico, another country that has benefited from American de-risking, have doubled over the past five years. Research published by the IMF finds that even in advanced-manufacturing sectors, where America is keenest to shift away from China, the countries that have made most inroads into the American market are those with the closest

industrial links to China. Supply chains have become more complex, and trade has become more expensive. But China's dominance is undiminished.

What is going on? In the most egregious cases, Chinese goods are simply being repackaged and sent via third countries to America. At the end of 2022, America's Department of Commerce found that four major solar suppliers based in South-East Asia were doing such minor processing of otherwise Chinese products that they were, in effect, circumventing tariffs on Chinese goods. In other areas, such as rare-earth metals, China continues to provide inputs that are hard to replace.

More often, though, the mechanism is benign. Free markets are simply adapting to find the cheapest way to supply goods to consumers. And in many cases China, with its vast workforce and efficient logistics, remains the cheapest supplier. America's new rules have the power to redirect its own trade with China. But they cannot rid the entire supply chain of Chinese influence.

Much of the decoupling, then, is phoney. Worse, from Mr Biden's perspective, his approach is also deepening the economic links between China and other exporting countries. In so doing, it perversely pits their interests against America's. Even where governments are worried about the growing assertiveness of China, their commercial relationships with the biggest economy in Asia are deepening. The Regional Comprehensive Economic Partnership, a trade deal signed in November 2020 by many South-East Asian countries and China, creates a sort of single market in precisely the intermediate goods in which trade has boomed in recent years.

For many poorer countries, receiving Chinese investment and intermediate goods and exporting finished products to America is a source of jobs and prosperity. America's reluctance to support new trade agreements is one reason why they sometimes see it as an unreliable partner. If asked to

choose between China and America, they might not side with Uncle Sam.

All this carries important lessons for American officials. They say that they want to be precise in how they guard against China using a “small yard and high fence”. But without a clear sense of the trade-offs from their tariffs and restrictions, the risk is that each security scare makes the yard bigger and the fence taller. The fact that the benefits have so far been illusory and the costs greater than expected underscores the need for laser focus.

Moreover, the more selective the approach, the greater the likelihood that trading partners can be persuaded to reduce their reliance on China in the areas that really matter. Without it, de-risking will make the world not safer, but more dangerous. ■



精益创新

下一代的谷歌们更加紧凑严明

像它们的科技巨头榜样一样，创业公司也推崇效率

扎克伯格将2023年称为Meta的“效率年”，这种高大上用语的实际意思是承认他的社交媒体帝国过于臃肿了。自去年11月以来，Meta已裁员2.1万人，约占其员工总数的四分之一。其他科技巨头的老板们也开始念诵“效率”真言。自去年10月以来，Alphabet、亚马逊和微软共裁掉了5万多人。尽管广告销售额上升，但“重构成本基础”之类的言语仍然出现在近日大型科技公司的季度财报电话会议上。这轮大放血（我们用大白话说吧）并不限于巨头。根据跟踪裁员情况的公司layoffs.fyi的数据，2023年全球各地近900家科技公司已经宣布的裁员总数已超过22万人。

低迷期对年轻公司的打击最大。由于利率不断上升，它们承诺的遥远未来的丰厚利润现在看来不那么诱人了。因此，风险资本家开始精打细算。在全球范围内，今年上半年的风险投资为1440亿美元，低于2022年同期的2930亿美元。那些找到了投资者的公司看到自己的估值被压低。创业公司股权平台Carta的数据显示，在2023年第一季度，近五分之一的风险投资交易是“降价融资”，即企业以低于以往的估值融资。在3月最新一轮融资后，金融科技明星公司Stripe的估值从950亿美元降至500亿美元。

这也逼迫有志成为下一个Alphabet或Meta的公司纷纷效仿榜样，摒弃在融资轻而易举的时代养成的习惯。眼下在硅谷人人都在谈效率。习惯靠疯狂砸钱赢得市场份额的公司发现自己处在不得不减脂的陌生境地。而且要减掉的脂肪还不少。

从工资表下手是个很好的开始。久经沙场的创始人抱怨说，工资是新公司最大的开支。7月，在面向程序员的网站Hacker News上，创业公司的招聘启事比去年同期减少了40%。创业公司普遍看起来已经更精简了。数据供应商CB Insights的资料显示，年轻公司的员工人数中位数正在下降。2018

年，完成了一轮1000万至2500万美元融资的公司一般约有50名员工。2023年，类似规模的公司有41名员工。规模较大的创业公司的雇员人数也下降了，一路直到每轮融资最多达5亿美元的处于后期阶段的创业公司都是如此（见图表）。

经济蓬勃发展时，公司雇了很多没有太多事可做的人。现在不同了。风险投资家汤姆·汤古兹（Tom Tunguz）指出，大多数创业公司都可以用更小的团队运营，对收入的影响可以忽略不计。科技公司不消说正在积极采用人工智能（AI）。微软旗下的开源程序平台GitHub推出了AI助手“co-pilot”，将程序员的生产率提高了30%。受益的不仅仅是极客们。其他员工也在使用基于AI的工具，从像ChatGPT这样帮营销人员炮制电子邮件的聊天机器人，到提高销售效率的智能软件等。一家员工不到10人的早期创业公司的创始人估计，AI已经让他公司的生产率提高了30%至40%。

只有少数几类创业公司没有受到投资者新萌生的吝啬风气的影响，而即便在它们中间，也有一类显现出了朴素节俭的精神：那些开发各种抢手的AI工具的创业公司。从打造ChatGPT的OpenAI出走的人士创建了Anthropic，它已融资12亿美元，雇有160名员工。由Alphabet旗下AI实验室DeepMind的前员工创办的Adept已融资4.15亿美元，雇有37人。可以把它们与之前创业热潮中的宠儿们比比看。瑞典支付公司Klarna在几年前经历了疯狂扩张，它融资达12亿美元时有2700名员工。数据库开发商Databricks在类似阶段有1700名员工。 ■



Lean innovation

Next-generation Googles run a tighter ship

Like their big-tech role models, startups embrace efficiency

MARK ZUCKERBERG dubbed 2023 Meta's "year of efficiency", corporate-speak for admitting that his social-media empire was bloated. Since November Meta has cut 21,000 jobs, or about a quarter of its workforce. Bosses of its fellow tech titans have also embraced the efficiency mantra. Alphabet, Amazon and Microsoft have collectively shed more than 50,000 jobs since October. Despite an uptick in ad sales, talk of "re-engineering the cost base" and the like still featured in big tech's quarterly-earnings calls late last month. The bloodletting (in plain English) is not limited to the giants. According to layoffs.fyi, a sackings-tracker, nearly 900 tech firms around the world have announced total job cuts of more than 220,000 in 2023.

The slump has hit younger firms hardest. Rising interest rates make their promise of rich profits far in the future look less juicy today. As a consequence, venture capitalists are stinting. Globally, venture-capital investment in the first half of this year was \$144bn, down from \$293bn in the same period in 2022. Those that find investors are seeing their valuations squeezed. According to Carta, an equity platform for startups, in the first quarter of 2023 almost a fifth of all venture deals were "down rounds", where firms raise money at a lower valuation than before. That of Stripe, a fintech star, fell from \$95bn to \$50bn after its latest funding round in March.

This is forcing aspiring Alphabets and Metas to follow their role models and ditch the habits acquired in the era of easy money. Efficiency is the talk of Silicon Valley. Firms accustomed to spending with abandon to win market share find themselves in the unfamiliar position of having to trim fat. And

there is plenty of fat to trim.

A good place to start is payroll. Battle-hardened founders gripe that salaries are young firms' biggest expense. In July startup job postings on Hacker News, a site for coders, were down by 40% compared with a year ago. The average startup is already looking leaner. Numbers from CB Insights, a data provider, show that the median number of employees at young firms is declining. In 2018 the typical firm that raised a round of \$10m-25m had some 50 employees. In 2023 a similar one employs 41. It is the same story for larger startups, all the way to late-stage ones raising up to \$500m per round (see chart).

In the go-go years firms hired lots of people who did not have that much to do. Not any more. Most startups, points out Tom Tunguz, a venture capitalist, can run with smaller teams, with a negligible impact on revenues. Tech firms are, naturally, embracing artificial intelligence (AI). An AI "co-pilot" on GitHub, a Microsoft-owned platform for open-source programs, improves coders' productivity by 30%. And it is not just the geeks who benefit. Other employees use AI-based tools, from chatbots like ChatGPT that churn out emails for marketers to clever software that improves sales efficiency. One founder of an early-stage startup with fewer than ten employees estimates that AI has already boosted his company's productivity by 30-40%.

The austere spirit is visible even among one of the few categories of startup that is unaffected by investors' newfound stinginess: those which develop all the sought-after AI tools. Anthropic, a firm founded by defectors from OpenAI, which created ChatGPT, has secured \$1.2bn with 160 employees. Adept, a company started by former employees of DeepMind, an AI lab owned by Alphabet, has raised \$415m with 37 employees. Compare that with darlings of the previous startup boom. Klarna, a Swedish payments company that experienced wild growth a few years ago, had 2,700

employees by the time it notched up \$1.2bn. Databricks, a database-maker, had a staff of 1,700 at a similar stage. ■



【首文】大可径直穿过峡谷

中国能避开通缩吗？

三个错误信条束缚了政府的手脚

过去两年来，大多数大型经济体的政策制定者陷入了滞胀的两难境地，苦不堪言。他们既要与高通胀搏斗，又要抵抗衰退的风险，前者需要大幅加息，后者却通常要求宽松政策。

中国是个例外。它现在要同时对付增长放缓和危险的低通胀：这是经济停滞，而非滞胀。新公布的数据显示，7月居民消费价格同比下降0.3%。官员们随即将之归咎于食品价格的波动。但通缩的压力要更为普遍。出口价格和出厂价格也在下行。一家房地产开发商在8月6日未能偿付债券利息，赤裸裸地提醒人们中国的房地产市场依然低迷。中国经济的“名义”增速（未剔除通胀影响）已低于实际增速（考虑了通胀影响）。这透露出经济中多方面价格都在下降。

低增长和通缩危险两相叠加，令人担忧。但这并不是一个两难困境。应对这两个问题的标准方法都是刺激措施，这应该能重振支出、拉动增长、驱除通缩。怪物斯库拉和卡律布狄斯是在海峡的同一边。

中国政府试图通过简化行政手续和出台方便消费者的规章来扭转局面，但它忽视了两个明摆着的政策工具：利率和中央政府开支。人民银行仅仅降息了0.1个百分点。考虑到通胀下降，实际借贷成本是在提高。而尽管财政部希望地方政府发行债券，它自己却不愿意更多发债。重担就落在了中国财政体系中压力最大的部分——地方政府及其融资平台。

几个于事无益的信条可能束缚了中央政府的手脚。首先是认为刺激政策无用。一些经济学家认为，企业和家庭不会借贷，因为它们已经背负着债务压力并且担忧中国的经济前景。然而这更说明了采取更强力的宽松财政政策的必要性，这些政策能够稳定就业、提高私人借贷者的收入，进而缓解经济不安全感。此外，还没真正尝试就认为宽松货币政策无效看起来很奇

怪。

一些中国官员似乎还陷入到一个谬误之中，那就是要给一只泄了气的轮胎充气只能通过那个漏气的破孔。意识到消费者信心低落，他们精准对焦头痛医头，比如延长游乐场营业时间、方便家电以旧换新等。实际上，提振信心和消费的最好办法是创造就业和提高工资。而要做到这些，最好的办法是宏观宽松，而不是微观修补。

中国政府可能还认为经济刺激与长期经济改革相抵触。中国领导人习近平渴望推动创新的、高收入的、绿色和强韧的“高质量”发展，而不是投资于冗余的基础设施、廉价制造业或投机性住房建设等“低质量”增长，这合情合理。中国的政策制定者知道，过去的大规模刺激留下了无人居住的楼房和车辆稀少的道路。

但改革和刺激不一定相互矛盾。加大对绿色基建或防洪设施的公共投资既能提振需求，也能帮助中国应对环境变化。进一步放宽户籍限制（在8月3日有所调整，但某些城市公共服务仍未对农村转移人口开放），将能让劳动力更自由地流动，增加消费。如果决策者不采取更多措施来驱除通缩危险，中国的增长——不论质量高或低——都会毫无必要地放缓。 ■



Strait-forward

Can China escape deflation?

Three false dogmas are inhibiting the authorities' response

FOR THE past two years, policymakers in most of the world's biggest economies have faced an excruciating stagflationary dilemma. They have wrestled simultaneously with high inflation, which demands steep interest rates, and fears of a recession, which would normally call for policy easing.

The exception is China. It is now struggling with both slowing growth and dangerously low inflation: stagnation, not stagflation. New figures show that consumer prices fell by 0.3% in July, compared with a year earlier. Officials were quick to blame volatile food prices. But the deflationary pressure is more widespread. The prices charged by exporters and other producers are tumbling. A property developer's missed bond payment on August 6th was a stark reminder of China's ongoing housing slump. And the economy's "nominal" growth rate (which does not strip out the effects of inflation) has dropped below its real, inflation-adjusted rate. This implies that many prices across the economy are falling.

This combination of slow growth and deflationary peril is troubling. But it is not a dilemma. The textbook response to both problems is stimulus, which should revive spending, lift growth and dispel deflation. Scylla and Charybdis are on the same side of the strait.

China's government is seeking to put things right by cutting red tape and setting consumer-friendly regulations, but it has neglected two obvious policy instruments: interest rates and central-government spending. The central bank has cut rates by only 0.1 percentage points. Given falling inflation, the real cost of borrowing is growing. And although the finance

ministry wants local governments to issue bonds, it is loth to do more itself. The burden is falling on the most stressed part of China's fiscal machinery—its local governments and their financing vehicles.

Several unhelpful beliefs may be inhibiting the central government. First is the view that stimulus is futile. Some economists argue that firms and households will not borrow because they are already saddled with debt and fear for China's economic future. Yet that only strengthens the case for more forceful fiscal easing, which would stabilise employment, improve the incomes of private borrowers, and thereby relieve feelings of economic insecurity. Moreover, it seems strange to argue that monetary easing cannot work before it has really been tried.

Some of China's officials also seem to have fallen for the fallacy that you have to reflate a tyre through the puncture hole. Aware that consumer confidence is low, they have zeroed in on such things as extending amusement parks' hours and making it easier to trade in old appliances. In fact, the best way to bolster confidence and spending is to create jobs and lift wages. And the best way to do that is macro easing, not micro fiddling.

China's government may also believe that economic stimulus is at odds with longer-term economic reform. Xi Jinping, its leader, is understandably eager to promote "high-quality" growth—innovative, well-paid, green and resilient—rather than "low-quality" growth, such as spending on redundant infrastructure, cheap manufacturing or speculative homebuilding. China's policymakers know that past stimulus sprees have left behind unoccupied flats and lightly used roads.

Yet reform and stimulus need not conflict. Further public investment in green infrastructure—or flood prevention—would both boost demand and help China adapt to a changing environment. Further easing of China's hukou restrictions, which were tweaked on August 3rd but still deny some

urban public services to migrants from the countryside, would let labour move more freely, and increase consumption. If policymakers do not do more to dispel deflation, China's growth, of high or low quality, will be needlessly slow. ■



【首文】全球商业

左支右绌的CEO

公司越来越多地被卷入政府间的竞争目标。该怎么办？

一直以来，高管得有三头六臂才行，要平衡员工、供应商，特别是股东的需求，同时还不不能逾越政府设定的限制。但他们的杂技表演在今天已达到前所未有的高难度。随着政府试图操纵公司行为，商业世界正在变得危险而无序。全球公司及其老板受到来自四面八方的力量拉扯。

鲜有跨国公司不受伤的。随着中美之间关系越发紧张，从美光科技（Micron）到英伟达等芯片制造商成了制裁的目标。中国的短视频应用Tiktok已被美国立法者盯上。拜登政府遏制对外投资的计划将影响到私募巨头和风投家。曾经古板低调的汽车制造商现在发现自己的投资被放在了聚光灯下，因为各国在争相吸引下一家电动汽车工厂落户。习近平已经驯服了中国的科技巨头。从银行家到酿酒商，所有人都被卷入了美国有毒的文化战。

这一切撕破了上世纪70年代后美国及大部分西方世界里政府与企业间的不成文协议。企业的目标是通过最大化其所有者的财富、保证提高效率、促进繁荣和创造就业来实现股东价值。政府设定税率，制定规则，但总体而言不干预企业运营。尽管这种设置带来的收益并没有平均地在整个社会中分配，但商贸因此而蓬勃发展，消费者因有了更多的选择和更便宜的商品而受惠。

游戏规则已经改变。疫情期间供应链脆弱不堪，中国愈发有威胁性，气候变化的危险近在眼前——在这种种因素的刺激下，政府愈趋统制主义。公司CEO需要一套新方法来应对新时代。

企业重新参与政治始于特朗普时代开启前夕。通过在社会议题上表明立场，老板们获得了途径来表达自己对民粹主义的厌恶——当然同时也能在员工和客户面前展现自己的美德。大约在那个时候，美国最大的资产管理

公司贝莱德（Blackrock）的老板拉里·芬克（Larry Fink）开始倡导ESG（环境、社会和治理）投资原则。

然而，这不仅没有解决社会问题，似乎只是加深了分歧。芬克被妖魔化，右翼说他做过头，左翼又批他做得不够。他并非个例。迪士尼的前老板鲍勃·查佩克（Bob Chapek）与佛罗里达州共和党籍州长罗恩·德桑蒂斯（Ron DeSantis）因为同性恋权利而开打嘴仗，是他下台的原因之一。在英国，Natwest的CEO艾莉森·罗斯（Alison Rose）因公司旗下银行关闭了脱欧派人士奈杰尔·法拉奇（Nigel Farage）的账户而辞职，当初关闭账户一定程度上和法拉奇的政治观点有关。这样的交锋除了伤人自尊，对长期盈利能力毫无帮助。

真正的战线更广阔，利害更大。政府似乎无时不在、无处不在。它们想通过赢回制造业岗位来纠正全球化中的问题，通过保护关键技术来加强国家安全，通过加快脱碳来对抗气候变化。

每一个目标都值得实现。但实现目标的手段有问题，或者说需要做出权衡取舍。制造业岗位并不像人们推崇的那样能带来高收入。在美国，大约1万亿美元的绿色补贴将降低效率，提高公司和消费者的成本。美国提出国家安全需要“小院高墙”，但除非政策制定者清楚补贴、出口管控和投资限制的风险，否则院子很可能会越筑越大，围墙越修越高。这些震动对大公司的影响远远超过谁该用哪个洗手间的争论。但在“反觉醒”潮出现而惹得一身腥后，很少有老板愿意承认这一点。

一些公司为了成为国家冠军企业，纷纷举起爱国大旗。这在中国和印度等国一直是常态，但这股风气正在吹向西方。去年英特尔在美国的两座芯片制造工厂破土动工后，老板帕特·盖辛格（Pat Gelsinger）说他“能感觉到国家荣誉感在心中涌动”。生成式AI也成了类似的极端爱国主义的舞台。马克·安德森（Marc Andreessen）等风投大咖纷纷对中国的AI将征服世界的风险表达惊恐。

其他高管则希望能靠保持隐身来躲避政治炮火。有了马云的前车之鉴——

这位曾经直言不讳的阿里巴巴老板被中国政府狠狠驯服——CEO们纷纷避开公众视线。腾讯的创始人马化腾近期开始露面，也只是口头上表示拥护中国共产党设定的新准则。在美国，受Z世代热捧的快时尚巨头Shein尽力掩盖其中国出身。Tiktok也表示，有关它的母公司字节跳动是中国公司的说法是一种“误解”。在西方的CEO中，就连马斯克这样的大嘴巴都学会了在中国要保持沉默。他最近去上海的特斯拉工厂访问没有安排媒体采访，甚至都没有在推特上发帖子。

然而这两种策略都很容易出纰漏。当你还要在世界其他地方开展业务，高举爱国大旗就会带来问题。英特尔不只在美国建厂，它也正在德国建厂。美国跨国公司一般平均有八家外国子公司，像通用汽车这样的巨擘则有百来家。而老板们自认为明哲保身的低调策略在其他人看来可能是自欺欺人。随便问一个美国议员认为Tiktok是哪国的公司就知道了。

那该怎么办呢？在一个剑拔弩张吵吵嚷嚷的世界中，企业不可能躲得开政治和地缘政治。但“反觉醒”带来的教训是，直言不讳可能会适得其反。在决定是否发声时，全球化公司的老板应把长期股东价值作为导航的北极星。他们所说的话越是直接影响到自身业务，他们的信誉就越高，给人以骗子或伪君子之感的风险也就越低。

这种方式或许还会包含提醒政客，效率和开放曾经给世界各个经济体带来巨大好处。在政府内部极度缺少这两方面的捍卫者之时，那也不是坏事。





Global business

The overstretched CEO

Companies are increasingly caught up in governments' competing aims. What to do?

CHIEF EXECUTIVES have long had to be contortionists, balancing the needs of employees, suppliers and above all shareholders while staying within the limits set by governments. But the twisting and stretching is now more fiendish than ever. The world is becoming dangerous and disorderly as governments try to manipulate corporate behaviour. Global companies and their bosses find themselves being pulled in all directions.

Few multinationals are unscathed. As tensions between China and America ratchet up, chipmakers from Micron to Nvidia have been the target of sanctions. TikTok, a Chinese-owned short-video app, is in the sights of American lawmakers. The Biden administration's plans to curb outbound investment will encompass private-equity giants and venture capitalists. Once-staid carmakers now find their investments in the spotlight, as countries vie to host the next electric-vehicle factory. China's tech behemoths have been tamed by Xi Jinping. Everyone from bankers to brewers has been ensnared in America's toxic culture wars.

All this rips up the unspoken agreement between government and business that held sway in America and much of the West after the 1970s. Businesses aimed for shareholder value, by maximising wealth for their owners, promising efficiency, prosperity and jobs. Governments set taxes and wrote rules but broadly left business alone. Although the gains of the system were not evenly spread across society, trade flourished and consumers benefited from greater choice and cheaper goods.

The rules have changed. Governments are becoming more dirigiste, spurred

by fragile supply chains in the pandemic, a more menacing China and the dangers of climate change. Company CEOs need a new approach for a new age.

Businesses' re-entry into politics began in the run-up to the Trump era. By taking a stand on social issues bosses saw a way to signal their distaste for populism—and surely also a way to signal their virtue to their employees and customers. It was around this time that Larry Fink, the boss of BlackRock, America's largest asset manager, became a proponent of investing using environmental, social and governance principles, or ESG.

Yet instead of solving social problems, that seemed only to deepen divisions. Mr Fink has been demonised by the right for going too far and the left for not going far enough. He is not alone. Disney's former boss, Bob Chapek, waged a battle over gay rights with Florida's Republican governor, Ron DeSantis, one reason he lost his job. In Britain Dame Alison Rose, head of NatWest, has resigned over the bank's cancellation of the Brexiteer Nigel Farage, partly over his political views. Such encounters bruise egos but do little for the long-term bottom line.

The real front is broader and the stakes are higher. Governments seem to be everywhere all at once. They want to correct the problems of globalisation by winning back manufacturing jobs. They want to enhance national security by protecting vital technologies. And they want to fight climate change by speeding up decarbonisation.

Each aim is worthy in its own terms. But the means to bring it about are flawed, or involve trade-offs. Manufacturing jobs are not the high-earning prize they are cracked up to be. Roughly \$1trn of green subsidies in America will reduce efficiency and raise costs for firms and consumers. America says national security requires "a small yard and high fence", but unless policymakers are clear about the risks from subsidies, export controls and

investment curbs, the yard is likely to get bigger and the fence grow taller. These convulsions affect big firms far more than arguments over who should use which bathroom. Yet, out of joint after the wokelash, few bosses are prepared to say so.

Some companies are wrapping themselves in the flag, so as to become national champions. That has long been the norm in places like China and India, but it is heading West. After Intel broke ground on two chipmaking fabs in America last year, Pat Gelsinger, its head, said that he “could feel the national pride welling up”. Similar jingoism is on display over generative AI. Grandees of venture capital such as Marc Andreessen express horror at the risks of Chinese AI conquering the world.

Others hope that by keeping under the radar, they will avoid political flak. Taking their cue from Jack Ma, the once-outspoken boss of Alibaba who was mercilessly brought to heel by the Chinese government, CEOs have ducked out of public view. Pony Ma, the founder of Tencent, surfaced recently only to pay lip service to new guidelines set by the Chinese Communist Party. In America Shein, a fast-fashion giant that is a favourite with Gen Z shoppers, does its best to hide its Chinese roots. So does TikTok, which says it is a “myth” that Bytedance, its owner, is Chinese. Among Western CEOs even a loudmouth like Elon Musk is learning the value of silence in China. His recent visit to Tesla’s factory in Shanghai provided no media access. He did not even tweet.

Yet both of these strategies could easily go wrong. Patriotic cheerleading is a problem when you do business elsewhere in the world. Intel is building fabs not just in America but in Germany, too. The average American multinational has eight foreign subsidiaries; a giant like General Motors has a hundred. And what the boss may see as a stealthy below-the-radar strategy can look to others like sticking your head in the sand. Just ask an American lawmaker where they think TikTok is from.

What to do? In a fractious world, businesses cannot hide from politics and geopolitics. But the lesson of the wokelash is that outspokenness can backfire. When deciding whether to speak up, bosses of global firms should use long-term shareholder value as their lodestar. The more directly what they say affects their business, the more credibility they have and the less risk of appearing a fraud or a hypocrite.

This approach may include reminding politicians of the benefits that efficiency and openness once brought to economies around the world. When governments seem to contain a dearth of champions for either, that would be no bad thing. ■



碟中世界

正视深加工食物的危险

各种添加剂和防腐剂给人类健康带来了风险

一袋薯片和一盘羽衣甘蓝沙拉，哪个更健康？这很容易回答。那么，一个现做披萨和一个使用相同的基本原料、包含同样多的卡路里的速冻预制比萨，哪个更健康？

许多关心饮食健康的人会本能地选择前者。他们也许会说，听说“加工食品”总归不大好。加工食品通常都很美味。（笔者就对咸香薯片尤其没有抵抗力。）而有廉价又丰富的卡路里很值得庆贺——毕竟在人类历史的大部分时间里这两点都不可得。但是，正如克里斯·范图尔肯（Chris van Tulleken）的新书《深加工人类》（Ultra-Processed People）所解释的那样，这种廉价和丰富都是有代价的。

医生兼电视主持人范图尔肯把“深加工食品”和“加工食品”做了区分。人们食用的东西几乎都经过某种形式的加工，比如稻米要经过收割和脱壳，动物要经过宰杀。他引用了食品科学家卡洛斯·蒙特罗（Carlos Monteiro）提出的定义，将深加工食品描述为“由各种成分配比而来，其中大多数成分仅用于工业生产，并要经过一系列工业过程，许多过程都需要用到先进的设备和技术”。现做的披萨只含有经基本加工的材料（小麦加工成面粉，西红柿做成酱，牛奶变成奶酪）。而速冻披萨含有硫胺素硝酸盐和磷酸钠，属于深加工食品。

深加工食品中的添加剂和防腐剂混合物以各种已知或未知的方式危害人类。它似乎会影响肠道微生物菌群，而这数以万亿计的细菌以多种方式维持着人体健康。深加工食品富含卡路里，但通常缺乏营养，会导致肥胖，这一定程度上是因为它们口味诱人，口感松软，会压制大脑发出的饱腹感信号，容易让人过量食用。

由于这种“科学怪粮”的生产成本低，价格便宜，因此人们会用它替代更健

康的食品，穷人就更是如此。体重超标曾经是财富的标志，而在当今的英国和美国妇女中，低收入群体的肥胖率更高。（奇怪的是，男性不同收入群体的肥胖率并没有差异，尽管美国男性的整体肥胖率要比女性高。）

深加工食品为何可能有害，原因并不总是很清楚，即使对科学家来说也是如此。有些添加剂单独或少量食用可能是安全的，但与其他化学物质混合使用或经常性食用就可能有害。如果真的“人如其食”，考虑深加工食品的影响就非常必要，但范图尔肯对干净食品的主张往往带有一股反资本主义的自豪感，比如他莫名其妙地把公司税最少化称作“深加工过程的一部分”。

环境也很重要。如果是居住在作者所说的“深加工食品无处不在，但很难吃到真正的食物”的“食物沼泽地”中，人们可能要花费大量的时间和金钱来搜寻新鲜食物。但大多数人的生活环境并非如此。偶尔吃吃快餐无可厚非，但任何吃得起更健康食物的人或许都应该适可而止。 ■



World in a dish

Confronting the dangers of ultra-processed food

A cocktail of additives and preservatives poses a risk to people's health

WHICH IS HEALTHIER: a bag of crisps or a kale salad? That is easy. Now which is healthier: a pizza made from scratch or one made from the same basic ingredients, with the same number of calories, pulled out of a box in the freezer?

Many people concerned with what they eat would instinctively say the former, perhaps citing a vague concern with “processed food”. Such food can often be delicious. (This columnist has a particular weakness for salty potato crisps.) And there is much to cheer about calories being cheap and abundant, when for most of human history they were neither. But as Chris van Tulleken’s new book, “Ultra-Processed People”, explains, that cheapness and abundance come at a cost.

Mr van Tulleken, a doctor and television presenter, draws a distinction between “ultra-processed food” (UPF) and “processed food”. Almost everything people consume is processed in some form: rice is harvested and hulled, animals are butchered. He uses a definition proposed by Carlos Monteiro, a food scientist, describing UPF as “formulations of ingredients, mostly of exclusive industrial use, made by a series of industrial processes, many requiring sophisticated equipment and technology”. A pizza made from scratch contains minimally processed food (wheat turned into flour, tomatoes into sauce, milk into cheese). The one in the freezer, with its thiamine mononitrate and sodium phosphate, is UPF.

The cocktail of additives and preservatives in UPF harm people in ways both known and unknown. It seems to affect the gut microbiome, the trillions of

bacteria that contribute to health in a range of ways. Calorie-rich but usually nutrient-poor, UPF contributes to obesity in part because its palatability and soft texture foster overconsumption, overriding satiety signals from the brain.

Because this frankenfood is cheap to produce and buy, UPF displaces healthier alternatives, particularly for poor people. Extra weight was once a sign of wealth, but among British and American women today, obesity rates are higher at lower-income levels. (Curiously, rates do not vary for men, even though a greater share of American men than women are obese.)

The reasons why UPF can be harmful are not always clear, even to scientists. Additives that may be safe in isolation or small quantities may be harmful in combination with other chemicals or when consumed regularly. If we are what we eat, considering the impact of UPF is essential, but too often Mr van Tulleken's case for clean food is accompanied by anti-capitalist preening: for instance, he nonsensically calls corporate-tax minimisation "part of ultra-processing".

Environment matters, too. People who live in what the author calls "food swamps", where "UPF is everywhere but real food is harder to reach", could spend large amounts of time and money seeking out fresh food, but that is not how most people live. There is nothing wrong with the odd fast-food trip, but anyone who can afford to eat less UPF probably should. ■



梧桐

投资者陷入乐观情绪。牛市能持续吗？

AI荣，万物荣

华尔街传奇基金经理约翰·邓普顿（John Templeton）曾说，牛市“生于悲观，长于怀疑，成于乐观，死于狂喜”。他在1939年将这一信条付诸实践。当其他人陷入欧洲战争的恐慌时，邓普顿却瞄上了纽约证券交易所那些股价低于一美元的股票，他借钱把所有这些股票各买了100股。没出几年，他便获得了400%的利润，并为后来的投资者打造了一个模板。即使在21世纪，邓普顿青睐的“极度悲观”时刻也是最佳买入时机。2009年3月，投资者对资本主义的未来感到绝望；2020年3月，投资者因新冠疫情和企业倒闭而绝望。这两次，闭着眼睛买股票都对了。

现在看来，2022年10月那一次也应该被算进去。当时，市场情绪无疑普遍悲观。多地央行以几十年来最快的速度加息。欧元区的通胀达到了两位数，美国的通胀率只是在缓慢回落。经济衰退似乎几成定局。欧洲再次发生战争。中国似乎卡在继续封锁和让疫情死亡人数飙升的两难困境里骑虎难下。在整个北半球，寒冬可能致使能源价格再次暴涨，糟糕的经济下滑变成了实实在在的危险。涵盖美国大公司的标普500指数从最高点下跌了近四分之一；德国DAX指数的跌幅更大。

与过往一样，当时确是个绝佳的买入时机。此后，标普500指数上涨了28%，达到了一年多来的最高点，只比2022年初的历史峰值低不到5%。而且，这次反弹的进程完全契合邓普顿的说法。它在绝望中诞生，然后进入怀疑期。几个月来，投资者一直在押注美联储不会把利息加到其理事们坚称打算要提升到的那个高位。与此同时，经济学家们在一旁告诫他们不要鲁莽行事。股价一直在频繁的变盘中战战兢兢地小幅上涨。

有那么几周，随着第一家、继而好几家美国地方银行因不断加息而倒闭，看起来是怀疑派赢得了胜利。实际上此时却是要转入乐观期了。AI能大幅

提升生产率的希望取代了对增长和通胀的担忧，成为主流的市场叙事。大型科技公司被认为能从这样的提升中获利——其股价果然飙升。

如今，狂欢已经蔓延到市场的其他部分。比较一下美国基准标普500指数和标普500“等权重”指数就能发现这一点。基准标普500根据市值对公司加权，因此由七大科技公司主导，而它的“等权重”版本赋予每只成分股相同的权重。从今年3月到6月，以科技股为主的基准指数一路走高，等权重指数则停滞不前。自6月以来，两个指数都有所攀升，但反映面更广的等权重指数表现更好。不过它们还都比不上KBW银行股指数。一开始的小幅领涨已经扩大为全面的牛市。

这种新的市场情绪不只显现在股市指数上。数据供应商彭博（Bloomberg）收集了23家华尔街投资公司对标普500指数的年终预期。自今年年初以来，这些投资公司中有14家上调了预期，只有一家下调了预期。美国个人投资者协会（American Association of Individual Investors）每周一次的调查显示，散户投资者正处于自2021年11月以来最乐观的心态。甚至长期死气沉沉的IPO市场可能也出现了复苏的迹象。7月19日，一家AI美容公司Oddity Tech在聚焦科技股的纳斯达克交易所上市，发行了价值4.24亿美元的股票。投资者提交的认购额超过100亿美元。

要保持股市当前势头，投资者必须继续把越来越多的钱投到股票上。如果他们打算这么做，那必然是相信以下三点中的至少一点。一是收益会上涨。二是其他可选择的投资的吸引力会变得不及股票，尤其是政府债券的收益率。第三，股票收益令人失望的可能性如此之低，而值得挤出钱来继续投到股票上，并接受回报减少。最后一种信心体现在了目前被压低的“股权风险溢价”上。该溢价是指投资者在放弃更安全的债券而投资有风险的股票时所要求的额外的预期回报。今年它已经跌到了2007至2009年全球金融危机爆发前以来的最低水平。换句话说，市场看来已处于狂喜的边缘。不知道邓普顿对此会作何感想？ ■



Buttonwood

Investors are seized by optimism. Can the bull market last?

An artificial-intelligence boom has turned into an everything boom

BULL MARKETS, according to John Templeton, “are born on pessimism, grow on scepticism, mature on optimism and die of euphoria”. The legendary Wall Street fund manager put this philosophy into practice in 1939. At a time when others were panicking about Europe’s descent into war, Templeton borrowed money to buy 100 of every share trading below \$1 on the New York Stock Exchange. Within a few years he had booked a 400% profit and forged a template for future investors. Even in the 21st century, Templeton’s favoured moments of “maximum pessimism” present the very best buying opportunities. In March 2009 investors despaired over the future of capitalism; in March 2020, over a pandemic and shuttered businesses. Both times, the correct response was to close your eyes and buy stocks.

It now looks like October 2022 should be added to the list. Pessimism was certainly rife. Central banks were raising interest rates at their fastest pace in decades. Inflation was hitting double digits in the euro zone and falling only slowly in America. Recession seemed just about nailed on. War had returned to Europe. China appeared trapped between lockdowns and soaring covid-19 deaths. Across the northern hemisphere, a cold winter threatened to send energy prices soaring again, turning a miserable downturn into a truly dangerous one. America’s S&P 500 index of leading shares was down by nearly one-quarter from its peak; Germany’s DAX by more.

True to form, it was an excellent time to buy. The S&P 500 has since risen by 28%. That puts it at its highest level in over a year, and within 5% of the

all-time peak it reached at the start of 2022. Moreover, the rally's progress has been positively Templetonian. Born on despair, it then advanced to the scepticism phase. Investors spent months betting that the Federal Reserve would not raise rates as high as its governors insisted they were prepared to lift them, while economists admonished their foolhardiness from the sidelines. All the time, with frequent reversals, stocks edged nervily upwards.

For a few weeks, as first one then several American regional banks collapsed in the face of rising rates, it looked like the sceptics had won the day. Instead, it was time to proceed to the optimism phase. Hope of an AI-fuelled productivity boom displaced fears about growth and inflation as the main market narrative. Shares in big tech firms—deemed well-placed to capitalise on such a boom—duly rocketed.

Now the party has spilled over into the rest of the market. You can see this by comparing America's benchmark S&P 500 index (which weights companies by their market value and so is dominated by the biggest seven tech firms) with its “equal-weight” cousin (which treats each stock equally). From March to June, the tech-heavy benchmark index raced ahead while its cousin stagnated. Since June both have climbed, but the broader equal-weight index has done better. And they have both been trounced by the KBW index of bank stocks. What started as a narrowly led climb has broadened into a full-blown bull market.

It is not just in stockmarket indices that the new mood is apparent. Bloomberg, a data provider, collects end-of-year forecasts for the S&P 500 from 23 Wall Street investment firms. Since the start of the year, 14 of these institutions have raised their forecasts; just one has lowered it. Retail investors, surveyed every week by the American Association of Individual Investors, are feeling their most bullish since November 2021. Even the long-moribund market for initial public offerings may be witnessing green

shoots. On July 19th Oddity Tech, an AI beauty firm, sold \$424m-worth of its shares by listing on the Nasdaq, a tech-focused exchange. Investors had placed orders for more than \$10bn.

If investors are to keep paying more and more for stocks, which they will have to do to keep the run going, they must believe at least one of three things. One is that earnings will rise. Another is that the alternatives, especially the yield on government bonds, will become less attractive. The third is that earnings are so unlikely to disappoint that it is worth coughing up more for stocks and accepting a lower return. This final belief is captured by a squeezed “equity risk premium”, which measures the excess expected return investors require in order to hold risky shares instead of safer bonds. This year it has plunged to its lowest since before the global financial crisis of 2007-09. The market, in other words, appears on the verge of euphoria. What would Templeton think of that? ■



巴托比

高管辅导是一种有效的公费疗法

这种辅导不一定就是讲些陈词滥调

在2004年的纪录片《Metallica：异种怪物》（Metallica: Some Kind of Monster）中，重金属乐队Metallica聘请了一位“提升表现辅导”来帮助解决成员间的分歧。但乐手们都无法忍受这位辅导员，最终团结一致，决定让他走人。一位前银行家在雷曼兄弟和瑞银工作多年后，聘请了一位辅导员来探讨自己下一步何去何从。他一共上了六节辅导课，每节40分钟，花费近8000美元，而最终获得的高见就是他应该找一个“靠他的资历来挣钱”的职位。

人们很容易把高管辅导贬为又一种地位象征，它让大权在握、本就自视甚高的高管更加膨胀。但这种把管理建议与心理疗愈相结合的辅导不一定就是花大价钱换来陈词滥调。很少有高管的职业生涯风平浪静一成不变，许多高管在转型时刻需要指导——此时仅靠自我对话已不足够。新冠疫情加剧了高水平人才的焦虑，也就增加了对高水平辅导的需求。专业培训服务机构Angel Advisors在2019年的一项研究发现，在美国，高管辅导行业目前价值20亿美元，这对一个看似很小众的行业来说是个大规模。这样大规模的需求的存在有力地表明专业辅导有其用处。

许多高管——尤其是CEO——很难跟其他人讨论自己面临的挑战。职位高低有别，这使得他们不便向员工吐露麻烦，因为这可能会削弱自己的权威。与此同时，保密规定禁止高管随便找一个外人讨论公司问题。被摩根大通吞并的投资银行嘉诚（Cazenove）的前老板罗伯特·皮克林（Robert Pickering）在他的回忆录《蓝血》（Blue Blood）中写下了自己的经历。“经营公司主要靠命令和控制，内部很少有人能成为你诉苦发牢骚的对象。”他解释道。与辅导员一起梳理问题帮助他制定了应对策略，以及更游刃有余地驾驭高层会议。

如果辅导员本人曾经做过高管，就能更能懂得高管的思维和心态。伦敦商学院（London Business School）的赫米尼娅·伊瓦拉（Herminia Ibarra）指出，许多拥有行业专门知识和人际交往能力的专业人士最终会厌倦运营的角色。有些人发现辅导高管是很有意义的人生第二幕。比如安娜·卢内伯格（Ana Lueneburger），她离开了企业界去辅导公司创始人和高管。她在与一位客户合著的《无滤镜曝光：CEO和辅导员》（Unfiltered: The CEO and the Coach）一书中概述了她的做法，即着重优势最大化，而不是改正短板。

作为本专栏的特邀撰稿人，笔者决定考虑一下自己的职场大计，所以去梅菲尔（Mayfair）的一家私人俱乐部跟卢内伯格上了一节临时辅导课。准备工作是填写大量问卷，包括“霍根领导力预测”（Hogan Leadership Forecast，这是一项对“缺陷和基于个性的绩效风险”的心理测评——既然你问了）。

辅导员通常会让客户描述在获得幸福和发展的道路上有哪些障碍（从同侪关系不顺和自我批评严苛，到驱动力和欲望干劲逐渐枯竭等）。由于时间有限，笔者提出讨论了一个困扰她工作的个人问题。喝喝茶喝喝苏打水，两个小时转瞬即逝，课程结束了。

尽管是当下的流行词，辅导并不是一门科学。但如果剥除掉所有那些围绕“走出舒适区、360度大变身”的车轱辘话，它确实仍是一个直觉的、协作的过程，其成功取决于辅导员和客户之间的默契。卢内伯格既没有召来“关爱自我”的迷魂曲，也没有专挑笔者想听的话说，而是转换了问题的角度——对于大多数客户来说，如果没有外界帮助，这一点不容易做到，因为许多人在工作中和其他方面都处在“自动驾驶”模式。

根据VIA性格问卷（和“霍根领导力预测”一起填写的），笔者在领导力方面得分低，但在讲真话方面得分高。有了这新的凭证，我想对你说的是：如果你是高管，给自己找一位辅导员吧。辅导不一定要围绕你职业道路上的危机或岔路口展开。最好的结果是它可以指明高管面对的障碍物究竟为何。最不济也就是与一个一片好心而且一般都很聪明的人聊了一通，而对

方可以帮你进一步确认一些常识常理。如果费用还可以报销，何乐而不为呢？ ■



Bartleby

Executive coaching is useful therapy that you can expense

The practice does not have to be an exercise in platitudes

IN A DOCUMENTARY from 2004, “Metallica: Some Kind of Monster”, members of the titular heavy-metal band hire a “performance-enhancement coach” to help them resolve their disagreements. The musicians cannot stand him and end up bonding over their decision to get rid of him. When an ex-banker, after years of working at Lehman Brothers and UBS, hired a coach to discuss his next steps, the nugget of wisdom he acquired in the course of half a dozen 40-minute sessions setting him back almost \$8,000 was that he should seek a role where he would be “paid for his experience”.

It is tempting to paint executive coaching as one more status symbol inflating a sense of high-powered managers’ already-ample sense of self-importance. Yet the practice—which combines management advice with therapy—does not have to be an expensive exercise in platitudes. Few executives remain static in their careers, and many need guidance at moments of transition, when relying on an internal monologue is not enough. The covid-19 pandemic, which heightened the anxiety felt by high-performers, increased the need for skilled coaching. A study from 2019 by Angel Advisors, a professional training service, found that coaching in America is now a \$2bn industry—large for what might seem like a niche business. The existence of such demand strongly suggests that professional grooming has its uses.

Many executives, especially CEOs, find it difficult to discuss the challenges they face. Hierarchy makes it tricky to share problems with employees as it can undermine the boss’s authority. At the same time, confidentiality forbids executives from discussing company problems with random

outsiders. Robert Pickering, former boss of Cazenove, an investment bank since swallowed by JPMorgan Chase, wrote about his experience in his memoir, “Blue Blood”. “Running a firm is largely command and control, and there are very few insiders with whom you can share gripes and frustrations,” he explains. Working with a coach helped him develop coping strategies, as well as command the boardroom.

Coaches can understand the executive mindset better if they were once executives themselves. Herminia Ibarra of London Business School notes that many professionals with industry expertise and people skills eventually tire of operational roles. Some find coaching to be a meaningful second act. Take Ana Lueneburger, who left the corporate world to coach company founders and the C-suite. Her approach, outlined in “Unfiltered: The CEO and the Coach”, a book she co-wrote with one of her clients, focuses on maximising strengths rather than fixing weaknesses.

Your columnist, a guest Bartleby, decided to consider her own game plan by going to a private club in Mayfair for an ad hoc coaching session with Ms Lueneburger. Preparation consisted of filling extensive questionnaires, including the Hogan Leadership Forecast (a psychometric assessment of “derailers and personality-based performance risks”, since you ask).

The coach customarily asks the client to describe impediments to happiness and development (from difficult peer relationships and a tough inner critic to withered motivation and drive). Given the time constraints, Bartleby discussed a personal issue which troubles her at work. Two hours sipping tea and sparkling water passed in a flash and then the session was over.

Coaching is not a scientific operation, jargon du jour notwithstanding. But if you strip away all the talk of circling back to 360-degree change from your comfort zone, you do end up with an intuitive, collaborative process, the

success of which depends on chemistry between the coach and the client. Ms Lueneburger neither appealed to the siren song of self-care nor merely told Bartleby what she wanted to hear. Instead she shifted the angle of the problem, which is not easy to do unaided for most clients themselves, many of whom operate on autopilot at work and elsewhere.

According to the VIA character questionnaire (filled out alongside the Hogan), Bartleby scores poorly in leadership but highly in speaking the truth. With these new credentials, her message is: if you are a member of a C-suite, get yourself a coach. It does not have to revolve around a crisis or a fork in your career path. At its best, it can illuminate snags executives face. The worst that can happen is spending time with a well-meaning, and typically intelligent, interlocutor, who can help consolidate common sense. If you can put the fee on your expense account, what's not to like? ■



关键行动

中国控制关键战争矿物的供应

最近限制这些矿物出口的举措突显了西方面临的危险

大宗商品策略师汤姆·普赖斯（Tom Price）在2014年参观了中国西南部一座“有趣的小建筑”。这是当地交易公司泛亚的一个仓库，储存着镓、锗和铟等金属。该公司的“库存”就放在货架上的盒子里。然而，对其中某些矿物而言，这么一点供应却已经是大部分全球库存了。一年后，泛亚被中国政府关闭，政府留下了库存——以及矿藏和用于生产更多此类金属的工厂。

如今，西方国家也希望自己能够生产更多这些矿物。7月4日，中国宣布将限制镓和锗的出口——2022年，中国的镓和锗产量分别占全球产量的98%和60%。这些金属的产量很小，商业价值不大，但它们对于某些军事装备（包括激光、雷达和间谍卫星）却至关重要。限制出口的决定强调“关键”矿物并不限于镍或锂等支撑经济增长的矿产。有十几种不起眼的矿物对于一个更基本的需求同样至关重要，那便是维持军队战斗力。

战争矿物家族成员五花八门，历经了世代变化。锑在圣经时代被用作药物和化妆品，现在是一种用于电缆护套和弹药的阻燃剂。自1900年代起，钒就以其耐疲劳的特点而闻名，如今与铝混合用于飞机机身材料。铟是一种柔软、有延展性的金属，自第二次世界大战以来一直用于飞机发动机轴承的涂层。

战争矿物家族在冷战时期迅速扩大。早在钴开始被用作电池材料之前，1950年代的核试验就表明它可以耐高温。这种蓝色金属很快就被添加到制造穿甲弹的合金中。钛与钢一样坚固，但比钢轻45%，也变成了理想的武器材料。钨也是如此，它的熔点是所有金属中最高的，是至关重要的弹头材料。微量的铍与铜混合，可以生成出色的电和热导体，经久不易变形。

几十年后，随着军事技术的进一步飞跃，其他矿物的超能力逐渐为人所

知。镓被用于通信系统、光纤网络和航空电子传感器的芯片组。锗的红外透过性让它可以被用于夜视镜。稀土被用于生产高性能磁体。钢中添加极少量的铌（每吨只需添加200克）可大幅提高钢的硬度。这种金属经常用在现代喷气发动机中。

除了各自不同特性外，这些强大的矿物还具有某些共同的家族特征。首先，它们极少在自然界中以单质形式存在，而通常是精炼其他金属的副产品。例如，锌矿石中含有微量的镓和锗化合物。钒存在于60多种不同的矿物中。因此，这些金属的生产成本高昂、需要专门技术、耗能高且污染环境。而由于全球市场很小，先开始投资生产的国家可以保持较低的成本，这让它们获得了难以动摇的优势。

这就解释了为什么战争矿物的生产极其集中（见图表1）。我们列出的13种战争矿物中，每一种的前三大出口国都占到全球供应量的60%以上。中国是其中八种矿物的绝对最大生产国；局势混乱的矿业国家刚果是另外两种矿物的最大生产国；更可靠的贸易伙伴巴西的铌产量占世界的十分之九，不过其中大部分销往中国。许多矿物在短期内不可能被替代，特别是对于尖端军事用途而言。就算找到可替代的材料，性能通常会受折损。

生产集中、精炼复杂和用途紧要这三者相结合，意味着这些金属的交易一般都很低调。交易量太小，交易方也太少，无法在交易所出售。由于没有现货交易，也就没有公开价格。潜在买家必须靠估价，价格差异很大。钒相对便宜，每公斤约25美元。铪可能要每公斤1200美元。

这些都大大增加了建立新的供应链的难度。美国正在得克萨斯州投资建设稀土金属提纯工厂，计划于2025年投入使用。西方国家中只有澳大利亚和加拿大拥有还算丰富的稀土金属矿藏，美国正在推动它们提高生产和出口量。它还在尽力与有矿藏待开发的印太地区新兴市场缔结关系。

咨询公司欧亚集团（Eurasia Group）的斯科特·杨（Scott Young）认为，即便如此，美国军队至少在2030年之前仍将容易受到供应紧张的影响。冷战时期，美国的库存一度相当大，但在柏林墙倒塌后被清理掉了（见图表

2)。目前其战略储备主要是石油和天然气等能源大宗商品。

欧洲、日本和韩国若要摆脱对中国的依赖，可能要比美国再多花几十年，因为它们既没有矿藏，也缺乏美国的外交影响力。这并不意味着它们的军队将迎来高科技金属荒，但它们可能不得不从美国进口，而这些金属的价格已经因盟友争相重建库存而上涨。去年俄罗斯入侵乌克兰引发的天然气危机加剧了欧洲对美国燃料的依赖。金属供应紧张可能会让山姆大叔对惊慌失措的采购官员们产生更大的吸引力。 ■



Mission-critical

China controls the supply of crucial war minerals

Recent moves to restrict their flow highlight a danger to the West

IN 2014 TOM PRICE, a commodities strategist, visited a “funny little building” in China’s south-west. It was a warehouse where Fanya, a local trading firm, stored metals including gallium, germanium and indium. The company’s “stockpiles” simply sat in boxes on shelves. Yet for some of the minerals, these meagre supplies represented the majority of global stocks. A year later Fanya was closed by China’s government, which kept the stash—as well as the reserves and plants to produce more.

Today Western countries wish they, too, could produce some more. On July 4th China announced that it would restrict exports of gallium and germanium, of which it supplied 98% and 60% of global output, respectively, in 2022. Produced in tiny quantities, the metals have little commercial value. They are nevertheless crucial for some military equipment, including lasers, radars and spy satellites. The decision highlights that “critical” minerals are not limited to those which underpin economic growth, such as nickel or lithium. A dozen obscure cousins are also vital for a more basic need: maintaining armies.

The eclectic family of war minerals spans generations. Antimony, known in biblical times as a medicine and cosmetic, is a flame retardant used in cable sheathing and ammunition. Vanadium, recognised for its resistance to fatigue since the 1900s, is blended with aluminium in airframes. Indium, a soft, malleable metal, has been used to coat bearings in aircraft engines since the second world war.

The family grew rapidly in the cold war. Long before cobalt emerged as

a battery material, nuclear tests in the 1950s showed that it was resistant to high temperatures. The blue metal was soon added to the alloys that make armour-penetrating munitions. Titanium—as strong as steel but 45% lighter—also emerged as an ideal weapons material. So did tungsten, which has the highest melting point of any metal and is vital for warheads. Tiny amounts of beryllium, blended with copper, produce a brilliant conductor of electricity and heat that resists deformation over time.

The superpowers of other minerals became known decades later, as military technology made further leaps. Gallium goes into the chipsets of communication systems, fibre-optic networks and avionic sensors. Germanium, which is transparent to infrared radiation, is used in night-vision goggles. Rare earths go into high-performance magnets. Very small additions of niobium—as little as 200 grams a tonne—make steel much tougher. The metal is a frequent flyer in modern jet engines.

Beyond their varied properties, this group of mighty minerals share certain family traits. The first is that they are rarely, if ever, found in pure form naturally. Rather, they are often a by-product of the refining of other metals. Gallium and germanium compounds, for example, are found in trace amounts in zinc ores. Vanadium occurs in more than 60 different minerals. Producing them is therefore costly, technical, energy-intensive and polluting. And because the global market is small, countries that invested in production early can keep costs low, giving them an impregnable advantage.

This explains why the production of war minerals is extremely concentrated (see chart 1). For each of our 13 war materials, the top three exporters account for more than 60% of global supply. China is the biggest producer, by far, for eight of these minerals; Congo, a troubled mining country, tops the ranking for another two; Brazil, a more reliable trading partner, produces nine-tenths of the world's niobium, though most of it is sent to China. Many minerals are impossible to replace in the near term, especially for cutting-

edge military uses. When substitution is possible, performance usually suffers.

The combination of concentrated production, complex refining and critical uses means trading happens under the radar. The volumes are too small, and transacting parties too few, for them to be sold on an exchange. Because there are no spot transactions, prices are not reported. Would-be buyers have to rely on estimates. These vary widely. Vanadium is relatively cheap: around \$25 per kilogram. Hafnium might cost you \$1,200 for the same amount.

All this makes building new supply chains much more difficult. America is investing in a purification facility for rare-earth metals in Texas, which is scheduled to come online in 2025. It is nudging Australia and Canada, the only two Western countries with decent reserves, to produce and export more rare metals. It is also doing its best to forge ties with emerging markets in the Indo-Pacific, where there are deposits waiting to be tapped.

Even so, America's army will remain vulnerable to a supply squeeze until at least 2030, reckons Scott Young of Eurasia Group, a consultancy. Its cold-war stockpiles, once sizeable, were liquidated after the fall of the Berlin Wall (see chart 2). Its strategic stash now mostly comprises energy commodities such as oil and gas.

Weaning themselves off China might take decades longer for Europe, Japan and South Korea, which are devoid of deposits and lack America's diplomatic clout. That does not mean their armies will run short of high-tech metals, but they will probably have to buy them from America—at a price already buoyed by their ally's scramble to rebuild stockpiles. Last year's gas drama, prompted by Russia's invasion of Ukraine, amplified Europe's dependence on American fuel. The metals squeeze threatens to make Uncle Sam a still bigger magnet for panicked procurement officials. ■



世界毁灭者

奥本海默的秘密小城，曼哈顿计划的圣殿

新墨西哥州的一个小镇以自己是核弹发明地为豪

走在新墨西哥州洛斯阿拉莫斯（Los Alamos）的城镇历史中心，每个转角都可以看到罗伯特·奥本海默（J.Robert Oppenheimer）的“身影”。当地活动中心就位于奥本海默路（Oppenheimer Drive）旁，在这里先前举办了奥本海默节，庆祝克里斯托弗·诺兰（Christopher Nolan）拍摄的关于这位原子弹之父的新电影上映。一尊奥本海默的铜像矗立在一条街道的拐角，戴着帽子叼着烟斗，潇洒干练。当地酒吧举行有关奥本海默的趣味问答竞赛。为致敬奥本海默当年在新墨西哥沙漠引爆原子弹的“三位一体核试验”（Trinity test），这里有特里尼蒂路（Trinity Drive）、特里尼蒂急诊室（Trinity Urgent Care）和山上特里尼蒂圣公会教堂（Trinity on the Hill Episcopal Church）。

1942年，奥本海默受命负责曼哈顿计划（Manhattan Project），他选择在洛斯阿拉莫斯建造实验室。在美国政府看来，这是制造原子弹的理想地点。这里的沙漠台地和黄松林提供了与世隔绝的隐秘环境。而奥本海默选择新墨西哥州这片“魔力之地”也有他个人的原因。在诺兰的电影中，由西里安·墨菲（Cillian Murphy）饰演的奥本海默一开始就承认自己想念新墨西哥，他和弟弟在那里曾经拥有一个牧场。“小时候，”他说，“我想过如果能找到一个方法把物理学和新墨西哥州结合起来，我的人生就完美了。”

除了历史和风景，这个小镇最引人注目的就是前身为奥本海默科学园区的洛斯阿拉莫斯国家实验室（Los Alamos National Laboratory），核武器研究一直在这里继续着。但在诺兰的电影上映后，这里的居民铺开了迎宾的红地毯。旅游业热度大增。曼哈顿计划国家历史公园（Manhattan Project National Historical Park）的负责人温迪·伯曼（Wendy Berhman）说，自去年以来，这里的游客人数翻了一番不止。

即使在好莱坞大腕突然光临这片沙漠的一年之后，当地人仍然对他们念念不忘。“我相信，诺兰决定在奥本海默的房子里拍摄的那一刻我就在场，”洛斯阿拉莫斯历史协会的莱斯利·林克（Leslie Linke）说，“我能从他的眼神中看出来。”

诺兰的影片着重刻画了奥本海默的内心挣扎，一方面不懈追求科学探索，另一方面对于自己实验室的发明的致命用途充满道德疑虑。而洛斯阿拉莫斯的那些曼哈顿计划的圣地让人感到的更多的是欢庆而非沉重。镇上的各种标牌致敬科学家们“结束了第二次世界大战”，“阻止了全球冲突”。然而，对奥本海默的遗产的一种重新审视正在慢慢发生。游客中心的海报提到那些因为政府要建造奥本海默的秘密城市而被迫离开自己土地的西班牙裔农民和部落。暴露在三位一体核试验的辐射下的被称为“下风口居民”的新墨西哥人说，自己的健康是美国核武优势的牺牲品。

也许洛斯阿拉莫斯近来声名鹊起会加速故事的重新讲述。但就目前而言，这个小镇就是奥本海默的天下，时时刻刻如此。“罗伯特建造了那地方，”由小罗伯特·唐尼（Robert Downey Jr）饰演的终极反派路易斯·施特劳斯（Lewis Strauss）说，“他集创立者、市长和警长于一身。”■



Destroyer of worlds

Oppenheimer's secret city is a shrine to the Manhattan Project

A tiny town in New Mexico is proud to be the place the bomb was invented

WALK AROUND the old historic centre of Los Alamos, New Mexico, and J. Robert Oppenheimer greets you at every turn. The local event centre—which hosted an Oppenheimer festival to celebrate the release of Christopher Nolan’s new film about the father of the atomic bomb—is just off Oppenheimer Drive. A bronze statue of Oppenheimer, dapper hat and pipe included, stands on a street corner. The local pub offers Oppenheimer trivia. To pay homage to the “Trinity test” detonation of Oppenheimer’s bomb in the New Mexican desert, there is Trinity Drive, Trinity Urgent Care and Trinity on the Hill Episcopal Church.

When Oppenheimer was recruited to run the Manhattan Project in 1942, he chose to build his laboratories in Los Alamos. The site, in the government’s view, was an ideal place for bomb-building. The desert mesas and ponderosa pine forests offered solitude and secrecy. But Oppenheimer also had a personal reason for picking the Land of Enchantment. Early in Mr Nolan’s film, Oppenheimer (Cillian Murphy) admits to being homesick for New Mexico, where he and his brother owned a ranch. “When I was a kid”, he says, “I thought if I could find a way to mix physics and New Mexico, my life would be perfect.”

The most notable thing about the town, apart from its history and vistas, is that it is home to the Los Alamos National Laboratory, the successor to Oppenheimer’s science campus, where research on nuclear weapons continues. But the release of Mr Nolan’s film has residents rolling out the red carpet. Tourism is surging. Wendy Berhman, who runs the Manhattan Project National Historical Park, says visitor numbers have more than

doubled since last year.

Locals are still starstruck, even a year after Hollywood's glitterati descended on their stretch of desert. "I believe I was there when Nolan decided to film in the Oppenheimer house," says Leslie Linke of the Los Alamos Historical Society. "I could see it in his eyes."

Mr Nolan's film dwells on Oppenheimer's internal battle between his relentless pursuit of scientific inquiry and his moral qualms about the lethal purpose of his lab's invention. Yet Los Alamos's shrines to the Manhattan Project feel more celebratory than sombre. Plaques around town salute the scientists whose work "ended world war two" and "deterring global conflict". A re-examination of Oppenheimer's legacy is slowly taking place, however. Posters in the visitor centre mention the Hispanic homesteaders and tribes that were forced off their land so the government could build Oppenheimer's secret city. New Mexicans exposed to radiation from the Trinity test, known as "Downwinders", say their health was sacrificed for America's atomic advantage.

Perhaps Los Alamos's newfound fame will hasten that retelling. But for now, the town is all Oppenheimer, all the time. "Robert built that place," says Lewis Strauss (Robert Downey Jr), the film's eventual villain. "He was founder, mayor and sheriff, all rolled into one." ■



【首文】阳光灿烂的日子

天气预报已取得长足进步。它的未来更光明

要充分发挥其潜力，需要做三件事

二战后，一台名为MANIAC的计算机在美国普林斯顿（Princeton）被研制出来，它每秒可以快速运算一万次。这种非凡的能力被用来解决两个重要问题：模拟热核爆炸和地球天气。这是MANIAC的发明者当时所能想到的两个最重要的用处。

今天速度最快的计算机一小时的运算量要耗费MANIAC一整个宇宙历史的时长——138亿年——才能完成。不过，尽管今天的超级计算机在性能和应用范围上都已提升，它们还是有很大一部分算力被用在武器和天气上。它们在氢弹研制中的作用除了带来一种无言的恐惧，对大部分日常生活无甚影响。但它们在世界各地的天气预报机构中所做的工作在几乎所有地方都有实际应用。

根据世界银行和其他机构的研究，数值天气预报（NWP）每年带来1620亿美元的收益。当今任何一个农民或军事指挥官都能证实它的成效。日常生活的方方面面也能感受到它的存在。所有智能手机都少不了代表太阳、雨、风或云的图标。人们根据天气预报决定出门不带伞也更有把握了。

随着机器学习和其他形式的人工智能（AI）的应用，天气预报还会更加完善。用于NWP的超级计算机根据当前的天气情况、物理定律以及各种经验法则计算未来几天的天气；这种高分辨率计算随随便便就能消耗万亿级的算力。而现在，仅仅用历史天气数据来训练的机器学习系统差不多已能媲美超级计算机的预报，至少在某些方面是这样。如果AI在其他领域的进步有什么参考意义的话，那么它在预报天气上的能力也才初露端倪。

此外，在某些情况下，使用AI似乎能够揭示出NWP仅靠计算无法得出的一些天气现象。而且AI相对较低的成本会吸引一些新来者进入气象业务。这些新来者有望带来为客户量身定制的产品，以及打开新市场的创意。

要充分利用这些潜力，需要做三件事。一是确保良性竞争不会损害基本框架。主导NWP的大部分是政府机构，它们投入了大量精力整合来自世界各地的观测结果，从而把天气信息统一处理为它们的模型所需的形式。这些机构可以向专门市场出售高价值的天气预报产品来收回成本。

要做到最好，就需要用这些处理好的数据来训练AI。但如果AI做到了最好，几乎肯定会抢走现有天气预报机构的一些业务。因此必须找到一条折中路线，既让新来者能得到大量数据来训练它们的AI，同时又不会让现有的预报机构损失太大。否则就可能危及它们精心创建的系统——它们使用这些系统把观测结果和计算转化为AI以及世界所依赖的数据集——至少目前是这样。

第二件事是将AI和数据处理结合起来，以应对气候变化。目前还不可能以天气预报的分辨率来运行气候模型。为AI系统打造的新硬件可能会有所帮助（芯片制造商英伟达对此有兴趣）。还可以用AI从这些模型所做的预测中寻找规律，使它们能够提供更多的有用信息，并作为一个桥梁，让非专业人士更容易利用它们的预测成果。

要能更容易利用成果，首先人们要有更便捷的获取信息的渠道。2019年，全球适应委员会（Global Commission on Adaptation）表示，如果能提前24小时预报破坏性天气事件，可以减少30%的损失；向发展中国家的预警系统投资八亿美元，每年可减少30亿至160亿美元的损失。因此，世界气象组织（World Meteorological Organisation）已经将2027年前实现“全民预警”作为其首要任务。该组织秘书长佩蒂瑞·塔拉斯（Petteri Taalas）认为，全世界四分之三的人拥有手机，却只有一半的国家有提醒民众的灾害预警系统，简直是荒唐。

要解决好这个问题并不需要什么突破性创新，只需少量的投资、详尽的规划、目标明确的磋商，以及有足够的政治决心来克服那些不可避免的制度障碍。这样的努力不是MANIAC的发明者所做的那种普罗米修斯式的大胆革新；它既不会点燃世界，也不会像之前的应用那样一直不温不火。但它应该可以挽救成千上万人的生命，保住千百万人的生计。■



A spell of sunshine

Weather forecasting has come far. Its future is brighter still

Three things need to be done to make the most of its potential

MANIAC, A COMPUTER designed at Princeton after the second world war, could perform a blistering 10,000 calculations a second. This extraordinary power was applied to two main problems: modelling thermonuclear explosions and the Earth's weather. They were the two most consequential applications the machine's creators could imagine.

It would have taken MANIAC the entire 13.8bn-year history of the universe to perform as many calculations as today's fastest computer can carry out in an hour. But though their abilities and ambit have increased, today's supercomputers still see a great deal of their capacity devoted to weaponry and weather. Their contributions to H-bomb design add little to most everyday lives beyond an undercurrent of dread. But their work on the weather at forecasting outfits around the world finds practical application almost everywhere.

Research from the World Bank and others puts the benefits of numerical weather prediction (NWP) at \$162bn a year. Its success can be attested to by any modern farmer or military commander. It can also be felt in the fabric of everyday life. No smartphone lacks icons redolent of sun, rain, wind or cloud. Deciding to leave an umbrella at home on a forecaster's advice is no longer necessarily a triumph of hope over experience.

The application of machine learning and other forms of artificial intelligence (AI) will improve things further. The supercomputers used for NWP calculate the next days' weather on the basis of current conditions, the laws of physics and various rules of thumb; doing so at a high resolution

eats up calculations by the trillion with ridiculous ease. Now machine-learning systems trained simply on past weather data can more or less match their forecasts, at least in some respects. If advances in AI elsewhere are any guide, that is only the beginning.

What is more, in some cases the AI approach seems able to reveal aspects of the weather's behaviour that NWP cannot reach by calculation alone. And AI's lower costs will attract new entrants into the weather business. They can be expected to bring products exquisitely tailored to customers' needs and fresh ideas that open new markets.

Three things need to be done to make the most of the possibilities. One is to ensure that healthy competition does not erode basic infrastructure. The mostly governmental outfits that dominate NWP put a great deal of effort into assimilating observations from around the world into the consistent representations of the weather their models need. The costs of this can be defrayed by selling high-value forecasts into specialist markets.

To do their best work, AIs will need to be trained on the data in those representations. But that best work will almost certainly undercut some of the current forecasters' wares. So a modus vivendi has to be found whereby being generous with the data new entrants need to train their AIs does not leave existing forecasters too much out of pocket. To do otherwise could threaten the meticulously set up systems they use to turn observation and computation into the data sets on which the AIs and the world rely, at least for the time being.

The second thing to be done is to bring together AI and number-crunching to deal with climate change. At the moment it is not possible to run climate models at the resolution used for weather forecasting. New hardware being built for AI systems could help (Nvidia, a chipmaker, is interested). And AI could also be used to look for patterns in the projections such models

produce, making them more informative, and as an interface that makes their insights more accessible to non-experts.

Before that becomes an issue, better access is needed in the here and now. In 2019 the Global Commission on Adaptation reported that 24 hours' notice of a destructive weather event could cut damage by 30%, and that a \$800m investment in early-warning systems for developing countries could prevent annual losses of \$3bn-16bn. Accordingly, the World Meteorological Organisation has made "Early Warnings for All" by 2027 its priority. Its chief, Petteri Taalas, argues that, given three out of four of the world's people have mobile phones, it is outrageous that only half their countries have systems to warn them of disaster.

No breakthroughs are required to put this right, just some modest investment, detailed planning, focused discussion and enough political determination to overcome the inevitable institutional barriers. It is not an effort in the Promethean tradition of MANIAC's begetters; it will neither set the world on fire nor model the ways in which it is already smouldering. But it should save thousands of lives and millions of livelihoods. ■



生育技术

改良造娃

体外受精让大多数女性失望。但新研究给未来投去曙光

一九七八年七月，路易斯·布朗（Louise Brown）在曼彻斯特出生。她父母的左邻右舍惊讶地发现，世界上第一个“试管婴儿”竟是“正常的”：两只眼睛、十根手指、十个脚趾头。自那以后的45年里，体外受精（IVF）已成为世界各地治疗不孕不育症的主要方法。已有至少1200万人从玻璃器皿中的受精卵生长而来。大约每45秒就有一名试管婴儿降生。他们和其他人一样健康、平平无奇。但对于他们经历了漫漫求子路的父母来说无异于奇迹。

在一个六分之一人口患有不孕症的世界里，这样的成功当然值得庆祝。但人们不大讨论体外受精的弊端。大多数疗程都失败了。这让女性以及夫妇情侣们陷入梦想和沮丧的循环，同时也激励了一个辅助生殖产业兜售虚假的希望。改善这种局面的障碍在于人类对生育的基本机制的了解止步不前。但现在，科学终于取得了进展，将为未来世代的准父母们带去更多的希望，更少的心碎。

多年来，体外受精在造婴方面的成功率已经提升，对于扛下了治疗大头的女性来说也已变得更安全。出现双胞胎和三胞胎的几率大幅下降，减少了高风险怀孕的数量。激素治疗变得更安全。配合卵子和精子冷冻保存、捐赠及代孕，体外受精为包括同性情侣和单身人士在内的众多原本无计可施的人们开辟了一条通往为人父母的路径。

但这个过程仍然累人且昂贵。女性要承受身体上的痛苦，而不论男女都要面对巨大的情感折磨。对于许多人来说，生育治疗是一种难以负担的奢侈品；例如在美国，一个治疗周期的费用可高达2万美元。一些国家基于保守的道德准则限定治疗数量。直至2021年，法国法律只允许已婚异性夫妇接受体外受精治疗。中国等许多国家都禁止冻卵这种延长生育年龄的操作。

作。

太多时候，这种痛苦和花费都是徒劳。2018年出生的77万名试管婴儿共耗费了约300万个治疗周期。许多女性经历一轮又一轮激素注射，有时还要辗转多家诊所。在美国和英国，即使经过数年和多达八个周期的治疗，也只有约一半人能抱着孩子回家。

这就助长了一个向极度渴望孩子的老客户反复兜售的辅助生殖产业。当一个治疗周期失败，许多诊所会拿出缺乏监管的“附加定制”选项——它们并不能明显提高成功几率，甚至可能反而降低几率。一项治疗可能收费几百至几千美元。

这些问题都源于同一个根本原因。尽管繁殖是人类生理的最基本方面之一，但对于新生命是如何产生的，科学家已经掌握的知识却少得惊人。最基本的元素毋庸赘言：一个精子和一个卵子必须结合。但生育的细胞、分子和遗传基础的许多方面都仍然迷雾重重。

一名女性的卵子储备如何在她出生前就已决定了？人类对此知之甚少。也不清楚为何它们的数量和质量会逐渐衰减直到绝经——在哺乳动物中已知只有人类和五种鲸鱼有更年期。胚泡如何在子宫内着床并连接至供血系统的复杂过程也仍是个谜。不孕不育通常被归类为“女性健康”，但男性因素在大约一半的不育异性情侣中至少发挥了一定的作用——尽管具体如何作用往往尚不清楚。

面对这一切，体外受精治疗是远远不够充分的。这种方法最初是为解决输卵管堵塞的问题——布朗的母亲就是因此而一直怀不上孩子。但如今，随着更多情侣在更高龄时尝试要孩子，女性的卵子储备减少日益可能是问题所在。在这一点上，体外受精所做的是收集更多卵子并尽可能提高它们受精的几率——相当于给了人们更多次掷骰子的机会。这会帮到少数幸运儿，但如果沒有一种全新的解决方法和新的治疗，许多求子者将经历一次又一次的失望。

最近的科研工作带来了一些希望。日本和美国的研究人员正在探索利用干

细胞（它们能够变成身体许多专门组织的任何一种）从皮肤和血细胞中造出卵子，这一过程称为体外配子生成（IVG）。在日本，研究人员用源自母鼠尾巴尖上的细胞繁育出了健康的幼鼠。今年早些时候，他们宣布拥有两个遗传生父的小鼠幼崽诞生。两个鼠爸爸一个贡献了精子，一个贡献了皮肤，这些皮肤先被转化为干细胞，再转化为卵子。

一些团队正在研究把这类方法应用于人类。就算有朝一日真能获得足够安全的细胞来获得健康的宝宝，这一天也还很遥远。但相关研究正在为精子和卵子的形成提供新见解。有了体外配子技术，研究人员可能不再需要依赖捐赠的卵子、精子和胚胎（通常由接受体外受精术的人们慷慨提供）来做研究。还有些团队正在用干细胞构建胚胎模型，名为“胚状体”。“胚状体”永远不会进入子宫，但可以帮助展示那些在子宫内的真正的胚胎经历了什么。

随着时间推移，新的疗法也可能随之而来。同性情侣可能会和异性情侣一样，获得和自己有遗传关系的子女。正在接受变性手术的跨性别者或许不再需要牺牲掉自己的生育能力。

所有这一切的发生都需要时间——这就是为什么体外受精技术仍然会很重要，而且需要投资和监管。对生育机制的理解提升应该有助于提高体外受精的成功率，降低其情感和经济成本。

新疗法最终可能预示着自布朗出生以来生育技术的最大变革。民意调查显示，在许多国家，人们生孩子的数量比他们想要的少，部分原因是他们推迟了生育时间。上世纪六七十年代的性解放让女性在不想生孩子的情况下可以选择不生，而新兴技术可能会带来一场新的革命，让女性——以及男性——在想生孩子的时候能生。 ■



Fertility technology

Making babymaking better

IVF is failing most women. But new research holds out hope for the future

AFTER LOUISE BROWN was born in Manchester in July 1978, her parents' neighbours were surprised to see that the world's first "test-tube baby" was "normal": two eyes, ten fingers, ten toes. In the 45 years since, in vitro fertilisation has become the main treatment for infertility around the world. At least 12m people have been conceived in glassware. An IVF baby takes its first gulp of air roughly every 45 seconds. IVF babies are just as healthy and unremarkable as any others. Yet to their parents, most of whom struggle with infertility for months or years, they are nothing short of miraculous.

In a world where one person in six suffers from infertility, such successes are rightly celebrated. Less discussed are the problems of IVF. Most courses of treatment fail. That subjects women and couples to cycles of dreaming and dejection—and gives the fertility industry an incentive to sell false hope. The obstacle is a lack of progress in understanding the basic mechanisms that determine fertility. At last, however, the science is making headway, holding out more promise and less heartache for generations of parents to come.

Over the years IVF has become better at making babies and safer for the women who bear the brunt of the treatment. The rate of twin and triplet deliveries has plummeted, reducing the number of risky pregnancies. Hormone treatments are safer. Combined with egg and sperm freezing, donation and surrogacy, IVF has given many, including same-sex couples and singletons, a path to parenthood where they had none.

Yet the process remains gruelling and costly. It is physically painful for

women, and emotionally draining for both sexes. For many, fertility treatment is an unaffordable luxury; in America, for instance, a cycle can cost \$20,000. Some countries ration treatment according to a conservative moral code. Until 2021 French law permitted IVF only for married heterosexual couples. Many countries including China forbid egg freezing, which extends reproductive years.

All too often, the pain and the cost come to nothing. The 770,000 IVF babies born in 2018 required some 3m cycles. Many women go through round after round of hormone injections, sometimes moving from one clinic to the next. In America and Britain roughly half go home with a baby in their arms, even after several years and as many as eight cycles of treatment.

This has fostered a fertility industry selling to repeat customers desperate to conceive. When a cycle fails, many clinics offer poorly regulated menus of “add-ons” that do not demonstrably raise the chances of success, and may even reduce them. They can charge hundreds to thousands of dollars for a treatment.

These problems all share a fundamental cause. Although reproduction is one of the most basic aspects of human biology, scientists have an astonishingly poor grasp of how a new life comes about. The essentials are obvious: a sperm and an egg must meet. But many of the cellular, molecular and genetic underpinnings of babymaking remain a mystery.

Little is known about how a woman’s stock of eggs is set before she is even born; or why they fade in number and quality until menopause, which among mammals is known to occur only in humans and five species of whale. The intricacies of how an embryo buries into the womb and connects to the blood supply are also mysterious. Infertility is often classed as “women’s health”, yet male factors play at least some role in roughly half of heterosexual infertile couples—though how is often unclear.

In the face of all this, IVF is woefully inadequate. It was devised as a fix for the blocked Fallopian tubes that prevented Ms Brown's mother from conceiving. But today, when more couples try for children later in life, a woman's declining stock of eggs is increasingly likely to be the problem. Here, IVF works by giving people more rolls of the dice, by collecting more eggs and maximising the odds that they will be fertilised. That will work for the lucky few, but without an entirely new approach and new treatments, many aspiring parents will endure one disappointment after another.

Recent scientific work offers some hope. Researchers in Japan and America are exploiting stem cells, which have the ability to become any of the body's many specialised tissues, to make eggs from skin and blood cells, a process called in vitro gametogenesis (IVG). In Japan healthy mouse pups have been created from cells that originated on the tips of their mothers' tails. Earlier this year researchers announced that they had delivered mouse pups that shared two genetic fathers. One had contributed sperm, the other skin, which was first turned into stem cells and then into eggs.

Some teams are working towards applying these techniques to humans. If cells safe enough to make healthy babies will ever be available, they are still far off. But the research is providing new insights into how sperm and eggs are made. IVG means that researchers may no longer need to rely for their studies on donated eggs, sperm and embryos, often generously provided by IVF patients. Other teams are using stem cells to build embryo models (dubbed "embryoids"). These will never see the inside of a womb but they can help show what happens to the real embryos that do.

In time, novel treatments may follow. Gay couples could have children that are as genetically related to them as those of straight ones. Trans people who are undergoing gender reassignment could possibly do so without sacrificing their fertility.

All this will take time—which is why IVF will remain important, and why it needs investment and regulation. A better understanding of fertility should help raise the success rate of IVF, bringing down its emotional and financial costs.

New treatments could eventually herald the biggest transformation in fertility technology since Ms Brown was born. Polling shows that in many countries people have fewer children than they would like, partly because they are putting off babymaking until later. Where the sexual revolution of the 1960s and '70s gave women the choice not to have babies if they did not wish to, emerging technology could usher in a new revolution, empowering women—and men—to have the babies they want, when they want them. ■



热浪照常升腾

极端气温将人们区隔为“安享凉爽的和吃尽苦头的”

一本关于热浪的新书读来就像恐怖故事【《先死于高温》书评】

《先死于高温》。杰夫·古德尔著。利特尔布朗公司；400页；29美元/25英镑。

一开始可能会是喉咙沙哑，嘴唇发干，舔多少次都没用。随着酷热击垮身体，头抽痛起来，视力变得模糊，接着整个世界陷入了黑暗。塞巴斯蒂安·佩雷斯（Sebastian Perez）死亡那天可能就经历了这般感受。

在俄勒冈州的威拉米特山谷（Willamette Valley），橡树和花旗松点缀着这个郁葱葱郁的葡萄酒之乡，这里6月末的最高气温通常徘徊在25°C左右。2021年6月26日早上，气温达到38°C，但佩雷斯仍然和往常一样出门上班，他要确保他受雇干活的苗圃里的小树有足够的水分抵御灼人的炎热。到下午3点，气温已经上升到41°C，佩雷斯已经倒下。他是一名移民农工，千里迢迢来到俄勒冈州，只为赚到足够的钱在危地马拉给妻子玛丽亚盖一座房子。“我答应过会等他，”她说，“现在他却躺在一个盒子里回家了。”

资深气候记者杰夫·古德尔（Jeff Goodell）的新作《先死于高温》（The Heat Will Kill You First）读来就像一本恐怖故事集。一对夫妇和他们一岁的女儿在北加州徒步时死于过热。2003年，一名巴黎女子在热浪过后回到自己的公寓，发现家里覆着一层干结的血和尿液。她楼上的邻居死了，一个多星期都没人发现尸体。

人类向大气中排放温室气体，造成气温上升，这本书是对其致命后果的一次非凡的调查。不像野火和飓风会产生火焰漩涡、将天空染成末日般的橙色，并淹没城市，热浪不容易用影像捕捉到。高温的屠杀悄无声息，它每年夺走的美国人的生命比其他任何天气都要多。“如何让一个隐形杀手的故事不再隐形？”古德尔问道。一些决策者正在为此努力，他们建立了新

的高温预警系统，并像对飓风那样给热浪命名。

这本书最重大的一个要点是，高温的危害不公平地落在了最无力自保的人身上。古德尔写道：“热浪是一场掠夺性事件，它单把最脆弱的人群挑出来除掉。”富裕的地方和人可以种植树木遮荫、涂上吸热沥青以反射更多的阳光、铺上锌屋顶、使他们的城市成为有空调的绿洲，或者搬到更凉快的地方。但对贫困人口和贫困地区来说，适应起来要困难得多。在专门讨论“廉价冷空气”的一章的结尾，古德尔总结道：“空调最持久的遗产可能是它在安享凉爽和吃尽苦头的人之间划下了一道鸿沟。”

这本书不只描绘了烈火地狱般的磨难。一些气候科学作者让读者淹没在数据中，他们好像只是写给其他活动家看的。古德尔不同，他把故事讲得生动活泼。读者会遇到许多令人难忘的人，他们努力弄明白哪些极端天气事件可以归因于气候变化，以此提高人们对气候变化的认知；他们帮助气候变化的受害者，为穿越亚利桑那州沙漠的移民送水，或者为农场工人争取更安全的工作条件。

古德尔果敢无畏的调查之旅会让一些读者看得精疲力竭。为了阐释海冰融化的影响，古德尔在加拿大北极地区与北极熊对峙，并从智利乘船到南极洲，途中穿越了一条危险的水路。在西得克萨斯州，他攀上了一块由古代海洋生物骨骼组成的岩层，这块岩层在2.6亿年前还在水下。

其他读者可能会掩卷而后怕。今年7月，全球平均气温在一周内三次打破纪录。三分之一的美国人生活在政府目前发布了极端高温警告的地区，欧洲也似乎随时准备打破之前的气温记录。《先死于高温》来得再适时不过了。 ■



The heat also rises

Extreme temperatures separate “the cool and the damned”

A new book on heatwaves reads like a horror story

The Heat Will Kill You First. By Jeff Goodell. Little, Brown and Company; 400 pages; \$29 and £25

IT MAY BEGIN with a cracked throat, lips that stay dry no matter how many times they are licked. As the heat overwhelms the body, the head throbs and vision goes blurry, before the world turns black. This is probably how Sebastian Perez felt on the day he died.

In late June in Willamette Valley, Oregon, where oak and Douglas fir trees dot the state’s lush wine country, top temperatures usually hover around 25°C (77°F). On the morning of June 26th 2021 it hit 38°C, but Mr Perez still went to work as usual, to try to ensure that the young trees at the nursery where he was employed had enough water to withstand the searing heat. By 3pm the temperature had risen to 41°C, and Mr Perez had collapsed. A migrant farmworker, he had journeyed to Oregon to make enough money to build his wife Maria a house back in Guatemala. “I promised I would wait for him,” she says, “and now he’s coming home in a box.”

“The Heat Will Kill You First”, a new book by Jeff Goodell, a longtime climate journalist, reads like an anthology of horror stories. A couple and their one-year-old daughter die of overheating on a hike in northern California. A Parisian woman returns to her flat after a heatwave in 2003 to find her home caked with blood and urine. Her upstairs neighbour had died, and no one found the body for more than a week.

The book is a remarkable exploration of the deadly consequences of rising temperatures wrought by humans pumping greenhouse gases into the

atmosphere. Unlike wildfires and hurricanes—which create whirls of flame, paint skies an apocalyptic orange and drown cities—heatwaves cannot easily be captured on film. Heat slaughters silently, snuffing out more American lives each year than any other type of weather. “How do you make visible the story of an invisible killer?” asks Mr Goodell. Some policymakers are trying, by creating new heat-warning systems and naming heatwaves as they do hurricanes.

The book’s biggest takeaway is that the harm from heat falls unfairly on those least able to protect themselves. “A heatwave is a predatory event,” writes Mr Goodell, “one that culls out the most vulnerable people.” Rich places and people can plant trees for shade, paint heat-absorbing asphalt to reflect more sunlight, retile zinc roofs, make their cities oases of air-conditioning or move to colder places. But adaptation is much harder for poor people and places. At the end of a chapter devoted to “cheap cold air”, Mr Goodell concludes that “the most enduring legacy of air-conditioning may be the divide it has created between the cool and the damned.”

The book isn’t all fire and brimstone. Unlike some climate-science writers who drown readers in data and seem to write only for other activists, Mr Goodell tells his story colourfully. Readers meet many memorable people working to raise awareness of climate change by figuring out which extreme weather events can be attributed to it, and helping its victims by leaving water for migrants crossing the Arizona desert or campaigning for safer conditions for farmworkers.

The author’s intrepid reporting will make some readers feel lazy. To illustrate the effects of melting sea ice, Mr Goodell faces down polar bears in the Canadian Arctic and crosses a treacherous passage on the way from Chile to Antarctica by boat. In West Texas he scales a rock formation made of the skeletons of ancient sea creatures, which 260m years ago was under water.

Other readers may feel frightened after reading this book. In July the average global air temperature broke records three times in a week. A third of Americans live in areas where the government is currently issuing warnings about extreme heat, and Europe looks poised to break previous temperature records. “The Heat Will Kill You First” could not be more timely. ■



熊彼特

好莱坞罢工大片票房可能要砸

明星vs老板

七月十三日，伦敦一家电影院里，一群光鲜亮丽的电影人和不那么光鲜亮丽的记者们一边嚼着爆米花，一边观看环球影业新片《奥本海默》（Oppenheimer）的首映式。当观众等待电影主演——希里安·墨菲（Cillian Murphy）、艾米莉·布朗特（Emily Blunt）、马特·达蒙（Matt Damon）等人入场时，上台致意的却是充满歉意的电影导演克里斯托弗·诺兰（Christopher Nolan）。他宣布，演员们刚刚回家了。“他们正在写标语，加入罢工纠察队。”

美国演员工会早些时候发起的罢工正好撞上美国编剧工会在五月开始的罢工，这在美国娱乐业引爆了一颗炸弹。其影响将传得更远：去年全球票房最高的十大影片中有九部是美国制作的，而美国的流媒体服务现在已经进入了世界各地的客厅。当明星们与电影公司对决时，世界上伟大的娱乐机器已经陷入停顿。

上一次编剧和演员一起罢工时，罗纳德·里根还在台上——还不是美国总统，而是演员工会的总裁。1960年时的争论焦点是电视，以及大银幕演员的作品在小荧幕上重播时该拿到什么样的报酬。今天的对抗也是关于新技术的。

其中一个担忧是人工智能。编剧和演员希望得到保证不会用它来制作剧本或克隆演员。更大的争论围绕流媒体。随着拥有百年历史的电影公司与苹果和亚马逊等财力雄厚的新对手争夺订户，“流媒体之战”导致内容支出激增。研究公司安培分析（Ampere Analysis）估计，去年全球电视和电影公司在节目制作上的支出超过2300亿美元，几乎是十年前支出的两倍。美国演艺界的就业增长速度大约是整体就业增长速度的两倍。

一些“演艺人才”仍然感觉自己受了亏待。流媒体平台会支付慷慨的预付

款，但在节目未来取得成功时给的分成更少。因此，虽然出演一部“哑弹”的报酬比十年前要高得多，但参演了一部大热剧不再意味着一生衣食无忧。尽管流媒体的产出往往在创造性上令人满意，比广播电视台更有拿奖项的潜力，但其剧季较短，导致工作不稳定。演员和编剧希望在节目上线时获得更高的最低工资和基于成功度的报酬。

从表面上看，他们处于强势地位。没有了编剧，创作管道就空了。没有了演员，雷德利·斯科特（Ridley Scott）的《角斗士》续集等正在制作中的内容已经停掉。即使电影已经制作完成，没有明星来宣传也会很难营销。7月15日，迪士尼不得不召集穿着米奇和米妮服装的艺人在《鬼屋》（Haunted Mansion）首映式上走红毯。8月的威尼斯电影节将是一场孤独的盛会。9月份的艾美奖颁奖典礼可能会被取消；有些人怀疑罢工是否会持续到明年3月的奥斯卡颁奖典礼。毫不奇怪，事实证明，罢工的明星们比电影公司里穿着西装的大佬更善于表达他们的担忧。演员工会现任主席弗兰·德雷舍（Fran Drescher）利用自己多年出演《保姆》（The Nanny）的经历，斥责“恶心”的电影公司头头儿们拿高薪。迪士尼老板鲍勃·艾格（Bob Iger）在被称为“亿万富翁夏令营”的太阳谷度假胜地接受采访作为回应；大约在同一时间，有消息称他最近委托建造了一艘新游艇。

然而，相比里根掌权之时，明星们今天这一役将更难打。罢工对电视节目表的干扰更小了，因为反正也不再遵照什么节目表。点播时代意味着观众在打开应用时面对海量的选择，缺上一个俩的也不显眼了。流媒体还减少了好莱坞对美国的依赖，不管是观众还是制作。奈飞（Netflix）是最极端的例子：根据安培分析公司的数据，其2.38亿订阅用户中有超过三分之二生活在海外，而过去12个月委托制作的节目中近三分之二是在海外制作的。（一位曾经的竞争对手机推测，它甚至可能很乐意将观众的消费从昂贵的美国作品转向这些成本更低的节目。）

在这个由系列电影主导的世界里，演员的经济影响力也比以前小了。6月，华纳兄弟更换了“超人”；索尼已经派出了多位蜘蛛侠（最近的一个是动画版）。正如美国队长的扮演者安东尼·麦基（Anthony Mackie）所说：“超级英雄的进化意味着电影明星的死亡。”随着观众厌倦了超级英

雄，电影公司正在寻找新的系列电影。今年迄今为止收入最高的电影是环球影业对电子游戏《超级马里奥兄弟》（Super Mario Bros）的动画重制。

最重要的是，娱乐业的困境意味着电影公司无法增加支出。像《夺宝奇兵》这样的大片票房继续低迷，预计今年的票房仍将比疫情前低四分之一。广播和有线电视业务正处于极度衰退之中。艾格在太阳谷接受采访时坦率地谈到了它们的未来：“构成这个行业的基础并在多年里带来巨额利润的商业模式肯定已经被打破了。”他说。华尔街已经开始要求流媒体不仅要带来增长，还要带来利润，从而引发了巨大的削减成本的热潮。甚至在罢工之前就有项目被取消。去年，华纳兄弟砍掉了一部已经拍摄完毕的《蝙蝠女》电影。罢工行动为进一步削减成本提供了有益的掩护：“许多股东和高管很乐意清理资产负债表。”一位前流媒体高管表示。演员们在纠察线上奉献了奥斯卡级别的表演。这一次，他们面对的是一群难取悦的观众。■



Schumpeter

Hollywood's blockbuster strike may become a flop

Stars v suits

MUNCHING POPCORN, a crowd of glamorous movie people and somewhat less glamorous journalists gathered in a London cinema on July 13th for the premiere of “Oppenheimer”, a new film from Universal Pictures. As the audience waited for the entrance of the movie’s stars—Cillian Murphy, Emily Blunt, Matt Damon and others—they were greeted instead by an apologetic Christopher Nolan, the film’s director. His cast had just gone home, he announced. “They’re off writing their signs, to join the picket lines.”

The strike called moments earlier by America’s Screen Actors Guild, which coincides with one by the Writers Guild of America that began in May, has detonated a bomb under America’s entertainment industry. The reverberations will travel much farther: nine of the ten biggest box-office hits worldwide last year were American-made, and American streaming services now reach into living rooms everywhere. As the stars face off against the studios, the world’s great entertainment machine has ground to a halt.

The last time writers and actors went on strike together Ronald Reagan was president—not yet of the United States, but of its actors’ union. The argument then, in 1960, was about television, and how big-screen actors should be compensated when their work was replayed on the small screen. Today’s confrontation is also about new technology.

One concern is artificial intelligence. Writers and actors want guarantees that it won’t be used to churn out scripts or clone performers. The bigger

argument is over streaming. The “streaming wars” have seen a surge in content spending, as century-old studios compete for subscribers with deep-pocketed new rivals like Apple and Amazon. Worldwide, TV and film companies spent more than \$230bn on programming last year, nearly double their expenditure a decade earlier, estimates Ampere Analysis, a research firm. Jobs in American show business are growing about twice as fast as employment overall.

Some “talent” still feel short-changed. Streamers make generous upfront payments, but they offer a smaller share in their projects’ future success. So whereas an appearance in a flop is much better paid than it was a decade ago, being part of a smash hit no longer means being set up for life. And although the streamers’ output tends to be creatively fulfilling, with more potential for awards than broadcast TV, their shorter seasons make work precarious. Actors and writers want higher minimum wages and a success-based payment when shows are released.

On the face of it they are in a strong position. Without writers, the creative pipeline is empty. Without actors, works-in-progress like Ridley Scott’s “Gladiator” sequel have been shut down. Even completed films will struggle without stars to promote them. Disney had to rustle up entertainers in Mickey and Minnie costumes to walk the red carpet at the premiere of “Haunted Mansion” on July 15th. The Venice film festival this month will be a lonely affair. The Emmy awards, in September, could be derailed; some wonder if the strike might even last until the Oscars, next March. Unsurprisingly, the striking stars are also proving better at communicating their concerns than the suits in the studios. Fran Drescher, current president of the actors’ union, drew on her years starring as “The Nanny” to scold “disgusting” studio chiefs for their fat salaries. Bob Iger, Disney’s boss, responded with an interview from a Sun Valley getaway known as “billionaires’ summer camp”; around the same time news leaked that he recently commissioned a new yacht.

Yet the stars will struggle more than they did when Reagan was in charge. Strikes are less disruptive to TV schedules now that there is no longer a schedule to disrupt. The on-demand era means viewers face a sea of choice on opening their apps; any gaps are less obvious. Streaming has also made Hollywood less reliant on America, both in terms of its audience and in terms of production. Netflix is the most extreme example: more than two-thirds of its 238m subscribers live overseas, and nearly two-thirds of the shows it commissioned in the past 12 months are being made abroad, according to Ampere Analysis. (It may even be happy to shift its viewers' consumption away from expensive American productions and towards to these lower-cost shows, speculates one sometime rival.)

In a world dominated by franchises, actors also wield less economic clout than they used to. In June Warner Bros replaced its Superman; Sony has fielded multiple Spider-Men (the most recent is animated). As Anthony Mackie, who plays Captain America, has put it: "The evolution of the superhero has meant the death of the movie star." And as audiences tire of superheroes, studios are finding new franchises. This year's highest-earning movie so far is Universal's animated reboot of "Super Mario Bros".

Above all, the distressed state of the entertainment business means studios are in no shape to increase their outgoings. Big titles like "Indiana Jones" continue to fizzle at the box office, which this year is expected still to be a quarter lower than before the pandemic. The broadcast and cable-TV businesses are in terminal decline. In his Sun Valley interview Mr Iger was frank about their future: "The business model that forms the underpinning of that business, and that has delivered great profits over the years, is definitely broken," he said. Wall Street has begun to demand that streamers deliver not just growth but profit, causing an almighty rush to trim costs. Even before the strike, projects were being cancelled. Last year Warner Bros canned a completed "Batgirl" film. The industrial action provides helpful cover for more cost-slashing: "A lot of shareholders and executives are

happy to clean up their balance-sheets," says one former streaming executive. The actors are delivering Oscar-worthy performances at the picket lines. This time, they face a tough crowd. ■



加大热度

最近的热浪是否表明气候变化正在加速?

在各种各样的地方录得各种各样的破纪录数字【深度】

七月三日，全球平均温度创下历史新高，之后估测气温持续高于去年才创下的上一个纪录。7月出现连续高温天原本或许不足为奇。地球上三分之二的陆地在北半球，并且陆地升温速度比海洋快，所以整个地球一年中最热的时候就是北半球的夏季。但最高气温往往会出现得更晚一些。今年的高温天来得这么早、温度这么高、持续这么久，是前所未见的。

海洋的情况也一样（见图表）。自3月13日以来，中低纬度地区的海面温度高于1979年以来任何一年的同一天。全球海面温度通常在南半球夏季时最高（地球上大部分的海洋都在南半球），而如今却在南半球冬季时达到了创纪录的水平。

不仅全球平均气温上升，某些地方还出现了极端高温。据报道，7月16日，新疆吐鲁番盆地（有时被称为中国的死亡谷）一地的气温高达52.2°C。在美国那个正牌的死亡谷，同一天最高气温达到了53.9°C。比这些在偏远沙漠里出现的极端高温更紧要的是，在一些有数亿人口居住的地方，气温也一直处于危险的高位。7月6日，在测得有史以来最高的7月气温后，北京市政府在两周内发布了第二次高温红色预警。7月19日，美国亚利桑那州凤凰城的气温连续第19天超过43°C。意大利及其周边许多国家也同样酷热难耐（见地图）。

当被问及这是怎么回事时，一位气候科学家冷冷地幽默道：“我猜这可能和大气中温室气体的积聚有点关系。”大气中温室气体增多，导致更多太阳辐射的热量被困在地表附近，并被海洋吸收。在夏威夷的莫纳罗亚山（Mauna Loa），5月测量到的二氧化碳浓度达到了百万分之424，是300多万年来的最高水平。二氧化碳是最主要的长寿命温室气体。另外两种长寿命温室气体甲烷和一氧化二氮也达到了人类历史上的最高水平。相比于

人类活动开始加厚温室的玻璃外壳之前，全球平均温度上升了1.2°C左右。

气候也有自然变化成因，其中最著名的是厄尔尼诺南方涛动（ENSO）现象，它正在为全球高温火上浇油。ENSO是发生在热带太平洋的海风和洋流的来回震荡。热带太平洋的海水有时会吸收过多的热量，有时又会释放过多热量。6月，世界进入了热量释放的“厄尔尼诺”期。厄尔尼诺对全球气温的影响往往要在它出现后的一年左右才达到高峰。但从眼下的海洋温度看来，这次的厄尔尼诺自一开始便势不可挡。

除了这些全球效应，还有一个问题是，把一条钟形曲线的顶部稍微向右移动一丁点也会大大改变曲线尾部的值。哥伦比亚大学的气候科学家詹姆斯·汉森（James Hansen）表示，那种在上世纪50年代到80年代间还是百年一遇的酷暑如今已经变成了五年一遇。如果世界各地出现酷暑的几率都更高了，那么多个区域同时遭受酷热的几率也会加大。

那么，大气中的“保温层”增厚、太平洋释放热量以及年与年之间差异的随机影响是否足以解释今年夏天反常的高温呢？还是还有什么别的原因？

汉森认为是有的。他认为世界变暖的速度在2010年代似乎经历了一次阶跃式变化，尽管他还没能让同行们信服这一点。今年夏天的反常现象，尤其是北大西洋地区连续录得创纪录高温，可能有助于增加他的说服力。牛津大学的气候模拟专家迈尔斯·艾伦（Myles Allen）表示，“如果今后几年我们看到有论文认为〔大西洋的反常现象〕不仅仅是又一个极端现象，我不会感到惊讶。”

有几个因素可能正加快气候变暖。一个是去年1月太平洋的洪加东加-洪阿哈阿帕伊海底火山（Hunga Tonga-Hunga Ha'apai）喷发给平流层带来的变化。这是自菲律宾的皮纳图博火山（Mount Pinatubo）喷发以来地球上最大的一次火山喷发。1991年，皮纳图博火山向平流层喷射了数千万吨二氧化硫气体，这些气体反射了一部分的太阳光。全球气温因此下降了约0.5°C，并持续了一年左右。

洪加火山喷发时，并没有向平流层喷射那么多的含硫气体。但它却喷出了

大量的水蒸气——在7000万至1.5亿吨之间。水蒸气是一种强力温室气体。在低层大气中，它会很快凝结成雨或雪。而在平流层中，它会存留很长时间。研究认为，洪加火山喷发让平流层中的水蒸气增加了13%。这应该会让地球变暖。不过，就算洪加火山是目前全球高温的因素之一，它的影响也已经在减弱。

其他可能因素的影响正在逐渐加大。当冰河期结束时，大气中的甲烷含量急剧上升，带来了更加温暖的“间冰期”气候。一些科学家指出，近年来大气中甲烷含量的增加可以证明，类似的变暖可能正在发生。整个20世纪，大气中的甲烷含量都在上升，主要源于化石燃料使用增加以及农业。甲烷含量在本世纪刚开始时趋于平缓，但现在正以前所未有的速度增长。

毫无疑问，这其中仍然有农业和化石燃料的因素。但是，伦敦大学皇家霍洛威学院（Royal Holloway）的地球科学家尤安·尼斯波特（Euan Nisbet）及其同事撰写的不久前被《全球生物地球化学循环》（Global Biogeochemical Cycles）接受的论文认为，甲烷增多并不能完全归咎于这两点。

他们认为，增多的甲烷可能来自热带湿地的扩大，那里的植物腐烂时会产生甲烷。这有可能是导致冰河期末期甲烷激增的一个因素。果真如此的话，就意味着可能在今天启动了一种反馈循环，与过去那些似乎已经运作过的循环类似。甲烷越多，升温就越多。升温越多，湿地就越多，从而产生更多甲烷。

这种观点目前还只是推测。或许更合理的解释是硫的排放在下降。燃烧煤和重燃油会产生大量二氧化硫。二氧化硫一旦进入大气层就会形成硫酸盐微粒，进而造成空气污染，导致每年数十万人死亡。几十年来，环境监管机构一直在想办法减少硫的排放。

但低层大气中的硫酸盐微粒会反射阳光，就像火山喷发后平流层中产生的硫酸盐微粒一样。而且与通常极其干燥的平流层不同，低层大气中的硫酸盐微粒有助于形成云，进而反射更多阳光。控制污染也一并使得这种让气

候变冷的副作用被削弱了。

一个特别相关的事件是2020年有关船舶燃料硫含量的新规定生效。国际海事组织（International Maritime Organisation）出台该规定是基于它每年能挽救约四万人性命的估计。一般认为新规使得航运业的硫排放减少了超过80%。这一点可以从全球范围内“船尾迹”的减少得到证明。船舶排放的废气中含有硫酸盐微粒，以这些颗粒为凝结核而形成的水滴聚集在一起，生成的又细又长的云便是船尾迹。船尾迹越少、越暗淡，且其他云朵也变稀薄的话，就表示反射回太空的阳光越少——阳光大部分被下面的海洋吸收了。

众所周知，在气候模型中很难捕捉到悬浮微粒对云量的间接影响。对于航运污染可能让气温下降了多少，不同估算结果之间的差异能达到十倍之大。但汉森认为这种变化可以合理地解释他在数据中看到的加速变暖的大部分。从1970年到2010年，全球变暖的速度为每十年升温 0.18°C 。大约从2015年起，汉森认为，速度已经达到每十年 0.27°C 到 0.36°C 之间，是之前的1.5到两倍。艾伦及其同事去年发表的一份研究报告发现了类似的变暖趋势，但该报告同时警告称，这可能是受到自然变化的强烈影响，而悬浮微粒的影响比汉森认定的要小得多。“很难量化人类在这些看似前所未有的事件中所起的作用。”艾伦提醒道。

酷热的世界可能会想办法在不损害空气质量和人类健康的情况下，让硫酸盐继续发挥其降温的特性。2006年，大气科学家保罗·克鲁岑（Paul Crutzen）建议，可以通过不断向平流层直接喷射少量含硫微粒来实现这一目标。由于不会有雨水将它们冲走，高高悬浮在平流层的微粒比在低层大气中存在的时间要长得多。

这就意味着，向平流层添加几百万吨二氧化硫（从技术上讲很有可能实现）带来的降温效果将相当于人类每年向低层大气中排放的约一亿吨二氧化硫。而就和变暖本身一样，它对极端气温的影响将大于对平均气温的影响。分布曲线尾部的那些负面事件发生的可能性会大大降低。

作为“太阳地球工程”的一种形式，这种思路存在争议，而且争议的理由也站得住脚。人们还不能准确预测它对平流层化学结构的影响。特别值得关注的是它可能会对臭氧层造成何种影响。臭氧层阻挡了大量来自太阳的有害紫外线辐射，让它们不能到达地面。

由于太阳地球工程对气温和降雨量的影响会因地而异，适用于一个国家的降温方式未必符合其他国家的需求。当前任何一个全球治理体系都无法解决此类争端。最重要的是，这么一项不用停用化石燃料就可以让地球降温的技术很可能会让逐步淘汰化石燃料的进程放缓，甚至泡汤。

到目前为止，这些担忧占据了上风。太阳地球工程的研究一直处于边缘地位，它在气候政策中可能发挥的作用基本上没有被讨论过。就算有，所有参与此类讨论的人也都强调，这项工程充其量只能被视为脱碳的一种补充——在世界经济脱离化石燃料的进程中起到稍微减少极端风险的作用。但是人们担忧它会被用作一种替代方案，这种担忧有足够的说服力，因此很普遍。

不过，如果2023年不是个反常年份，而是世界确实正在进入一个加速变暖的时期，人们可能会重新评判太阳地球工程，不再那么排斥它。减少排放应该能在几十年里减缓地球变暖；倘若能以极大的热情全力减排，地球还可能在本世纪停止变暖。但在此期间，减排却不会让地球降温。如果世界各国确实想要给地球降温，看起来太阳地球工程是唯一的答案。■



Turning up the heat

Are the current heatwaves evidence that climate change is speeding up?

All sorts of records are being broken in all sorts of places

ESTIMATES OF Earth's average temperature, having set a new record on July 3rd, have yet to fall back below the previous record, which was set just last year. That a run of very hot days should happen in July is, by itself, perhaps unsurprising. Two-thirds of the Earth's land is in the northern hemisphere, and land warms up faster than water does, so northern summers are the hottest times of year for the planet as a whole. But the highest temperatures tend to come later in the season. That this year's should start so early, rise so high and run so long is unprecedented.

So is what is happening in the oceans (see chart). Since March 13th the sea-surface temperature in low- and mid-latitudes has been higher than on the same day in any year since 1979. Normally highest in the southern summer (most of Earth's water is in the south), temperatures are at record levels in the southern winter.

Within the rising global averages lie savage peaks in particular places. On July 16th a site in the Turpan Depression in Xinjiang, sometimes called China's Death Valley, reported a high of 52.2°C. In America, in Death Valley proper, the same day saw a peak of 53.9°C. Of more immediate concern than isolated spikes in deserts, temperatures have been dangerously high in places where hundreds of millions of people live, too. On July 6th, after the city measured its highest July temperature ever, authorities in Beijing announced their second red alert for heat in two weeks. July 19th marked the 19th day in a row that the temperature in Phoenix, Arizona, has exceeded 43°C. Things are similarly sweltering in Italy and many nearby countries (see map).

Asked how such a thing might be, one climate scientist replies drily “I suspect it might have something to do with accumulation of greenhouse gases in the atmosphere.” More greenhouse gas in the atmosphere results in more of the warmth from the sun being trapped near the surface and absorbed by the oceans. The level of carbon dioxide, the most important long-lived greenhouse gas, as measured at Mauna Loa, a mountain peak in Hawaii, reached 424 parts per million in May, the highest it has been for over 3m years. Methane and nitrous oxide, two other long-lived greenhouse gases, have also reached levels never before experienced by humans. The world is now, on average, around 1.2°C warmer than it was before humans started thickening the glass in the greenhouse.

The climate has natural variations, too, and the most famous of them, the El Niño Southern Oscillation (ENSO), is adding to the warmth. ENSO is a sloshing back and forth in the winds and currents of the tropical Pacific ocean which sometimes sees the waters suck up more heat, and sometimes sees them give more heat out. In June the world entered an “El Niño” phase, in which heat is released. The greatest effect of an El Niño on global temperatures tends to be seen after it has been in place for a year or so. But today’s ocean temperatures look like evidence of this one getting off to a flying start.

On top of these global effects, there is the fact that moving the top of a bell curve even a touch to the right can change the values in the tail a lot. According to James Hansen, a climate scientist at Columbia University, the sort of summer which would have been a once-in-a-century event between the 1950s and 1980s has become a once-every-five years event now. If sweltering summers are more likely everywhere, the chances of more than one region being affected at a time go up, too.

So are the thickening of the atmospheric blanket, an outpouring of heat from the Pacific and the random effects of year-on-year variation enough to

explain this summer's freakish temperatures? Or is there something more going on?

Dr Hansen thinks there is. He argues that the rate at which the world is warming seems to have gone through a step change in the 2010s, though he has not yet convinced his peers. This summer's surprises, especially a run of record temperatures in the North Atlantic, might help change that. "I wouldn't be surprised if we see papers appearing over the next few years saying [the Atlantic anomaly is] more than just another extreme," says Myles Allen, a climate modeller at Oxford University.

Several things could be speeding up warming. One is the change to the stratosphere brought about by the eruption of Hunga Tonga–Hunga Ha'apai, a submarine Pacific volcano, in January 2022. This was the largest eruption on Earth since Mount Pinatubo, in the Philippines. In 1991 Pinatubo injected tens of millions of tonnes of sulphur-dioxide gas into the stratosphere, where it reflected some of the sun's light. The result was a worldwide cooling of about 0.5°C that lasted about a year.

The Hunga eruption did not throw anything like that much sulphur into the stratosphere. But it did pump in a great deal of water vapour; between 70m and 150m tonnes. Water vapour is a powerful greenhouse gas. In the lower atmosphere it condenses out into rain or snow fairly quickly. In the stratosphere, though, it lingers for longer. The Hunga eruption is thought to have increased the amount of water vapour in the stratosphere by 13%. That would have warmed the planet—though if Hunga is playing a role, it is one that is already waning.

Other possible influences are waxing. When ice ages end, methane levels in the atmosphere shoot up, ushering in the warmer climate of the "interglacial" to come. Some scientists cite recent increases in methane levels as evidence that something similar may be afoot today. Methane

levels rose throughout the 20th century, mainly because of the rising use of fossil fuels and agriculture. They flattened off at the beginning of the 21st century, but are now growing faster than ever.

Some of this is doubtless still because of farming and fossil fuels. But a paper by Euan Nisbet, an Earth scientist at Royal Holloway, and his colleagues, and recently accepted for publication in *Global Biogeochemical Cycles*, argues that not all the extra methane can be explained that way.

The researchers think that the surplus may be coming from the growth of tropical wetlands, whose plants produce the gas when they rot. This is one candidate for the mechanism that drives the methane spikes seen at the end of ice ages. If true, it opens up the possibility of a feedback loop starting today similar to the ones that seem to have operated in the past. More methane means more warming, which means more wetlands, and therefore more methane.

That idea is speculative, for now. Perhaps a more plausible culprit is falling emissions of sulphur. The burning of coal and heavy fuel oil produces a lot of sulphur dioxide. Once in the atmosphere that gas forms sulphate particles. These particles cause air pollution leading to hundreds of thousands of deaths every year. Environmental regulators have been trying to reduce sulphur emissions for decades.

But sulphate particles in the lower atmosphere reflect sunlight, just like those created in the stratosphere after volcanic eruptions. And, unlike those in the normally bone-dry stratosphere, particles lower down can help create clouds which reflect away more sunshine still. Controls on pollution mean that this climate-cooling side effect has been weakening.

Of particular relevance are new regulations on the sulphur content in shipping fuel that came into force in 2020. The regulations were brought

in by the International Maritime Organisation on the basis of estimates that they would save around 40,000 lives a year. They are thought to have reduced sulphur emissions from shipping by more than 80%. The evidence is visible as a worldwide decline in “ship tracks”, long, thin clouds created when sulphate particles in a ship’s exhaust provide nuclei around which water droplets can form. Fewer, fainter ship tracks and other clouds mean less sunlight is bouncing back out to space, and is instead being absorbed by the oceans below.

The indirect effects that aerosol particles have on cloud cover are notoriously hard to capture in climate models. Estimates of how much cooling shipping pollution might have caused vary by a factor of ten. But Dr Hansen thinks the changes could plausibly explain most of the quicker warming that he sees in the data. From 1970 to 2010 the warming trend was 0.18°C a decade. Since around 2015, Dr Hansen thinks it has been between 0.27°C and 0.36°C per decade—between half as high again and twice as high. A study by Dr Allen and his colleagues published last year sees a similar increase in the trend, but warns that it may be strongly influenced by natural variability, with aerosol effects playing a much smaller role than that which Dr Hansen would assign them. “Quantifying the role of human influence in these apparently unprecedented events is hard,” Dr Allen cautions.

A sweltering world might try to find a way to keep the cooling properties of sulphates without the drawbacks for air quality and health. In 2006 Paul Crutzen, an atmospheric scientist, suggested this might be done by continuously injecting small amounts of sulphur directly into the stratosphere. Since there is no rain to flush them out, high-flying stratospheric particles last much longer than those in the lower atmosphere.

That means that a few million tonnes of sulphur dioxide added to the stratosphere—technically quite plausible—could provide as much cooling

as the 100m tonnes or so that humans dump into the lower atmosphere each year. And as with warming itself, its effect on extremes would be greater than its effect on averages. Unwelcome things in the tail of the distribution could be made a lot less likely.

This idea, a form of “solar geoengineering”, is controversial, and with good reason. Its effects on stratospheric chemistry cannot yet be predicted accurately. Of particular concern are what it might do to the ozone layer, which screens out a good deal of the sun’s harmful ultraviolet radiation before it reaches the ground.

Because solar geoengineering’s effects on rainfall, as well as temperature, would differ from place to place, a cooling tailored to the needs of one country might not be to the taste of others. Settling such disputes is beyond any current system of global governance. Above all, a technology that could cool the planet without ending fossil-fuel use might well slow or even scupper that phase-out.

So far these worries have carried the day. Research on solar geoengineering has been side-lined, and its possible role in climate policy has gone largely undiscussed. All those who take part in such discussions as there are stress that solar geoengineering should at best be seen as a complement to decarbonisation, shaving off extreme risks while the world moves towards a fossil-free economy. But the fear that it would instead be treated as an alternative is sufficiently persuasive as to be pervasive.

If 2023 is not an aberration, though, and the world really is moving into an accelerated phase of warming, that reluctance might be reassessed. Emissions reduction should be able to slow the warming of the Earth within a few decades. Pursued with real zeal, it might bring it to an end this century. But it provides no cooling in the meantime. If that proves to be what the world wants, solar geoengineering is the only thing which looks able to

provide it. ■



新车型

特斯拉主导电动汽车的新路径出人意料

变得更像自己颠覆的行业【深度】

特斯拉在2011年表示，它的目标是成为“21世纪最引人注目的汽车公司，加速世界向电动汽车的转向”。这在当时听来很像痴人说梦。自2003年成立以后的八年里，该公司仅仅生产了1650辆电动汽车。它的第一款畅销汽车Model S当时尚未上路。

今天，如果说在2008后出任这家汽车制造商老板的马斯克尚未实现那个目标，那几乎同样会被认为是一派胡言。在一个准入壁垒森严的行业里，他的公司是一个罕见的反叛者，已经以惊人的速度发展壮大。2023年第一季度，特斯拉的Model Y小型SUV成了全球最畅销的汽车。第二季度共交付了46.6万辆车，超出了分析师的预测（见图表1）。马斯克承诺今年的销量将从2022年的130万辆增至200万辆，这样的目标似乎不再是异想天开。7月15日，第一辆棱角分明、复古未来风的皮卡Cybertruck下线。特斯拉刚刚公布了其德国工厂的扩建计划，希望将工厂产能翻一番，达到每年100万辆。

除了几乎凭一己之力重构了汽车这样交通工具，马斯克还重塑了汽车行业。他专注于少数几个车型，简化生产，从而控制了成本。去年，特斯拉的营业利润率为17%，在非小众汽车制造商中，只有保时捷（年产量不足100万辆）的业绩与其相当。

马斯克计划到2030年实现年产2000万辆电动汽车，这是当今最大汽车制造商丰田年产量的两倍，特斯拉还创建了辅助自动驾驶系统。要以此主导汽车行业的抱负无疑吸引了投资者，他们对特斯拉的估值约为9000亿美元。这比2022年初超过1万亿美元的估值有所下降，但仍高于排在其后的九家最有价值车企的总和。老牌车企正在争先恐后地将产品线电气化，并效仿马斯克的垂直整合生产模式，同时抵御一批电动汽车新势力的挑战。

这些新来者中有许多是中国企业，都试图成为下一个特斯拉。

现在的问题是，特斯拉能否在更长的时间里保持这样的高增长和盈利。该公司在7月19日最新季报中公布的利润率为9.6%，比前一个季度费劲达到的11.4%还要低，这是它为了与价格更低的对手竞争而大幅降价（见图表2）所致。它作为一家硅谷思维方式的颠覆性科技公司的优势有被侵蚀的危险。巴克莱银行的丹·利维（Dan Levy）表示，在本个十年内实现哪怕年产500万至600万辆车（比马斯克年产2000万辆的目标更现实）都需要“采用传统汽车业技能”。为了能继续充当一股颠覆力量，特斯拉可能需要变得更像被它撼动的古板汽车行业一些，这有些自相矛盾。

投资银行杰富瑞（Jefferies）的菲利普·霍乔斯（Philippe Houchois）指出，特斯拉在电池、软件和制造生产率方面仍领先于更传统的竞争对手。但对手正在迎头赶上。霍乔斯指出，在营销和产品规划等领域，它们已经超越了特斯拉。当大尺寸、高价格、大电池、长续航的Model S上市时，特斯拉在很大程度上统霸了电动汽车市场。如今，驾驶者有数十个品牌的500款左右的电动车型可以选择。经纪公司盛博（Bernstein）估计，今年可能会推出约220款新车型，2024年还会有180款（见图表3）。面对各方竞争，特斯拉要实现快速增长可不容易。

与传统车企“总有一款适合你”的做法不同，特斯拉只生产五款车型（如果算上Cybertruck），并且主要依赖其中两款。Model 3（小型轿车）和Model Y占它销量的95%。相比之下，丰田的两款畅销车型卡罗拉和RAV4荣放仅占该日本公司销量的18%。特斯拉要实现Model 3和Model Y合计销售300万至400万辆的目标，每款车型都需要占据同级别汽车市场的50%（即价位4万至6万美元的大众市场车型和价位4.5万至6.5万美元的SUV市场）。盛博指出，迄今还没有任何一家汽车制造商在这两个细分市场获得超过10%的占有率。

而且特斯拉的这两个车型都在老化。Model Y已经问世三年，Model 3刚过六年，这让它们在一个历来重视新颖度的行业中吸引力下降。汽车制造商保持销量增长的经验法则是每2至4年做一次改款，每4至7年彻底更换设

计。特斯拉计划在今年对Model 3的外形和科技感内饰“改款”，以行业标准来看似乎有些晚了。

特斯拉需要远远超越当前的战略，不能只是提供软件更新来改进其汽车的某些功能或添加新功能。这在最初吸引技术迷客户“尝新”时可能有用，但不太可能打动普通驾车者。一种解决方案是为现有车型提供更多选择。巴克莱估计Model 3有180项选装配置，相比同等价位的宝马3系轿车（汽油动力）的19.5万项只是个零头。但这会带来马斯克迄今为止一直在避免的那种复杂性。

另一种提高销量的途径是推出新车型，例如Cybertruck或一款低价大众市场车型，后者的非正式名称为“Model 2”，2.5万美元起，马斯克承诺将在未来两三内开始销售。然而，新车型也带来了新挑战。盛博表示，皮卡市场的全球销量为130万辆，规模相对较小，而且Cybertruck大胆的造型可能会限制其吸引力。而尽管低价的特斯拉汽车可以扩展公司的市场而不仅限于美国、中国和欧洲，但它们的利润率几乎肯定会更低，从而进一步抑制公司的整体盈利能力。此外，像老牌车企一直以来所做的那样，让区域分公司获得更大的自主权以管理响应本地的喜好，又会增加复杂性和成本。

马斯克可能也无法再回避行业内通行的其他高成本做法。一是营销。其他所有大型车企都在广告上花费巨资，特斯拉不一样，它推广产品靠的是口碑和马斯克本人的传奇形象。巴克莱银行认为，特斯拉不做广告以及绕过经销商直接向客户销售的做法为公司在售出的每辆车上节省下2500至4000美元的成本。但因为要寻求新客户，也因为马斯克对推特（他花费440亿美元的副业项目）的管理引发的舆论两极分化可能会影响到特斯拉的销售，该公司很可能会放弃一部分节省成本的做法。马斯克也承认了这一点，他表示公司可能将首次“试着做一点广告”。

另一个特斯拉拖了很久才妥协的业内常见操作是降价。马斯克曾承诺永远不打折，也不积累库存。这两件事他的公司近期都做了。过去五个季度的产量都超过了销量。经历了多年来年均60%的高速增长之后，从2022年第二季度至2023年第一季度，季度销量平均增速为30%至40%。为了提升销

量，马斯克去年年底开始大幅降价，某些车型的降价幅度高达25%。果然，第二季度的销量同比增长了80%以上，另一方面自然是利润率相应萎缩。与竞争对手相比，投资者对马斯克降价的容忍度更高。7月17日，福特宣布大幅下调F-150 Lightning电动皮卡价格，其股价应声下跌了6%。但投资者可能不会永远这么宽容。

随着各种成本上升，特斯拉将努力在其他方面继续削减成本，特别是在生产制造上。今年3月，该公司推出了所谓的“开箱工艺”，想要通过简化甚至取消一些生产工序让汽车变得“简单得多也便宜得多”。目前尚不清楚马斯克到底打的是什么算盘。尽管马斯克在工程创新上颇有建树，但之前在试图颠覆汽车制造时至少经历过一次惨败——他曾想用机器人替代人类员工生产Model 3，结果连他自己都坦言这导致了“生产地狱”，公司在2018年差点因此破产。

马斯克面临的最后一个新挑战也是他与西方老牌车厂共同面临的另一个挑战，即该如何对待中国。特斯拉一半以上的汽车在上海的巨型工厂里生产，但它在中国似乎不再享有从前的特殊待遇。在上海建厂时，特斯拉不像其他外国车企那样必须与中国合作伙伴合资，当时中国需要马斯克为中国车主供应电动汽车，并且很重要的是，中国想要通过引进特斯拉促进自己新兴的电动汽车行业提升水平。

这种安排成效极佳。据信第二季度特斯拉在中国卖出了15.5万辆车，比前三个月增长了13%。但投资公司招银国际证券认为，随着买家转向快速进步的本土品牌，特斯拉的市场份额可能已从上一季度的16%下滑至14%以下。现在特斯拉需要中国更胜于中国需要特斯拉，从该公司被迫于7月6日与其他汽车公司一道签署承诺书可见一斑。特斯拉承诺停止价格战，公平竞争，弘扬“社会主义核心价值观”。咨询公司Sino Auto Insights的涂乐表示，如今传言四起，说中国当局正在拒绝特斯拉提高在华产能的努力。更别说还有日益麻烦的中美商业地缘政治了。

如果特斯拉要实现到2030年每年销售600万辆车且营业利润率达到14%（巴克莱银行的利维认为这有可能实现），那么它可能至少需要避免

以上提到的部分陷阱。考虑到特斯拉擅长让怀疑者大跌眼镜，认为它绝无可能做到会是愚蠢的。例如，它可以通过新的收入来源弥补一部分销售增长放缓，最近向福特和通用汽车的车主开放充电网络的交易就是如此。随着品牌逐渐由数字化的驾驶体验而非车身外壳或操控性来定义，特斯拉卓越的软件（包括未来真正的完全无人驾驶系统）或许能允许它继续提供比竞争对手更少的车型。涂乐认为，特斯拉将通过在德国等国生产更多汽车（包括低成本汽车）来降低“中国风险”。特斯拉是21世纪初无可争议的最引人注目的汽车公司。如果它想保住这个头衔，它必须为之而努力。 ■



A new model

Tesla's surprising new route to EV domination

Become more like the industry you disrupted

IN 2011 TESLA stated an aim of becoming “the most compelling car company of the 21st century, while accelerating the world’s transition to electric vehicles”. At the time this was easy to dismiss as crackers. In the eight years since its founding in 2003 the firm had manufactured a piddling 1,650 EVs. Its first big-selling car, the Model S, had yet to hit the road.

Today it is almost as mad to argue that Elon Musk, the carmaker’s boss since 2008, has not achieved that goal. His company, a rare insurgent in an industry with formidable barriers to entry, has grown at neck-snapping speed. In the first quarter of 2023 Tesla’s Model Y mini-SUV was the world’s bestselling car. In the second quarter it delivered a total of 466,000 cars, beating analysts’ forecasts (see chart 1). Mr Musk’s promise of 2m sales this year, up from 1.3m in 2022, no longer seems fanciful. On July 15th the first Cybertruck, an angular, retro-futuristic pickup, rolled off the production line. Tesla has just unveiled an expansion plan for its German factory, where it wants to double capacity to 1m vehicles per year.

Besides almost single-handedly reimagining the car, Mr Musk has done the same to the car industry. His focus on streamlined manufacturing of only a handful of models has kept costs at bay. Last year Tesla boasted operating margins of 17%; among non-niche carmakers only Porsche, which churns out fewer than 1m cars annually, matched its performance.

Mr Musk’s ambition to dominate the auto business—by making 20m cars a year by 2030, double the current output of today’s top manufacturer, Toyota, and by creating the go-to self-driving system—certainly compels investors,

who value Tesla at around \$900bn. That is down from over \$1trn in early 2022 but still more than the next nine most valuable carmakers put together. Incumbents are scrambling to electrify their product ranges and to copy Mr Musk's vertically integrated approach to production, while fending off a wave of EV newcomers, many of them Chinese, all trying to be the next Tesla.

The question now is whether Tesla can keep growing as fast and as profitably as it has for much longer. In its latest quarterly earnings on July 19th, it reported margins of 9.6%, even lower than the 11.4% it eked out in the three previous months, as it slashed prices in order to compete with cheaper rivals (see chart 2). Its advantages as a disruptive tech firm with a Silicon Valley mindset are in danger of being eroded. To make even 5m-6m cars a year this decade, a more realistic target than Mr Musk's goal of 20m, would require "embracing the techniques of legacy auto", observes Dan Levy of Barclays, a bank. In order to remain a disruptive force, Tesla may, paradoxically, need to become a bit more like the stodgy car business it has shaken up.

Tesla maintains a lead over its more established rivals in batteries, software and manufacturing productivity, notes Philippe Houchois of Jefferies, an investment bank. But competitors are catching up. In some areas, like marketing and product planning, they have overtaken it, notes Mr Houchois. When it launched the Model S—large and pricey with big batteries and a long range—it had the EV market largely to itself. Nowadays motorists can choose between 500 or so EV models from dozens of marques. Bernstein, a broker, estimates that around 220 new models may be launched this year and another 180 in 2024 (chart 3). For Tesla to grow fast in the face of all this competition will be difficult.

Unlike incumbent carmakers' "something for everybody" approach, Tesla manufactures just five models (if you count the Cybertruck) and relies

heavily on two of them. The Model 3, a small saloon, and the Model Y account for 95% of the vehicles Tesla shifts. By comparison, Toyota's two bestsellers, Corolla and RAV4, make up just 18% of the vehicles sold by the Japanese firm. For Tesla to hit its target of selling a combined 3m-4m Model 3s and Model Ys, each model would need to control 50% of the cars in its class (\$40,000-60,000 mass-market cars and \$45,000-65,000 SUVs, respectively). According to Bernstein, no carmaker has ever had more than 10% in those two segments.

And both models are ageing. The Model Y is three years old and the Model 3 has just turned six, which makes them less desirable in a business where novelty has historically counted for a lot. Carmaking's rule of thumb to keep sales chugging along is to refresh models every 2-4 years and redesign them completely every 4-7 years. Tesla's planned "refresh" of the Model 3's styling and its tech innards this year looks late by industry standards.

The company will need to go well beyond its current strategy, of offering software updates that improve some of its cars' features, or that add new ones. This may have done the trick for its original customer base of early-adopter techies but is unlikely to cut it with the average motorist. One solution is to offer more options for its existing range. Barclays estimates that the Model 3 comes in 180 configurations, a fraction of the 195,000 trims for a comparable (petrol-powered) BMW 3 Series saloon. But this would introduce the sort of complexity Mr Musk has hitherto shunned.

Another route to higher sales is to launch new models, like the Cybertruck or a low-cost mass-market vehicle—unofficially called the "Model 2" and with prices starting at \$25,000—which Mr Musk has promised to start selling in the next couple of years. New models, though, come with new challenges. The relevant pickup market, with global sales of 1.3m, according to Bernstein, is relatively modest—and the Cybertruck's bold styling may limit its appeal. And though low-cost Teslas could expand the company's

market beyond America, China and Europe, they would almost certainly generate lower margins, further depressing the company's overall profitability. Moreover, granting regional ventures greater autonomy to manage regional differences in taste, as established carmakers have historically done, again adds complexity and costs.

Mr Musk may no longer be able to avoid other expensive industry practices. One is marketing. In contrast to all other big carmakers, which spend princely sums on ads, Tesla has depended on word-of-mouth and Mr Musk's own larger-than-life persona to promote its products. Barclays reckons that eschewing ads and, by selling directly to buyers, bypassing dealers, currently saves the company \$2,500-4,000 for every car it sells. As it seeks new customers, and as Mr Musk risks affecting Tesla sales with his polarising stewardship of Twitter, his \$44bn side-project, the company is likely to forgo some of those savings. Mr Musk has conceded as much, saying that, for the first time, his company might "try a little advertising".

Another carmaking staple to which Tesla has belatedly come around is price cuts. Mr Musk had pledged never to offer discounts or allow inventory to build up. His company has lately done both. Production exceeded sales in the past five quarters. After growing at an average annual rate of 60% for years, quarterly sales volumes expanded by an average of 30-40% between the second quarter of 2022 and the first quarter of 2023. To shift more vehicles Mr Musk began slashing prices late last year, by up to 25% on some models. Sales duly ballooned, by more than 80% in the second quarter, compared with a year ago. The flipside was those duly contracting margins. Investors have tolerated Mr Musk's price cuts more than in the case of his rivals: on July 17th Ford's share price fell by 6% after it announced hefty discounts on its F-150 Lightning EV pickup. They may not stay so forgiving for ever.

As its various costs rise, Tesla will try to keep cutting them elsewhere,

notably in manufacturing. In March it unveiled what it called the “unboxed process”, designed to make cars “significantly simpler and more affordable” by streamlining or even eliminating stages of production. It is unclear what exactly Mr Musk has in mind. Despite his record of engineering ingenuity, at least one previous attempt to up-end car manufacturing, by replacing people with robots for the Model 3, led to what Mr Musk himself candidly described as “production hell” and near-bankruptcy in 2018.

Mr Musk’s last fresh challenge—and another one he shares with incumbent Western carmakers—is what to do about China. Tesla, which makes more than half its cars at its giant factory in Shanghai, no longer seems to hold its privileged position in the country. It was allowed to set up without the Chinese joint-venture partner required of other foreign carmakers, at a time when China needed Mr Musk to supply EVs for Chinese motorists and, importantly, to encourage China’s own budding EV industry to raise its game.

That has worked too well. Tesla is thought to have sold 155,000 cars in China in the second quarter, 13% more than in the previous three months. But China Merchants Bank International Securities, an investment firm, reckons its market share may have slipped below 14%, from 16% in the preceding quarter, as buyers switched to fast-improving home-grown brands. In a sign that Tesla now needs China more than China needs Tesla, the company was obliged to sign a pledge on July 6th with other car firms to stop its price war and compete fairly in line with “core socialist values”. Tu Le of Sino Auto Insights, a consultancy, says rumours are rife that the Chinese authorities are pushing back against Tesla’s efforts to increase manufacturing capacity in China. And that is before getting into the increasingly fraught geopolitics of Sino-American commerce.

If Tesla is to sell 6m cars a year at an operating margin of 14% by 2030, which Mr Levy of Barclays thinks possible, it probably needs to avoid at least some

of these pitfalls. It would be foolish to dismiss that eventuality, given Tesla's knack for confounding sceptics. It could, for example, offset part of the decline in sales growth with new revenue streams, such as recent deals to open its charging network to Ford and General Motors customers. As brands become defined by the digitally mediated experience of driving rather than the body shell or handling, its superior software—including, one day, self-driving systems—may allow it to keep offering fewer models than its rivals. Mr Le thinks Tesla will mitigate the China risk by manufacturing more of its cars in Germany and other countries, including low-cost ones. Tesla has been by far the most compelling car company of the early 21st century. If it is to hold on to that title, it must work for it. ■



【首文】经济乐观主义

世界经济并未脱险

通胀下降是个好消息。但要欢呼实现“软着陆”还为时过早

经济学家们并不以乐观著称，但如今他们的欢欣鼓舞显而易见。不久前，由于美联储不断加息以对抗通胀，美国经济衰退似乎不可避免。其他国家的央行也纷纷效仿，它们的通胀问题因美元飙升而变得越发严重——这对以美元计价借贷和交易的新兴市场来说尤其是个问题。但6月美国总体通胀降至3%的消息让人们燃起了希望，期待着美联储预计在7月26日进行的下一次加息将会是最后一次，而其他央行也可能放松政策。股市因此上涨，债券收益率下降，美元接近美联储开始加息以来的最低水平。

让这股涌动的希望更显异乎寻常的是，此时世界经济正在放缓。7月17日，中国报告第二季度经济相比第一季度仅增长0.8%，尽管此前许多人以为，在政府去年12月放弃“清零”政策后经济会繁荣起来。随着消费者走出封锁，开始更多地外出就餐和减少购买居家办公设备，全球制造业受挫。而且，尽管今年上半年美国经济增长强劲，但大多数预测人士认为它很快就会放缓。

不过，他们越来越觉得美国经济不会萎缩了。而对于像美国这样过热的经济体来说，增长降温刚好足够缓解通胀却又不致引发衰退，那便是最好的情况。中国本身没有通胀问题，虽然它重新开放后的经济表现令人失望，但也意味着人们担心的全球大宗商品价格飙升并未成为现实。这帮了欧洲的忙，欧洲已经用船运液化天然气取代了俄罗斯的管道天然气。

但若认为世界经济已经在走向所谓的软着陆，那就错了。原因有三。首先，尽管通胀下降，但仍远高于各国央行2%的目标。美国总体通胀的下降是由能源价格的一次性下跌推动的：除去食品和能源后价格比一年前高出4.8%。在欧元区这个数字是5.5%，而且这两个经济体目前的工资增长仍远超生产率增长。

换句话说，富裕国家距离完全消除通胀高企还有一段路要走——许多经济学家预计最后一里路会最为艰难。尽管3%至4%的顽固通胀不会像近期令人担忧的价格飙升那样抢占头条，但对央行官员来说它仍然是个问题。他们可能不得不做出选择：是要采取比目前的预期更紧缩的政策，还是默默放弃2%的目标？无论选哪个都会扰乱资产市场，还可能影响实体经济。

第二个风险是，全世界现在正感受到经济降温的好处，但可能一时还看不到它的代价。到目前为止，美国劳动力市场已经不怎么费力地实现了再平衡，靠的是减少空缺岗位而不是裁员。招聘依然强劲，裁员也很少。由于岗位空缺不像此前那么多了，工资增长已经放缓。但是没人知道就业市场这种“减脂”而非“掉肌肉”的状态还能持续多久——最近几个月空缺岗位的减少已经停滞，这不是好事。在整个富裕世界，有证据表明，对劳动力短缺心有余悸的公司一直在囤积它们不需要的员工；有几个国家的平均工作时长一直在下降。一旦公司认为留住那些未来可能需要也可能不需要的员工的成本太高，那么裁员可能会突然增多。

第三个危险是，世界大型经济体之间存在差异，这意味着美联储压力减轻之时，其他地方的政策制定者还在担忧。英国正在庆祝6月的年通胀降幅超过预期，但是因为基础物价和工资增长在7%左右，该国仍然是一个让人不安的异数。日本才刚刚开始收紧货币政策；随着通胀上升，日本央行可能会在7月底再次调整长期债券收益率的上限。中国可能正在应对一种结构性的增长放缓，其经济就像日本在上世纪90年代初经历的那样受到坏账的拖累，且通胀一直过低。

换句话说，无论看向哪里，通胀和利率最终会落在何处都存在着巨大的不确定性。当然可以庆祝好消息。但世界经济尚未全身而退。 ■



Economic optimism

The world economy is still in danger

Falling inflation is good news. But it is too early to hail a “soft landing”

ECONOMISTS ARE not known for their optimism, but today their good cheer is palpable. Not long ago it seemed that an American recession was inevitable, as the Federal Reserve kept raising interest rates to fight inflation. Other central banks were following suit, their inflation problems made worse by a surging dollar—a particular problem for the emerging markets that borrow and trade using America's currency. Yet news that America's headline rate of annual inflation fell to 3% in June has fed hopes that the Fed's next rate rise, which is expected on July 26th, will be its last and that other central banks might relax, too. Stocks are up, bond yields are down and the greenback is at close to its weakest since the Fed began raising rates.

The surge of hope is all the more unusual because the world economy is slowing down. On July 17th China reported that its economy grew by a mere 0.8% in the second quarter compared with the prior three months, even though many had expected a boom after the government abandoned its “zero-covid” policy in December. Global manufacturing has suffered as consumers came out of lockdowns and began eating out more and buying less home-office equipment. And, although America grew strongly in the first half of the year, most forecasters expect the economy soon to slow.

Increasingly, however, they are not expecting it to shrink. And growth cooling just enough to bring down inflation without a recession is the best-case scenario for overheated economies like America's. Even the disappointing reopening in China, which does not have an inflation problem of its own, has meant a feared surge in global commodities prices

has not materialised. That has helped Europe, which has replaced piped Russian gas with shipments of the liquefied sort.

Yet it would be a mistake to assume that the world economy is now on track for a so-called soft landing, for three reasons. The first is that inflation, though lower, remains far above central banks' 2% targets. The fall in America's headline rate has been driven by a one-off decline in energy prices: exclude food and energy, and prices are 4.8% higher than a year ago. In the euro zone the figure is 5.5%, and in both economies wages are still growing far in excess of productivity growth.

In other words, the rich world has some way to go before it is fully disinflated—and many economists expect the last mile to be the hardest. Though stubborn inflation of, say, 3-4% does not grab headlines as much as recent alarming price rises, it would still be a problem for central bankers. They might have to choose between more tightening than is currently expected and tacitly abandoning their 2% goals. Either would be disruptive for asset markets and potentially for the real economy, too.

The second risk is that, whereas the world is seeing the benefits of cooling off now, the costs may not be visible for a while. So far America's labour market has rebalanced fairly painlessly by reducing vacancies rather than jobs. Hiring is still strong and lay-offs are rare. With job openings less plentiful, wage growth has fallen. Yet nobody knows for how long the jobs market can shed fat rather than muscle—and in recent months the fall in job openings has stalled ominously. Across the rich world there is evidence that firms, scarred by the memory of labour shortages, have been hoarding workers they don't need; in several countries average hours worked have been falling. Should companies decide that it is too costly to cling to workers who may or may not be needed in the future, then lay-offs could rise abruptly.

The third danger is that divergence among the world's big economies means that even as the pressure on the Fed lifts, policymakers elsewhere remain worried. Britain is celebrating a larger-than-expected fall in annual inflation in June, but with underlying price and wage growth of around 7% it remains a troubling outlier. Japan has barely started its monetary tightening; with inflation rising, the Bank of Japan may adjust its cap on long-term bond yields again at the end of July. China could be contending with a structural growth slowdown in which the economy is weighed down by bad debts, as Japan's was in the early 1990s, and in which inflation is persistently too low.

Wherever you look, in other words, there remains immense uncertainty about where inflation and interest rates will eventually settle. By all means celebrate good news. But the world economy has not yet escaped unscathed.





焦点利率

美国抗通胀之战将变得更加复杂

对美联储来说，价格上涨降温的后果有悖直觉

之前，事情毫无悬念。在美联储最近一次会议召开前，投资者认为它再次加息的可能性接近99%。7月26日，确如市场预期，政策制定者在过去12次会议中第11次加息——这些加息构成了美国40年来最急剧的一轮货币紧缩。然而，美联储下一步何去何从却充满变数。

一些经济学家很有把握这会是美联储本轮加息周期的最后一次加息。通胀已从2022年的高位回落，6月的消费者价格同比升幅仅为3%。核心通胀（剔除了波动较大的食品和能源价格）稍显顽固，但也开始软化，显示基础价格压力正在缓解。这为美联储放松政策开辟了道路，有望引导美国经济走向备受热议的软着陆。摩根士丹利的埃伦·赞特纳（Ellen Zentner）预计美联储会“拖延观望”，预示着明年初会降息。

其他人则不那么肯定。过去几年，通胀总是把乐观派打个措手不及。比如说，假如能源价格反弹，消费者和企业可能会迅速上调对通胀的预期，促使美联储再次加息。如果目前初露苗头的住房价格反弹加速，也会加剧人们的担忧。劳动力市场活跃令人更加忧虑，因为工资快速上涨会加剧通胀。值得注意的是，迄今为止，美联储的激进行动几乎没有影响到美国工人：当前失业率为3.6%，与2022年3月美联储在本轮周期中首次加息时的水平一致（见图表1）。一般认为，这样的紧缩步伐会推高失业率。而实际上，新冠疫情过后经济复苏，愿意工作的工人增多，似乎为经济提供了缓冲。

经济学家之间观点的碰撞在美联储内部同样存在。过去两年来，美联储官员们对于通胀的危险口风一致，在大幅调整利率的决策上意见近乎统一。然而，最近几个月分歧开始浮现。美联储理事克里斯托弗·沃勒（Christopher Waller）代表更鹰派的声音。他在7月警告称，在通胀持续

得到改善之前，美联储可能继续加息。这给因6月物价数据低于预期而催生的过度乐观情绪泼了盆冷水。“一个数据点并不能代表一种趋势。”他警告说。亚特兰大联储主席拉斐尔·博斯蒂克（Raphael Bostic）则代表了相反观点，他甚至在最近一次加息之前就表示，美联储可能会停止加息。“通胀逐步回落的势头会持续下去。”他在6月下旬向听众打包票。

即使最近一次加息最终确实成为美联储本轮加息的顶点，主席杰罗姆·鲍威尔（Jerome Powell）在声明中仍保持鹰派口吻。他在加息后的新闻发布会上表示：“在我们看来，政策不够严厉，持续时间也不够长。”近几个月来，金融环境有所放松。美国最大股票指数标普500从3月（当时有几家地区性银行倒闭）的低位上升了近五分之一。鲍威尔口气更严肃也许是为了防止投资者过于冒进，加剧通胀势头。

想要维护“抗通胀斗士”声誉的美联储官员或许会宁可倾向强硬。渣打银行的史蒂文·英格兰德（Steven Englander）把美联储比作认为降雨概率为30%的天气预报员。强调可能出现降雨天气还是有道理的，因为相比预测下雨最终却是晴天，预测晴天最终却下雨显得更糟糕。

在实践中，美联储肯定会视经济数据来灵活应对。它看看北面邻国的例子就知道，政策立场是不可能一成不变的。加拿大央行在1月停止了加息周期，认为通胀已经见顶，但6月又被迫恢复紧缩，因为经济增长依然过热，通胀仍然过高，令人不安。

然而，美联储的任何选择都还是会有其风险。在今年余下时间内保持利率不变被视为是更鸽派的选择，但假如通胀继续回落，该政策实际上将越发染上鹰派色彩。不变的名义利率在实际上有越来越大的限制性（假设通胀预期随着物价压力减轻而降低）。因此，在这种情况下，希望维持当前政策立场的美联储官员们就应该要考虑降息了。在通胀居高不下的时候，美联储的任务很艰巨，但决策倒是相当直截了当的：除了加息别无选择。而从现在开始，它的任务看起来变轻松了，但决策却愈发让人头疼。■



Of great interest

America's battle with inflation is about to get trickier

Cooling price rises will have counterintuitive consequences for the Federal Reserve

IT WAS NEVER in doubt. In the run-up to the Federal Reserve's latest meeting, investors assigned a probability of nearly 99% to the central bank raising interest rates once again. On July 26th policymakers duly fulfilled those expectations, with their 11th increase in 12 meetings, together making for America's sharpest course of monetary tightening in four decades. The central bank's next steps, however, are clouded by uncertainty.

Some economists are convinced that this will be the Fed's last rate rise in this cycle. Inflation has come down from its highs in 2022, with consumer prices rising by just 3% year-on-year in June. Core inflation—which strips out volatile food and energy costs—has been a little more stubborn, but even it has started to soften, in a sign that underlying price pressures are easing. This opens a pathway for the Fed to relent, hopefully guiding America to a much-discussed soft landing. Ellen Zentner of Morgan Stanley, a bank, expects an “extended hold” for the Fed, presaging a rate cut at the start of next year.

Others are not so sure. Inflation has consistently wrong-footed optimists over the past couple of years. Were, for instance, energy prices to rally, consumers and businesses could quickly revise up their expectations for inflation, nudging the Fed towards another rate increase. If an incipient rebound in housing prices gathers pace, that would also fuel concerns. Vigour in the labour market adds to the worries, because fast-rising wages feed into inflation. Remarkably, the Fed's aggressive actions have barely affected American workers thus far: the unemployment rate today is 3.6%, identical to its level in March 2022 when the Fed raised rates for the first

time in this cycle (see chart 1). The pace of tightening would normally be expected to drive up unemployment. Instead, the recovery from the covid-19 pandemic, including an increase in the number of willing workers, seems to have cushioned the economy.

Opposing views among economists are mirrored within the Fed itself. For the past two years America's central bankers have spoken in similar terms about the peril of inflation, and have been nearly unanimous when it comes to big rate moves. In recent months, however, divisions have surfaced. Christopher Waller, a Fed governor, has come to represent the more hawkish voices. This month he warned that the central bank could continue raising rates until there is sustained improvement in inflation, dismissing the over-optimism bred by the weaker-than-expected price figures for June. "One data point does not make a trend," he warned. At the other end of the spectrum is Raphael Bostic, president of the Fed's Atlanta branch, who said even before the latest rate increase that the central bank could stop hiking. "Gradual disinflation will continue," he assured listeners in late June.

Even if the latest rate increase does end up marking the peak for the Fed, Jerome Powell, its chairman, has maintained a hawkish tilt in his pronouncements. "What our eyes are telling us is that policy has not been restrictive enough for long enough," he told a press conference following the rate rise. Financial conditions have loosened in recent months. The S&P 500, an index of America's biggest stocks, is up nearly one-fifth from its lows in March, when a handful of regional banks collapsed. With his sterner tone, Mr Powell may want to restrain investors from getting ahead of themselves, which could add to inflationary momentum.

Central bankers wanting to preserve their reputations as inflation-fighters may prefer to err towards toughness. Steven Englander of Standard Chartered, a bank, likens the Fed to a weather forecaster who thinks there is a 30% chance of rain. It still makes sense to highlight the potential for wet

weather, because predicting sun but getting rain is perceived as worse than predicting rain and ending up with sun.

In practice, the Fed is sure to be flexible, reacting to economic data. It can look north of the American border for an example of the impossibility of maintaining a fixed policy stance. The Bank of Canada had stopped its rate-rise cycle in January, thinking that inflation had crested. But in June it was forced to resume tightening because economic growth had remained too hot, and inflation too sticky, for comfort.

Ultimately, though, there are no risk-free choices for the Fed. What is seen as the more doveish option—holding rates steady for the rest of this year—will in fact take on an increasingly hawkish hue if inflation does continue to recede. Unchanged nominal rates would be ever more restrictive in real terms (assuming that inflationary expectations diminish alongside waning price pressures). In such a scenario central bankers wishing to maintain their current policy stance should therefore think about cutting rates. When inflation was sky-high, the Fed's task was tough yet its decisions quite straightforward: officials did not really have much choice but to raise rates. From here on, its task looks easier but its decisions more fraught. ■



亚洲的电池战场

将中国排除在外的电池供应链看起来无法实现

绿色产业政策与鹰派国家安全政策相互冲突

因四十年前开发了锂离子电池而与他人共获诺贝尔奖的科学家约翰·古迪纳夫（John Goodenough）在2018年接受采访时 表示：“我希望全世界的高速公路上都不再有汽车尾气。”古迪纳夫于6月25日去世，而他的梦想尚未实现。但世界各国政府都在努力实现这一目标，并取得了显著的成果。2019年至2022年间，全球电动汽车销量增长了四倍，去年突破了1000万辆。

然而，向电动汽车的快速转型却撞上了供应吃紧和地缘政治的顶头风。要满足预计的全球需求，2030年前制造锂离子电池所需的矿物供应必须每年增长三分之一。仅美国就需要数千万个电池，才能确保到2030年实现电动汽车占美国汽车销量一半的目标。然而，美国最大的竞争对手中国却是遥遥领先的第一大电池金属加工国和电芯及成品电池生产国。

即使是在中国以外的生产，其工艺也依然由中国企业主导。美国决策者认为这对美国供应链的韧性构成了威胁。这一切使得古迪纳夫的技术成为了新冷战中最重要的产业战场之一。

胜负将在集中了大多数电池供应链的亚洲决出。第一个瓶颈是材料生产和加工，包括锂和镍这两种最关键的电池材料。获得这两种金属的稳定供应对全球生产商来说至关重要。2022年生产的锂几乎一半来自澳大利亚，30%来自智利，15%来自中国。至于镍，印度尼西亚占去年全球总产量的48%，菲律宾占10%，澳大利亚占5%。

到目前为止，美国正在寻求与其中一些国家达成小范围的贸易协定，以获得矿产和生产能力，并通过《通货膨胀削减法案》（Inflation Reduction Act）向生产商提供巨额补贴。要享受到美国为新销售的电动汽车提供的7500美元税收抵免，生产商须达到在美国（或与美国签订自由贸易协定的

国家) 加工矿物和生产电池占比的日益收紧的要求。与此同时, 中国正在另行建设一条电池供应链。

印度尼西亚对镍矿的主导本身就是一个潜在的瓶颈。咨询公司普华永道去年的一项估计表明, 到2035年, 电动汽车生产每年将需要270万吨镍。印度尼西亚目前的产量仅160万吨, 其中大部分用于生产不锈钢。巨大的镍开采和加工产能如今正在规划或建设中。要摆脱对中国的依赖, 加工可能是供应链中难度最大的环节。据一项估计, 中国冶炼和加工了全球约四分之三的镍。它还拥有约三分之二的锂加工产能。就连这些数字也低估了中国的影响力, 因为在中国境外的许多加工项目都有中国公司参与。

印度尼西亚三座运营中的工厂采用高压酸浸法, 这种先进工艺无需熔化矿石就能从中提取镍。这些工厂都依靠中国的技术或运营能力, 或是两者兼而有之。为了确保镍的供应, 美国汽车制造商福特与中国矿业公司华友钴业成立了一家合资企业, 投资于一家印度尼西亚镍加工厂。华友钴业盛赞此次合作是对中国“一带一路”倡议的贡献, 但这种说法在华盛顿不太可能受到欢迎。福特已经因另一个中美合资项目而在美国内面临政治压力: 它与中国电池巨头宁德时代合作, 在密歇根州合资兴建了一家生产镍基和锂基电池的新工厂。按装车总容量计算, 宁德时代生产的电动汽车电池占全球三分之一以上。

中国企业压倒性的势力不仅仅是因为它们拥有令人赞叹的行业专门技术。矿业高管和专家认为, 这也反映了它们快速行动和承担风险的能力。从事开采和加工镍业务的西方公司数量本就不多, 还把更多时间花在了前期研究和准备工作上。日本矿业公司住友金属矿山去年退出了一个镍加工项目, 理由是与合作伙伴淡水河谷印尼公司(PT Vale Indonesia)存在分歧。该项目的可行性研究从2012年就开始了。

中国企业还主导着电池零部件的生产。总体而言, 中国电芯零部件产量至少占到全球一半, 在某些类别上超过70%。其余产能集中在韩国和日本。这三个东亚国家总计占中游电池零部件产能的92%至100%。即使美国能够获得足够的经过加工的矿物, 要实现自己的目标也需要把韩国和日本的

电池制造技术大规模部署到北美。

韩国的LG新能源是排在宁德时代之后的第二大电池制造商。该公司正在美国扩张，与现代、本田和通用汽车建立了合资企业。LG的目标是到2030年在北美生产278吉瓦时的存储容量，而2022年仅有15吉瓦时。这个目标可能过于乐观。该公司首席采购官金明焕（Kim Myung Hwan，音译）指出，建设成本上升、技术型员工短缺以及电池所用材料的价格波动都是快速增长的障碍。

一些亚洲制造商担心，未来多年里，海外生产的成本可能会高得令人望而却步。生产电池隔膜的日本公司W-Scope的董事大内秀雄表示：“更重要得多的是，要考虑如何让业务在10、15、20年内都保持盈利。”大内秀雄估计，美国若要实现2030年的电动汽车销量目标，仅它一国所需的电池隔膜就相当于2021年的全球产量。

政府政策是另一个不确定因素，尤其是因为许多亚洲电池制造商都指望得到持续数十年的财政支持。6月，美国的汽车工人联合会（United Auto Workers）批评拜登政府在向福特和韩国电池制造商SK ON位于密歇根的合资新工厂提供高达92亿美元的贷款时，没有附加严格的劳工权益条款。未来的共和党政府可能会减少或干脆废除本届政府的电动汽车目标。

这样的局面发人深省。扩大电池供应链以满足全球对电动汽车的巨大需求，这是有史以来最大的工业挑战之一。单是行业内现有的瓶颈都会让这件事困难重重。要为了气候、人类健康和许多其他方面的利益而实现这一壮举，又想将一个从大多数标准来看都是电池行业霸主的国家排除在外，大概率上是不可能的。■



Asia's battery battlefield

A battery supply chain that excludes China looks impossible

Green industrial policy and hawkish security policies are clashing

"I'D LIKE TO get all the gas emissions off the highways of the world," said John Goodenough, one of the Nobel-prize winning scientists who developed the lithium-ion battery four decades ago, during an interview in 2018. Goodenough died on June 25th before his dream could become reality. But governments around the world are scrambling to make it so, with remarkable results. Global sales of electric cars quintupled between 2019 and 2022, surpassing 10m units last year.

Yet the speed of the transformation is running into supply constraints and geopolitical headwinds. The supply of the minerals required to make lithium-ion batteries must grow by a third every year this decade to meet the estimated global demand. Tens of millions of batteries will be needed in America alone to meet its ambition to ensure half of all American vehicle sales involve electric vehicles by 2030. And yet its great rival, China, is by far the biggest processor of battery metals, producer of battery cells and manufacturer of finished batteries.

Even where production is done overseas, Chinese firms dominate the process. American policymakers see that as a threat to the resilience of America's supply chains. All of this makes Goodenough's technology one of the most important industrial battlefields of the new cold war.

The outcome will be determined in Asia, where most battery supply chains are based. The first bottlenecks are in materials production and processing—including two of the most crucial battery materials, lithium and nickel. Capturing a consistent supply of both metals will be crucial for

producers globally. Almost half of the lithium produced in 2022 came from Australia, 30% came from Chile and 15% from China. In the case of nickel, Indonesia's production amounted to 48% of the global total last year, with the Philippines making up another 10% and Australia 5%.

So far America is pursuing narrow trade agreements with some of those countries in order to gain access to minerals and production capacity, and it is offering enormous subsidies to producers through its Inflation Reduction Act. To benefit from America's \$7,500 credits for new EVs, producers must meet tightening requirements on the share of minerals processed and batteries produced in America or in a country with which America has a free-trade agreement. China is meanwhile building a parallel battery supply chain.

Indonesia's dominance in nickel is itself a potential bottleneck. An estimate last year by PWC, a consultancy, suggests that 2.7m tonnes of the stuff will be needed annually for EVs by 2035. Indonesia currently produces only 1.6m tonnes, most of which is used for stainless steel. A huge amount of capacity to mine and process the metal is being planned, or under construction. The processing may be the most difficult segment of the supply chain to make China-free. By one estimate, China smelts and processes about three-quarters of the world's nickel. It also has about two-thirds of the capacity for lithium processing. Even those figures underestimate Chinese heft, because a lot of processing outside China involves Chinese companies.

The three operational plants in Indonesia use high-pressure acid leaching, an advanced process that extracts nickel from its ore without melting it. All are based on Chinese technology, operational prowess, or both. To secure supplies of nickel, Ford, an American carmaker, formed a venture with a Chinese mining company, Huayou Cobalt, to invest in an Indonesian nickel-processing plant. The Chinese firm hailed the partnership for its contribution to China's Belt and Road Initiative, a sentiment unlikely to

have been popular in Washington. Ford is already facing political heat at home over a different venture with a Chinese firm: a new plant in Michigan, manufacturing both nickel-based and lithium-based batteries, for which it has joined forces with a Chinese battery giant, Contemporary Amperex Technology Co. Limited (CATL). The Chinese firm makes more than a third of the world's electric-vehicle batteries, measured by their total capacity.

The overwhelming presence of Chinese firms is not just a result of their impressive industrial expertise. It also reflects their ability to move quickly and take risks, according to mining executives and experts. The comparatively small number of Western companies working in mining and nickel processing spend more time conducting preparatory studies and work. Sumitomo Metal Mining, a Japanese minerals firm, withdrew from a nickel-processing project last year, citing disagreements with its partner, PT Vale Indonesia, another resources firm. The feasibility study into the project had been going on since 2012.

Chinese firms also dominate the production of battery parts. Among the components for battery cells, China accounts for at least half of production and more than 70% in some categories. The rest of the industry is concentrated in South Korea and Japan. Between them, the three East Asian countries make up between 92% and 100% of the mid-stream parts of the industry. Even if America secures enough processed minerals, meeting its goals will require a massive deployment of Korean and Japanese battery-manufacturing know-how into North America.

LG Energy Solution, based in South Korea, is the second-largest battery manufacturer after CATL. The company is expanding in America, with joint ventures under way with Hyundai, Honda and General Motors. LG aims to produce 278 gigawatt-hours (GWh) worth of storage capacity in North America by 2030, up from just 15GWh in 2022. That may be too optimistic. Kim Myung Hwan, the company's chief procurement officer, notes that the

rising cost of construction, shortages of skilled personnel and volatility in the price of the materials needed for batteries are all barriers to rapid growth.

Some Asian manufacturers worry that the cost of overseas production could be prohibitively high for years. “It’s much more important to think of how we make the business profitable for 10, 15, 20 years,” says Hideo Ouchi, director of W-Scope, a Japanese company that manufactures separators used in battery cells. Mr Ouchi estimates that to meet its goals on electric vehicles by 2030, America alone will need as much battery-separator material as was manufactured globally in 2021.

Government policy represents another uncertainty—especially as many Asian battery manufacturers are counting on decades’ worth of financial support. Last month America’s United Auto Workers union criticised the Biden administration for failing to attach strict labour-rights conditions to a loan of up to \$9.2bn to Ford and SK ON, a Korean battery-maker, for a new plant in Michigan. Future Republican administrations might reduce or simply scrap the current EV targets.

This amounts to a sobering picture. Expanding the battery supply chain to match the enormous global demand for electric vehicles represents one of the greatest industrial challenges ever attempted. Even the current order of bottlenecks in the industry will make it difficult. Pulling it off—for the good of the climate, human health and much else—without the country that, by most measures, dominates the battery industry may very well be impossible. ■



另一种巨石

在月球上意外发现了一块巨大的花岗岩

这一发现为了解月球历史提供了启示，并启迪了探索其他卫星的可能方法

在《2001太空漫游》（2001: A Space Odessy）中，斯坦利·库布里克（Stanley Kubrick）和阿瑟·C·克拉克（Arthur C. Clarke）想象月球表面下埋着一块巨石，结果证明这是个外星人的造物，它带人类踏上了通往群星之路。在月球背面带有火山特征的康普顿-贝尔科维奇区域（Compton-Belkovich）下面新发现的“岩基”不大可能有如此神力，但它为了解月球的过去提供了一些有趣的线索，并展示了一种探究其他行星内部的新方法的能力。

岩基是一种地质构造，是大量岩浆上涌侵入行星的地壳，并向侧边扩散时形成的。在地球上，这些岩基主要由花岗岩构成，例如，优胜美地（Yosemite）的岩石是内华达山脉岩基的一部分，日后的剥蚀让它们出露，并显现出刀刻斧凿般的壮丽景象。

康普顿-贝尔科维奇的岩基也是由花岗岩构成的，正是这一点暴露了它的藏身处。花岗岩比其他火成岩（即曾经熔融的岩石，如玄武岩）含有更丰富的钍，而钍具有放射性。钍衰变时加热了它栖身的花岗岩。通过中国首批绕月卫星嫦娥一号和嫦娥二号测得的微波辐射，亚利桑那州图森市的行星科学研究所（Planetary Science Institute）和得克萨斯州达拉斯的南卫理公会大学（Southern Methodist University）的马修·西格勒（Matthew Siegler）和封剑青领导的一个科学家小组计算出康普顿-贝尔科维奇地表下的岩石释放了多少热量。

科学家们假设其中的钍是以花岗岩中常见的那种浓度存在，从而计算出发热源可能的状貌。他们于本月稍早时发表在《自然》杂志上的最有把握的猜测是有一个较小的热团，直径可能在10到20千米，深度为几千米，在它之下是一个大得多也深得多的热团，直径可能有50千米，深几十千米。

这显示在月球深处发生着以前未被识别的有趣事情。火成岩是经过某种地质形式的蒸馏形成的。当深埋在地表之下的岩石被加热时，其中的一些成分比其他成分更容易熔化。当熔岩凝固，其矿物组成与原始母体的矿物组成已不再相同。

将地球或月球地幔中的岩石转化为玄武岩只需要一个蒸馏循环，由此形成的玄武岩构成了地球海洋下面的坚固地壳和月球上平坦的熔岩平原。不过，要形成花岗岩就需要分别多次蒸馏（这就是为什么它的铀浓度很高）。在地球上，这很容易实现：构造板块的碰撞提供了很多机会。而在平静且无板块的月球上则没有这样的作用机制，所以人们很容易以为这颗星球的岩石基本上就只会是玄武岩。新发现的花岗岩基表明有新的东西在起作用。也许是那里的岩石含水量异常丰富。也许是来自下面的热脉冲使它们反复熔化和凝固。

月球上的这个发现表明，类似的微波测量或许能为了解其他行星内部提供崭新的思路。之前没尝试过这种方法是由于一个先入为主的观念。绕地球运行的卫星使用微波接收器来测量大气中的水分。因为太阳系的其他遍布岩石的行星没有富含水的大气层，所以从来没有向它们发射过这类仪器。

但当中国发射嫦娥一号和嫦娥二号时，其目标是展示自己能够做环月探测研究，而未必是要做最好的这类研究。西格勒认为，配备了微波天线仅仅是因为此前已经演示了它们能正常运作，而且手头也再无更合适的设备。既然现在它们已经证明了自身价值，他希望这能引起未来航天器设计师们的注意。这些仪器可能会在研究木星的卫星时派上用场，因为它们对热量和水分的敏感性可能成为其他地表下探测器的有用补充。《2001太空漫游》的粉丝们不会忘记，故事中的巨石推动了一项前往木星的新任务。月球上的这个大石头说不定也会。 ■



Not that sort of monolith

An enormous—and unexpected—lump of granite has been found on the Moon

The discovery sheds light on lunar history, and suggests how other moons might be explored

IN “2001: A SPACE ODYSSEY”, Stanley Kubrick and Arthur C. Clarke imagined a monolith buried beneath the surface of the Moon which turned out to be an alien artefact that set humankind on a path to the stars. The “batholith” that has been discovered below Compton-Belkovich, a volcanic-looking set of features on the far side of the Moon, hardly promises that. But it sheds some interesting light on the Moon’s past, and shows the power of a new way of peering into the crusts of other planets.

A batholith is a geological formation created when a vast quantity of molten rock rises through a planet’s crust, spreading out sideways as it does so. On Earth, these batholiths are composed mostly of granite; the rocks of Yosemite, for example, are parts of the Sierra Nevada batholith uncovered and spectacularly sculpted by subsequent erosion.

The Compton-Belkovich batholith is also made of granite, which is what gave it away. Granite is richer in thorium than other igneous—that is, once molten—rocks, such as basalt, and thorium is radioactive. Its decay heats the granite that hosts it. Measurements of microwave emissions made by the first two Chinese satellites to orbit the Moon, Chang’e 1 and Chang’e 2, allowed a team of scientists led by Matthew Siegler and Jianqing Feng of the Planetary Science Institute in Tucson, Arizona and Southern Methodist University in Dallas, Texas to calculate how much heat was being given off by rocks under the surface at Compton-Belkovich.

Assuming that the thorium was present at the sort of concentrations

typically seen in granite allowed the scientists to calculate a likely shape for the source. Their best guess, published in *Nature* earlier this month, was that there is one smallish hot blob, maybe 10-20km across and a few kilometres deep, balanced on top of a much bigger, deeper one that might be 50km across and go down for tens of kilometres.

This suggests interesting goings-on in the depths of the Moon of a sort not previously recognised. Igneous rocks are made through a sort of geological distillation. When rocks far below the surface are heated, some components melt more easily than others; when the molten rock solidifies its mineral make-up is not the same as that of the original parent.

To turn rock from the mantle of Earth, or the Moon, into basalt requires just one cycle of distillation; basalt thus created makes up the solid crust under the oceans of Earth and the smooth lava plains of the Moon. To make granite, though, requires a number of separate distillations (which is what gives it high thorium concentrations). On Earth this is easily arranged; the collisions of tectonic plates provides lots of opportunities. On the placid, plateless Moon there is no such mechanism, and it has been easy to assume that basalt is for the most part all the planet has to offer. The granite batholith suggests something new at play. Perhaps the rocks in the area were unusually rich in water. Perhaps pulses of heat from below made them melt and freeze repeatedly.

The lunar discovery suggests that similar microwave measurements might provide novel insights into the innards of other planets. That this has not been tried before is due to a preconception. Satellites orbiting Earth use microwave receivers to measure water in the atmosphere. Because the solar system's other rocky planets do not have watery atmospheres, such instruments have not been sent to them.

But when China launched Chang'e 1 and 2 its aim was to show that it could

do science round the Moon, not necessarily to do the best such science. Dr Siegler thinks the microwave antennae were put on board simply because they had been shown to work and there were no more suitable instruments to hand. Now they have proved their worth, he hopes to see the designers of future spacecraft take note. One target where they might come in handy would be the moons of Jupiter, where their sensitivity to heat and moisture might be a useful addition to other sub-surface probes. Fans of "2001" will remember that its monolith spurred a new mission to Jupiter. Maybe the batholith will, too. ■



远程对决

居家办公之战蔓延全球

员工想在厨房里干活。老板要他们回办公室

远程工作成了众矢之的。摩根大通的杰米·戴蒙（Jamie Dimon）等银行CEO决心让居家办公随疫情一同消逝。对于这家美国最大的银行和高盛等华尔街巨头的员工来说，每周五天工作制已经永久回归。科技巨头也开始挥动鞭子。谷歌在重返工作岗位的规定中指出，员工出勤情况可能会被追踪并纳入绩效考评。Meta和Lyft希望员工回到办公桌前，要求今年夏末之前每周至少有三天在办公室工作。在公司老板们的不断施压下，在疫情时代关于远程工作可取性的共识似乎已告终结。

一项新出炉的全球调查显示了共识撕裂的程度。由斯坦福大学和德国智库慕尼黑经济研究所（Ifo Institute）等机构组成的WFH Research研究团队跟踪调查了34个国家里接受过中学及以上教育的全职员工的看法。研究表明，在全球范围内，雇主对远程工作的计划安排不能满足员工的期望。老板们担心完全远程工作会降低工作效率，近期的研究也加深了这种担忧。一项针对印度数据录入员的研究发现，员工居家办公的工作效率比常在办公室工作的同事低18%；另一项研究发现，一家亚洲大型IT公司的员工居家办公的工作效率比之前在办公室时低19%。微软近6.2万名员工的通信记录显示，随着远程工作的盛行，公司内部的职场社交网络陷于僵化，越发彼此孤立。

然而，来自高层的种种施压并没有削弱员工对远程工作的渴望。WFH Research的研究显示，员工希望相比现在能有更多时间在自家舒适的客厅里工作。平均而言，世界各地的员工期望有两天居家办公，比实际情况多了整整一天。英语国家的居家办公程度最高，不过员工还是希望得到更长的居家时间。在远程工作没那么普遍的地方也显现这种趋势（见图表）。日本和韩国的员工待在办公室的时间比例在全球居首，他们希望每周有超过四分之一的时间留给自己。欧洲人和南美人分别渴望每周有三分之一和

一半的时间居家。

渴望更多远程工作并不奇怪。不必苦苦忍受公共交通或拥挤的道路，节省下来的时间可以更好地平衡工作与生活。斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）参与管理WFH Research，他和同事的一篇论文显示，远程工作平均每天节省72分钟，一年下来总共可节省两周。盖洛普（Gallup）去年的一项民意调查显示，员工还表示在远程工作时感到最投入。全球平均而言，这些福利对于员工的价值相当于加薪8%之多，这也意味着有些人会宁愿减薪来保留这些特权。

还在不久前，随着公司在疫情后的招聘热潮中拼命笼络员工，在美国这个最受研究关注的市场，员工的需求和雇主的计划似乎正在趋同。但现在这种趋同正在减弱。与此同时，疫情已经导致居家办公的模式变得根深蒂固。目前，接受WFH Research调查的员工当中，三分之一的人采用了混合或完全远程的工作模式。要逆转这些模式没那么容易。

远程工作受到打压正赶上一些行业扩张放缓，这并非巧合。华尔街和硅谷的裁员让企业又重新掌握了主动权。然而即使在科技和金融行业，也有员工坚持自己的立场。今年5月，亚马逊称有300名员工发起罢工，抗议这家电商帝国重返办公室的政策（组织者称罢工人数接近2000人）。

另外一些公司则在悄悄地顺应时势。英国汇丰银行正计划从金丝雀码头的45层大楼搬迁到伦敦金融城里更小的处所。两家专业服务巨头德勤和毕马威则考虑缩减办公场地，转向更多远程工作。在居家办公的拉锯战中，双方的分歧仍可能缩小。问题是老板和员工谁会做出最大让步。

* 《2023年全球居家工作报告》，C.G.阿克索伊、J.M.巴雷罗、N.布鲁姆、S.J.戴维斯、M.道尔斯、P.扎拉特著 ■



The WFH showdown

The fight over working from home goes global

Employees want to toil in the kitchen. Bosses want them back in the office

REMOTE WORK has a target on its back. Banking CEOs, like Jamie Dimon of JPMorgan Chase, are intent on making working from home a relic of the pandemic. For staff at America's biggest lender and other Wall Street stalwarts like Goldman Sachs, five-day weeks are back for good. Big tech firms are also cracking the whip. Google's return-to-work mandate threatens to track attendance and factor it in performance reviews. Meta and Lyft want staff back at their desks, demanding at least three days of the week in the office by the end of the summer. With bosses clamping down on the practice, the pandemic-era days of mutual agreement on the desirability of remote work seem to be over.

Fresh data from a global survey shows how far this consensus has broken down. Across the world, employers' plans for remote work fall short of what employees want, according to WFH Research, a group that includes Stanford University and Ifo Institute, a German think-tank, which tracks the sentiment of full-time workers with at least a secondary education in 34 countries. Bosses fear that fully remote work dents productivity, a concern reinforced by recent research. A study of data-entry workers in India found those toiling from home to be 18% less productive than office-frequenting peers; another found that employees at a big Asian IT firm were 19% less productive at home than they had been in the office. Communication records of nearly 62,000 employees at Microsoft showed that professional networks within the company ossified and became more isolated as remote work took hold.

Yet all the pressure from above has done little to dent employees' appetite

for remote working. They want to be able to work more days from the comfort of their living rooms than they currently do, according to WFH Research. On average, workers across the world want two days at home, a full day more than they get. In English-speaking countries, which have the highest levels of home-working, there is an appetite for more. And the trend is spreading to places where remote work has been less common (see chart). Japanese and South Korean employees, some of the most office-bound anywhere, want more than a quarter of the week to themselves. Europeans and Latin Americans crave a third and half, respectively.

Desire for more remote work is not surprising. The time saved not having to battle public transport or congested roads allows for a better work-life balance. On average, 72 minutes each day is saved when working remotely, which adds up to two weeks over a year, according to a paper by Nicholas Bloom of Stanford, who helps run WFH Research, and colleagues. Employees also report that they feel most engaged when working remotely, according to a poll last year by Gallup. On average globally, workers value all these benefits to the tune of an 8% pay rise, implying that some would take a pay cut to keep the privileges.

Until recently, as firms desperately sought workers amid the post-pandemic hiring bonanza, employees' demands and employers' plans seemed to be converging in America, the best-studied market. This convergence is tailing off. At the same time, the pandemic has entrenched work-from-home patterns. At the moment, a third of workers surveyed by WFH Research have a hybrid or fully remote arrangement. Those practices will not be easy to unwind.

It is no coincidence that the crackdown on remote work is happening as some industries cool. Job cuts across Wall Street and Silicon Valley have handed power back to businesses. However, even in tech and finance some employees are standing their ground. In May Amazon said that 300

employees staged walkouts over the e-empire's return-to-work policies (the organisers said it was closer to 2,000).

Other firms are quietly adapting with the times. HSBC, a British bank, is planning to relocate from its 45-storey tower in Canary Wharf to smaller digs in the City of London. Deloitte and KPMG, two professional-services giants, want to reduce their office footprint in favour of more remote work. The gap between the two sides of the work-from-home battle may yet narrow. The question is whether the bosses or the bossed will yield the most. ■

*“Working from Home Around the Globe: 2023 Report”, by C.G. Aksoy, J.M. Barrero, N. Bloom, S.J. Davis, M. Dolls, P. Zarate ■



神药

大药厂对AI的潜力热情见涨

但也有人担心终结者降临

赛诺菲的老板保罗·哈德森（Paul Hudson）兴奋地挥动着手里的iPhone，急切地想要展示这家法国制药公司最新的人工智能（AI）应用plai。它依靠10亿多个数据点提供“零嘴式”信息，比如提醒某种药的库存即将见底；在和某家广告公司开会时可以问些什么；建议设立可能加快药物审批的临床试验点，等等。就像奈飞推送剧集一样，plai也能及时发送当下有用的信息，哈德森称之为“拍一拍”。他打趣说plai用了差不多四小时就实现了收支平衡，还说与大型咨询公司就一个数据管理项目对大企业要价三四亿美元相比，plai的成本是“小菜一碟”。赛诺菲的八万名员工有一成人天天使用它。

AI在制药业里并不新鲜。生物科技公司捣弄它已经有好些年。现在，大药厂对AI的兴趣也日益浓厚。去年，葛兰素史克的首席执行官艾玛·沃姆斯利（Emma Walmsley）表示，AI可以提高研发生产率，而这是该行业最严峻的挑战。莫德纳（Moderna）最近说自己“精准聚焦”AI。赛诺菲则是“放手一搏”。投资银行摩根士丹利估计，十年内，制药业为加快药物研发每年在AI上的花费可能达到500亿美元。

这些热情所聚焦的那类AI经过生物数据的训练，有可能改进总是得要碰运气的药物发现过程。新药可能要十年才能出现，耗资数十亿美元，成功率只有10%。即使是速度和效率上的微小改进也会带来巨大的价值。但科学家们一直难以用传统的统计工具驾驭生物大数据。机器学习让筛选大量信息成为可能，不管是临床患者数据，还是基因组序列和人体扫描影像等等。去年，谷歌旗下的AI实验室DeepMind取得了突破性进展，利用其AlphaFold系统预测了几乎所有蛋白质的结构，有朝一日也许有助于确定哪些分子具有治疗潜力。

虽然到目前为止只有十来种在研药物用到了AI，但这份清单可能会迅速变长——尤其是那些特性相对容易预测的简单的分子。在这些化学反应更直接明了的情况下，药物的未来看起来越来越像个计算问题。

在阿斯利康负责数据科学和AI的吉姆·韦瑟罗尔（Jim Weatherall）表示，这家英国公司70%的在研小分子都使用了这项技术。阿斯利康的AI运用一种名为“强化学习”的方法，不断调整其分子建议，推演调整后的分子可能会如何反应。伦敦生物科技创业公司E-therapeutics的老板阿里·莫塔扎维（Ali Mortazavi）说，比如，知道了肝脏中所有基因的序列，他的公司就可以用软件来设计RNA分子（这种分子更复杂，但鉴于它们与DNA的关联，这种复杂度本来就在预期内）。AI算法继而预测这些分子的活动，它们有可能让任何致病基因失效。

斯坦福大学的尤安·阿什利（Euan Ashley）提到了另一类AI应用。“知识图谱”是一种数据库，存储与基因、蛋白质、疾病及药物的相关数据以及连接它们的生物途径。它们同样可以帮助确定药物研发的新目标。与此同时，制药公司正在尝试运用“生成式”AI得出全新的化学和生物结构以供测试，就像ChatGPT能从互联网上获取文本并生成一首新诗或一篇文章那样。除了研发药物，plai之类的AI还有助于解决在一个受到高度监管、劳动密集的行业里长期存在的效率问题。

一些制药公司的老板担心，生成式AI胡编乱造的倾向可能会把研究人员带进死胡同。更有末世论意味的是，哈德森说，与他谈论AI的制药公司CEO中有一半都和其他许多人一样担心AI带来的生存威胁。在他本人看来，他预见到的是下一次工业革命，而不是机器人叛乱。 ■



Wonder drugs

Big pharma is warming to the potential of AI

But some worry the Terminator is coming

PAUL HUDSON, boss of Sanofi, is brandishing an iPhone. He is keen to show off the French drugmaker's new artificial-intelligence (AI) app, plai. It draws on more than 1bn data points to provide "snackable" information, from warnings about low stocks of a drug to questions for a meeting with an ad agency or suggestions to set up clinical-trial sites that could expedite drug approvals. Like Netflix recommendations, plai delivers "nudges", as Mr Hudson calls them, that are useful at that moment in time. He jokes that plai broke even in about four hours, and says the cost is "peanuts" compared with the \$300m-400m that big consultancies charge for a project to curate a big company's data. One in ten of Sanofi's 80,000 staff uses it every day.

AI is not new in drugmaking. Biotech firms have been tinkering with it for years. Now interest from big pharma is growing. Last year Emma Walmsley, chief executive of GSK, said it could improve the productivity of research and development, the industry's most profound challenge. Moderna recently described itself as "laser-focused" on AI. Sanofi is "all in". Morgan Stanley, an investment bank, reckons that within a decade the pharmaceutical industry may be spending \$50bn a year on AI to speed up drug development.

Most of the buzz revolves around AIs trained on biological data that could improve the hit-and-miss process of drug discovery. Drugs can take a decade to emerge, cost billions of dollars and succeed only 10% of the time. Even a small improvement in speed and efficiency would be hugely valuable. But scientists have struggled to tame biological big data with conventional statistical tools. Machine learning makes it possible to sift through piles of

information, from clinical patient data and genome sequences to images of body scans. Last year DeepMind, an AI lab that is part of Google, made a breakthrough using its AlphaFold system to predict the structure of almost all proteins, which may one day help identify which molecules have therapeutic potential.

Though only around a dozen drugs in development have so far involved the use of AI, the list may grow rapidly—especially for simple molecules with properties that are relatively easy to predict. In the case of these more straightforward chemistries, the future of medicine is looking ever more like a computational problem.

Jim Weatherall, who oversees data science and AI at AstraZeneca, says the technology is used in 70% of the British firm's small molecules in development. Using a technique called “reinforcement learning”, AstraZeneca's AI is constantly tweaking its molecular suggestions and playing out how a tweaked molecule might react. Ali Mortazavi, boss of E-therapeutics, a biotech startup in London, says that knowing the sequences of all the genes in, say, the liver, lets his firm use software to design RNA molecules (which are more complex but, owing to their links to DNA, predictably so). AI algorithms then predict the activity of the molecules, which can stop the function of any disease-causing gene.

Euan Ashley of Stanford University points to another AI application. “Knowledge graphs” are a kind of database that stores data about genes, proteins, diseases and drugs, as well as the biological pathways that connect them. They, too, can help identify new targets for drug development. “Generative” AI, meanwhile, is being trialled for suggesting entirely new chemical and biological structures for testing, just as ChatGPT can ingest text on the internet and spit out a new poem or essay. Beyond drug discovery, AIs like plai could help with the perennial problem of efficiency in a heavily regulated and labour-intensive sector.

Some pharma bosses worry that generative AIs' tendency to make stuff up could send researchers down blind alleys. More apocalyptically, Mr Hudson says half of the pharma CEOs he talks to about AI fear, like many people, the existential threats it poses. For his part, he foresees the next industrial revolution, not a robot uprising. ■



众里寻它

加拿大的一个湖泊可能成为人类地质时代开启的标志

钚、碳和塑料标志着地球历史进入了一个新阶段

人类总是声称自己与众不同，而从某种意义上说，所谓科学史就是一次又一次地戳穿这一说法。从科学角度讲，智人就是一种身上无毛的奇怪类人猿，它们在地球上生存了20万年——这对地球45亿年的历史来说只是一眨眼的功夫。

不过，过去二三十年里一些科学家提出，或许人类确实应该得到一些特别认可。2000年，荷兰气象学家兼化学家保罗·克鲁岑（Paul Crutzen）提出，人类对地球的影响足够深远，其效应将在地质记录中存续数百万年。正因如此，他认为，是时候让当前的全新世这个已经持续了大约1.2万年的地质时代落幕，并让一个新时代登场：人类世。

这个观点很快便流行起来。2016年，国际地质科学联合会（IUGS）下属的人类世工作组（以下简称AWG）经过投票，同意在理论上采纳“人类世”的概念。而在本月11日，AWG提议将一个可追溯到上世纪50年代的确切地质特征作为人类世开始的标志。AWG建议将这一殊荣授予加拿大的克劳福德湖（Crawford Lake）湖底的沉积物。这个湖距离多伦多大约20英里，是一个被水淹没的沉洞。

全新世开始的标志是气候自然变暖和全球冰盖退缩。而人类世的提法则反映出人类活动对地球造成了同样大规模的干扰。在过去250年里，人类让大气中的二氧化碳浓度增加了大约一半，达到了约300万年来的最高水平。10万年后的地质学家（如果那时还有地质学家的话）会清楚地看到这种骤增变化，而且它可能使得下一个冰河时代的开始推迟了数万年。

除了气候变化之外，还有其他标志。海洋和河流中不断沉积的微塑料形成了自然界中前所未见的化学物质沉积层。氮肥的使用打破了泥炭沼泽中化学同位素的平衡。世界正在经历一次大规模的物种灭绝。与此同时，航运

和航空旅行让许多尚未灭绝的动植物群分散到其他地方，远离了它们世代繁衍演化的地方。当今天的生物变成化石，累加到之前的记录上，就可以看到物种的灭绝和重新分布的情况。

根据国际地质科学联合会的规定，地质转变不仅须以特定事件为标志，还要以具体地质特征发生的具体变化为标志。（例如，6.35亿年前埃迪卡拉纪的开启就是以澳大利亚南部裸露岩石带的一种明显变化来界定的。）为人类世寻找合适标志已持续数年，AWG的公告标志着这项工作结束。科学家们考察了众多地点，包括旧金山河口和维也纳主广场下的沉积物等，最终选定了克劳福德湖。

克劳福德湖有几项优势。每年夏天，随着表层湖水变暖，成片的碳酸钙析出，然后沉入湖底。它们在湖底的沉积物中形成规则的白色条纹，很像树木的年轮。沉积物本身处在深水中，不受湖面上风浪的影响。因此它们包含了按时间顺序的林林总总的记录，从二氧化碳的浓度，到核武器爆炸产生的钚粒子——第一次核武器爆炸发生在1945年。

事实上，AWG已经提议，应该将随后钚的急剧增多（这种元素在原子时代之前很罕见）作为人类世开始的“首要标志”。鉴于钚的不稳定性，并非所有人都确信这是最佳选择。AWG考虑的钚的两种同位素的半衰期分别为6500年和2.4万年，这意味着几乎所有的钚都将在20万年内消失。异议者提出，化石燃料燃烧产生的粉煤灰比钚更适合做标志。粉煤灰和钚一样是地球上前所未见的东西。而和钚不同的是，在不受干扰的情况下，它将在岩石中存续千百万年。■



Choosing a fingerprint

A Canadian lake could mark the start of humanity's geological epoch

Plutonium, carbon and plastic mark a new phase in Earth's history

ONE WAY to view the history of science is as a repeated puncturing of humanity's claims to be special. In scientific terms *Homo sapiens* is an oddly hairless species of ape that has existed for 200,000 years—an eyeblink in Earth's 4.5bn-year history.

For the past couple of decades, though, some scientists have been arguing that perhaps humans do deserve a bit of special recognition after all. In 2000 Paul Crutzen, a Dutch meteorologist and chemist, suggested that human influence over Earth was sufficiently profound that its effects would remain visible in the geological record for millions of years. For that reason, he argued, it was time to bring down the curtain on the Holocene—the current geological epoch, which has lasted for the past 12,000 years or so—and ring in a new one: the Anthropocene.

The idea quickly caught on. In 2016 the Anthropocene Working Group (AWG), an appendage of the International Union of Geological Sciences (IUGS), voted in favour of adopting it in principle. And on July 11th it suggested a precise geological feature, dating back to the 1950s, that could mark the Anthropocene's beginning. The committee recommended bestowing the honour upon sediments laid down at the bottom of Crawford Lake, a flooded sinkhole about 20 miles from Toronto.

The beginning of the Holocene was marked by a natural warming of the climate and the retreat of the world's ice sheets. The idea behind the Anthropocene is that human activity has disturbed the planet on a similarly grand scale. Humans have boosted the concentration of carbon dioxide in

the atmosphere by about half in the past 250 years, to its highest level in around 3m years. That spike will be clearly visible to geologists 100,000 years from now, assuming any exist, and may have delayed the start of the next ice age by tens of thousands of years.

There are markers besides climate change, too. Microplastics in oceans and rivers are laying down sedimentary layers of chemicals never seen before in nature. Nitrogen fertilisers have altered the balance of chemical isotopes in peat bogs. The world is in the midst of a mass extinction. At the same time shipping and air travel have scattered much of the remaining flora and fauna far from where they evolved. Both the extinction and the redistribution will be visible when what is alive today joins the fossil record of the past.

The IUGS's rules say that geological transitions must be marked not just by a particular event, but by a specific alteration in a specific geological feature. (For instance, the start of the Edicarian period, 635m years ago, is defined by a visible change in a band of exposed rocks in southern Australia.) The AWG's announcement marked the end of a years-long search for a suitable marker for the Anthropocene. Scientists examined sites from the estuaries of San Francisco to the sediment beneath Vienna's main square, before settling on Crawford Lake.

The lake has several advantages. Every summer, as the surface waters warm, flakes of calcium carbonate precipitate out and drift to the bottom. There they form regular white bands amid the sediments, much like age rings in trees. The sediments themselves lie deep enough that they remain undisturbed by the wind and waves above. They therefore contain records, in date order, of everything from CO₂ concentrations to particles of plutonium from the explosions of nuclear weapons, the first of which happened in 1945.

Indeed, the AWG has proposed that the subsequent spike in plutonium—an element which was vanishingly rare before the atomic age—should serve as the “primary marker” for the beginning of the Anthropocene. Not everyone is convinced, for plutonium is unstable. The isotopes that the AWG have in mind have half-lives of 6,500 and 24,000 years, meaning almost all the plutonium will be gone within 200,000 years. Dissidents suggest that fly ash from fossil-fuel combustion would make a better alternative. Like plutonium, it is not something that the planet has seen before. And unlike plutonium, it will, if left undisturbed, hang around in the rocks for many millions of years to come. ■



【首文】制造业幻想症

对制造业的补贴和保护将损害世界经济

重塑全球供应链要付出巨大代价

尽管政客们一直都对制造业情有独钟，但他们想要造东西的渴望很少像今天这般热切。在西方，政客们正向制造商发放巨额补贴，尤其是芯片制造商和电池制造商等绿色技术相关公司。他们说自己这是在应对气候变化、加强国家安全，并纠正40年来让工人深受其苦、拖累经济增长的全球化进程。在新兴世界，政府希望当忧心忡忡的西方人把生产转移出中国时，自己能通过补贴在供应链中赢得一席之地。

这方面的花费巨大，而且还在不断加码。自美国的绿色补贴被签署为法律以来，其预估十年期开支已经上升了至少三分之二，可能突破一万亿美元。拜登政府还扩大了芯片制造补贴的适用范围。6月，德国把对一座英特尔芯片工厂建设的补贴从68亿欧元（76亿美元）增加到99亿欧元。印度中央政府正在补贴美光位于古吉拉特邦（Gujarat）的一家芯片“封装和测试”工厂，金额相当于印度高等教育年度预算的四分之一。英国反对党工党计划在上台后在绿色产业上每年投入280亿英镑（360亿美元），占GDP的比重几乎是美国的十倍。

一场工业“军备竞赛”正在展开。美国对此表示欢迎，说世界需要绿色技术和多元化的芯片供应。诚然，庞大的公共资金势必会加速绿色转型并重塑供应链，这种重塑应该会提升民主国家的安全。可惜，它所承诺的会随之而来的经济利好却只是一种幻想。补贴和保护制造业的政府更有可能损害而非助推本国经济。

在理想的情况下，促进制造业可以推动创新和增长。上世纪末，由于精心地促进制造业出口，韩国和台湾的经济赶上了西方。在飞机制造等行业，由于巨大的准入成本以及未来需求的不确定性，扶持新成立的公司是合理的，就像欧洲上世纪70年代对空客的支持。同样，有针对性的帮扶可以提

升国家安全。

而今天所采取的补贴方案很可能以失败告终，或者付出无谓的高昂代价。补贴芯片和电池行业的国家不是在寻求追赶式增长，而是在争夺尖端技术。电动汽车和电池市场不太可能变成空客和波音那种双头垄断。上世纪80年代，贸易保护主义者认为，鉴于日本通过补贴掌握了存储芯片制造技术，它将在战略上至关重要的半导体产业占据主导地位。结果并非如此。

重复生产减少了专业化分工，提高了成本，打击了经济增长。一些分析人士预计，美国得克萨斯州生产的芯片价格将比台湾生产的高出30%。拜登政府正在后知后觉地想办法向友好国家的汽车制造商提供电动汽车补贴。但大部分“购买美国货”的要求被写进了法律，不大可能更改。而这类法规正在被复制。慈善机构全球贸易预警（Global Trade Alert）估算，十年前全世界制定执行的贸易保护主义措施约有9000项。今天大约有3.5万项。

欧洲领导人认为，他们必须跟上美国的政策，否则将面临灾难性的去工业化。他们已经忘记了比较优势的道理，即无论外国政府开出多少张支票，也无论其贸易伙伴的生产率变得有多高，一个国家总有自己可以出口的产品。丹麦没什么汽车工业可言，但其人均GDP比德国高出11%。就连制造业给工人带来的好处也被夸大了，因为制造业岗位的薪资不再高于同等水平的服务性工作。

对制造业的痴迷极有可能适得其反。纽约州斥资近10亿美元建造了一家太阳能电池板工厂，并以每年一美元的价格租给特斯拉。该项目的初衷是打造一个制造业中心，然而已投入的每一美元的收益仅为54美分；据《华尔街日报》报道，这间工厂附近唯一新开的企业是一家咖啡馆。印度试图振兴其手机产业，但带来的岗位似乎大部分都是低价值的组装工作。韩国提供给我们的经验是，国家领军企业必须参与全球竞争，并允许其失败。而今天面临的诱惑是无论发生什么都要保护这类企业。

美国说自己想筑“小院高墙”。尤其当涉及国家安全时，花钱获取核心技术是值得的。然而，除非政策制定者清楚补贴的危险，否则围起来的院子只

会越来越大。不管今天那些大发补贴的人是出于怎样的良苦用心，他们的继任者很可能不会那么目标明确，同时会受到更多的游说。政府追求优质岗位、绿色转型或国家安全并没有错。但如果它们患上制造业幻想症，那只会让自己的国家走下坡。 ■



The manufacturing delusion

Subsidies and protection for manufacturing will harm the world economy

Reshaping the world's supply chains comes at a great cost

POLITICIANS HAVE always been captivated by manufacturing, but rarely has their desire to make things been as zealous as it is today. In the West they are doling out enormous subsidies to manufacturers, especially chipmakers and those behind green technologies, such as batteries. They say they are fighting climate change, enhancing national security and correcting for four decades of globalisation during which workers suffered and growth slowed. In the emerging world, governments hope that subsidies can secure a foothold in supply chains as worried Westerners move production out of China.

The sums being spent are vast, and growing. Since they were signed into law, the estimated ten-year cost of America's green subsidies has risen by at least two-thirds, and is likely to pass \$1trn. The Biden administration has also expanded the eligibility for chipmaking subsidies. In June Germany increased its handout to Intel to build a chip plant, from €6.8bn (\$7.6bn) to €9.9bn. India's central government is subsidising a Micron factory in Gujarat to "assemble and test" chips, spending an amount equal to a quarter of its annual budget for higher education. Eventually, Britain's opposition Labour Party wants to lavish £28bn (\$36bn) a year on green handouts which, as a share of GDP, would be nearly ten times more than America's.

An industrial arms race is under way. America welcomes it, saying the world needs green technologies and a diversified supply of chips. It is true that an ocean of public money is bound to accelerate the green transition and reshape supply chains in ways that should increase the security of

democracies. Alas, the accompanying economic benefits being promised are an illusion. Governments that subsidise and protect manufacturing are more likely to harm their economies than help them.

In ideal conditions, promoting manufacturing can add to innovation and growth. Towards the end of the 20th century South Korea and Taiwan caught up with the West thanks to the careful promotion of manufacturing exports. In industries like planemaking the enormous costs of entry and uncertain future demand can justify support for new firms, as when Europe backed Airbus in the 1970s. Likewise, targeted help can boost national security.

But today's schemes are likely either to fail or to prove needlessly costly. Countries subsidising chips and batteries are not pursuing catch-up growth but fighting over cutting-edge technology. The market for electric vehicles and batteries is unlikely to become an Airbus-Boeing style duopoly. In the 1980s protectionists argued that Japan would dominate the strategically vital semiconductor industry, owing to its subsidised mastery of memory-chip making. It did not turn out that way.

Duplicating production reduces specialisation, raising costs and hitting economic growth. Some analysts expect the price of a chip produced in Texas to be 30% higher than one made in Taiwan. The Biden administration is belatedly seeking ways to open up its electric-vehicle subsidies to carmakers from friendly countries. But most of the "Buy American" requirements are written into laws that may be all but impossible to amend. And they are being copied. A decade ago about 9,000 protectionist measures were in place worldwide, reckons Global Trade Alert, a charity. Today there are around 35,000.

European leaders think they must match America or face catastrophic deindustrialisation. They have forgotten the logic of comparative advantage, which guarantees that countries will always have something to

export, no matter how many cheques foreign governments write or how productive their trading partners become. Denmark has no car industry to speak of, but GDP per person is 11% higher than in Germany. Even the benefits to workers are overstated, because manufacturing jobs no longer pay a premium over comparable service work.

The potential for the manufacturing obsession to backfire is enormous. The state of New York spent nearly \$1bn building a solar-panel factory which Tesla pays \$1 a year to rent. The idea was to create a manufacturing hub but the project has returned only 54 cents in benefits per dollar spent; according to the Wall Street Journal, the only new nearby business is a coffee shop. India's attempt to boost its mobile-phone industry appears to have brought mainly low-value assembly work. The lesson from South Korea is that national champions must be exposed to global competition and allowed to fail. The temptation today will be to protect them, come what may.

America says it wants a “small yard and a high fence”. For national security, in particular, access to vital technologies is worth paying for. Yet unless policymakers are clear about the dangers of subsidies, the fenced-in yard will only get bigger. However well-intentioned those doling out money today, their successors are likely to be less focused and more lobbied. Governments are not wrong to pursue good jobs, the green transition or national security. But if they succumb to the manufacturing delusion, they will leave their countries worse off. ■



纽约入眠

华尔街的失业潮能有多猛？

从历史上看，裁员潮需要时间来蓄势加速

现在很容易指出零利率时代特有的一些现象。无聊猿的JPEG图像卖到数百万美元；用算法来给房屋定价并执行买卖；20来岁的码农创作TikTok视频记录“每日生活”，从头到尾都在展示自己怎么做点心。投行破纪录的利润似乎是那个黄金时代的又一个遗迹。过去为满足激增的需求而雇用的大批员工落入无所事事的状态。现在他们正被扫地出门。

第二季度财报还没公布，华尔街的金融机构就纷纷开始裁员。高盛第一季度裁掉了3200人；5月30日有报道显示它还要再裁250人——这一次大多是高级员工。摩根士丹利在第二季度裁员约3000人。美国银行（Bank of America）和花旗集团分别裁掉4000和5000人。裁员潮也侵袭了金融领域里一些没那么耀眼的角落。埃森哲和毕马威都抡起了板斧。

受影响的不仅仅是那些要把个人物品装进纸板箱的可怜家伙，还有纽约这座城市。就像科技业的裁员伤了旧金山的元气一样，金融业的裁员也会让素有大苹果之称的纽约元气大伤。加州大学伯克利分校的经济学家恩里科·莫雷蒂（Enrico Moretti）表示，让纽约和旧金山等城市欣欣向荣的每一个“知识型岗位”都会另外支撑起五个服务型岗位——有些是高薪工作（如律师），有些工资没那么高（如咖啡师）。即使不再解雇更多人，华尔街紧缩开支也会对经济产生负面影响。据纽约州审计长称，上一财年纽约州各公司的奖金池平均缩水了五分之一，是自2007至2009年全球金融危机以来的最大降幅。

新冠疫情期间，线上活动激增，工作方式似乎要永久性改变，科技公司大肆扩张。银行在当时的扩张程度虽没有那么大，但如今它在有些地方的裁员力度几乎赶上了科技公司。Meta的员工人数在2019到2022年间几乎翻了一番，但此后它又裁掉了大约一半的新增员工。高盛的员工数从2019年底

到2022年底增加了四分之一略多，从约3.8万增加到4.8万多。而如今高盛裁员约3450人，也就是裁掉了三分之一的新增员工。

其他银行的裁员动作要稍慢一些。摩根士丹利的员工人数在同一时期也跃升了三分之一，但它只裁掉了八分之一的新增员工。花旗集团的情况也差不多。华尔街之王摩根大通尚未大规模裁员。总的来说，失业可能会让纽约的经济略微放缓——也许翠贝卡街区（TriBeCa）的工业风loft公寓市场会降温——但对于纽约这种规模和活力的城市来说，这些打击不会是致命的。

但事情可能还远没有结束。科技业的裁员在2022年真正展开，当时将近16.5万个岗位被砍掉。而今天的斧头落下得又猛又快。自今年年初以来，已有超过21万个岗位被砍。历史表明，裁员潮是逐渐蓄势加速的。全球金融危机之后，银行花了好几年时间精简编制。就像科技公司一样，金融公司要回到疫情前的规模还需要把裁员规模扩大好几倍。尽管银行正在瘦身，但看起来还不够瘦。 ■



The city sleeps

How far will Wall Street job losses go?

History suggests firing seasons take time to build momentum

IT IS EASY now to point to phenomena that were features of the zero-interest-rate age. Ape JPEGs selling for millions of dollars; algorithms pricing and buying homes; 20-something tech workers making “day in the life” TikToks that consisted entirely of them making snacks. Record-breaking profits at investment banks appear to be another relic of the golden age. Workers hired to meet roaring demand have been left twiddling their thumbs. Now they are being shown the door.

Ahead of releasing their second-quarter earnings, institutions on Wall Street are trimming staff. Goldman Sachs culled 3,200 in the first quarter; on May 30th reports suggested the bank was letting go of another 250—this time mostly from among senior ranks. Morgan Stanley fired 3,000 or so in the second quarter. Bank of America has cut 4,000 and Citigroup 5,000. Lay-offs are also plaguing less glamorous bits of finance. Accenture and KPMG have both swung the axe.

This matters not only for the poor souls handed their belongings in a cardboard box, but for the city of New York. Just as tech lay-offs have hurt San Francisco, so finance lay-offs will hurt the Big Apple. According to Enrico Moretti, an economist at the University of California, Berkeley, each of the “knowledge jobs” that make cities like New York and San Francisco successful in turn supports another five service roles—some high-paying (like lawyers), others less so (like baristas). Even if there are not additional firings, Wall Street’s retrenchment will take a toll. According to New York’s state comptroller, the average bonus pool shrank by one-fifth in the last financial year, the biggest drop since the global financial crisis of 2007-09.

Although banks did not balloon quite as much as tech firms during the covid-19 pandemic, when online activity surged and working patterns seemed ready to change for good, the axe is cutting almost as deep in places. Meta's workforce nearly doubled in size between 2019 and 2022; the firm has since let go about half of new additions. Goldman's workforce expanded by just over one-quarter between the end of 2019 and the end of 2022, from around 38,000 to just over 48,000. By laying off some 3,450 people the firm has unwound one-third of this increase.

Other banks have been a little slower to scale back. At Morgan Stanley, where employment also leapt by one-third over the same period, just one-eighth of the increase has been unwound. It is a similar story at Citigroup. There have yet to be major lay-offs at JPMorgan Chase, the king of Wall Street. Altogether, job losses might slow New York's economy a tad—perhaps the market for TriBeCa lofts will cool—but they will hardly prove a fatal blow to a city of its size and vitality.

Yet perhaps there is further for the story to run. Tech-industry lay-offs got going in earnest in 2022, when almost 165,000 jobs were lost. They are now coming thick and fast. Since the start of the year, more than 210,000 jobs have been cut. History suggests that firing seasons build momentum. It took years for banks to downsize in the wake of the global financial crisis. Just as with the tech companies, lay-offs would need to be several times bigger to return financial firms to their pre-pandemic sizes. Although banks are trimming the fat, they do not yet look lean. ■



摩登原始餐

一家比利时公司想制作猛犸象汉堡

灭绝物种的DNA也激发了其他商业计划【新知】

只要猫王的一缕头发就行了。取出他的DNA，用聚合酶链反应（PCR）技术可以复制数百万次。这是美国生物学家凯利·穆利斯（Kary Mullis）在上世纪90年代推销的商业计划。穆利斯在上世纪80年代帮助开发了PCR技术；1993年，他与他人共享了诺贝尔奖。他成立了名为“星基因”（StarGene）的公司，希望通过出售镶嵌了名人的DNA的珠宝来赚钱。

这个想法从未真正实现过。但这并没有阻挡后来的一大批公司希望从死去的个体甚至已灭绝的整个物种中掘金。比如为人造肉行业生产合成蛋白质的比利时创业公司Paleo。一定程度上受到“童年时期迷恋史前时代”的驱动，其首席执行官赫尔墨斯·桑克托鲁姆（Hermes Sanctorum）热切地想将业务扩展到制作猛犸象汉堡。

该公司与瑞典古遗传学中心（Centre for Palaeogenetics）合作，从在西伯利亚永久冻土中发现的120万年前的猛犸象牙齿中获得了DNA片段。他们将这些片段与亚洲象和非洲象（猛犸象现存最近的亲戚）的DNA相结合，期望以此重建猛犸象肌红蛋白的编码基因，肌红蛋白是使肉类口感丰富、颜色鲜红的蛋白质。

这个基因被插入酵母的DNA中，就开始产生猛犸象肌红蛋白。再将这种蛋白质与马铃薯淀粉之类的粘合剂、油、盐和其他调味品混合在一起，使其味道和质地都像汉堡。Paleo公司的专利称，这种肌红蛋白会在汉堡的其他成分中引发一系列化学反应，从而产生其他方式无法获得的风味。在桑克托鲁姆看来，猛犸象汉堡的味道比牛肉“更加醇厚浓郁”。该公司在2月的第一轮融资中筹集了1200万欧元（1310万美元），并暗示它的猛犸象肉将很快上市。据报道，几家素食汉堡制造商和一家冰河时代主题公园对此

感兴趣。

Paleo并不是唯一一家研究猛犸象肉的公司。澳大利亚公司Vow表示，它把改造过的猛犸象肌红蛋白注入实验室培育的绵羊干细胞中，制造出了排球大小的猛犸象肉块。已融资超过1亿美元的创业公司Geltor选择了另一种已经灭绝的大象。它对乳齿象的DNA进行了测序，并用这种DNA来制造胶原蛋白这种存在于皮肤和肌腱中的蛋白质。这些胶原蛋白最终变成明胶，用于制作软糖。

各种公司认为可能会有价值的还不限于已灭绝的动物。英国化妆品公司Haeckels正尝试重现已灭绝的花的香味，用于制作香水。Geltor也生产用于化妆品的人体胶原蛋白。也许提取某位名人的DNA制成胶原蛋白会大受欢迎？■



The Fred Flintstone diet

A Belgian company wants to create woolly-mammoth burgers

DNA from extinct species is inspiring other business plans, too

JUST A STRAND of Elvis's hair would do. Pluck out his DNA and it could be copied millions of times using a technique called the polymerase chain reaction (PCR). That was the business plan pitched in the 1990s by Kary Mullis, an American biologist. Mullis had helped develop PCR in the 1980s; in 1993 he shared a Nobel prize. "StarGene", as his company was known, hoped to make money by selling jewellery stuffed with celebrity DNA.

The idea never quite worked out. But that has not stopped a slew of newer firms also hoping to mine gold from dead individuals—or even entire species. Paleo, for instance, is a Belgian startup that creates synthetic proteins for the artificial-meat business. Driven in part by a "childhood fascination with prehistory", Hermes Sanctorum, the company's CEO, is keen to expand the business into making woolly-mammoth burgers.

Working with the Centre for Palaeogenetics in Sweden, the firm has obtained fragments of DNA from mammoth teeth found in the Siberian permafrost that are up to 1.2m years old. These fragments were combined with DNA from Asian and African elephants, the mammoth's nearest living relatives, to reconstruct what the firm hopes is the mammoth version of the gene that encodes myoglobin, a protein that helps give meat its rich taste and vibrant red colour.

That gene was inserted into the DNA of yeast, which duly began turning out mammoth myoglobin. The protein was mixed with binders such as potato starch, oil, salt and other flavours so that it resembled the taste and texture of a burger. Paleo's patent claims the myoglobin causes a range of chemical

reactions between other ingredients in the burger, producing flavours that are obtainable in no other way. Mr Sanctorum, for his part, says mammoth burgers taste “more intense” than beef. The firm raised €12m (\$13.1m) in its first funding round in February, and hints its mammoth meat will be publicly available soon. Several vegan-burger makers and an ice-age theme park are reportedly interested.

Paleo is not the only company exploring mammoth meat. Vow, an Australian company, says it has made a volleyball-sized lump of the stuff by injecting engineered mammoth myoglobin into lab-grown stem cells derived from sheep. Geltor, a startup that has raised more than \$100m, opted for a different extinct, elephantine species. It took sequenced mastodon DNA and used it to produce collagen, a protein found in skin and tendons. The stuff was eventually turned into gelatine for gummy sweets.

And it is not just extinct animals that companies think might prove valuable. Haeckels, a British cosmetics firm, is attempting to engineer scents from extinct flowers for use in perfumes. Geltor has also produced human collagen for use in the cosmetics business. Perhaps engineering some from a celebrity’s DNA would be a hit? ■



【首文】巨大的干扰

美国反垄断机构迷失焦点

紧盯科技公司和交易规模，让它忽略了真正有害的市场支配力

近年来，反垄断机构毫不掩饰它们对大公司和大型并购交易的反感。美国联邦贸易委员会（FTC）主席莉娜·卡恩（Lina Khan）上任前曾表示，这几十年来反垄断机构的监管力度不足。除了起诉亚马逊和谷歌滥用市场支配力外，监管机构还力图阻止微软以690亿美元收购动视暴雪（Activision Blizzard），又阻拦医疗公司安进（Amgen）收购地平线治疗（Horizon Therapeutics）。欧洲同样是这套积极干预的做法。英国的反垄断机构一直高调出击；欧盟委员会在7月12日对生物技术巨头因美纳（Illumina）违规收购癌症早筛公司Grail处以4.32亿欧元（4.8亿美元）的罚款。

这种对大公司的大范围打击令人质疑监管机构是否积极过头了。7月11日，美国一个地方法院驳回了FTC对微软收购动视暴雪的禁令。FTC将提出上诉，但此前曾叫停该交易的英国反垄断机构突然发出信号表示愿意展开谈判。该收购案启动至今已近18个月，即使最终成功，也足以冷却未来的并购热情。同时，只盯着规模可能会影响政策制定者解决真正阻碍竞争的问题，导致消费者利益受损。

理论上，反垄断机构的这股劲头应该受到欢迎，毕竟在任何自由市场经济中，活跃竞争都是必不可少的。上世纪80年代过后，崇商的风气限制了美国监管机构和法院的行动。从1990年代到2010年代，美国司法部平均每年调查的并购案数量从180宗降至70宗。公司利润是市场支配力的象征，过去十年，公司利润比之前30年高出20%至40%（视乎衡量标准在该区间浮动）。像2006年惠而浦和美泰克合并这样的并购导致产品价格上升。过去20年有近2000宗医院合并交易，平均而言，最后价格是上涨了，医疗质量却不见起色。

然而，正如动视暴雪的收购波折所示，规模不一定是坏事。美国的五大科

技巨头占到美国研发总投入的四分之一。诚然，几十年来美国和欧洲大部分地区的企业集中度均已上升。但这番扩张似乎主要源于技术带来的规模经济增长，而非市场支配力。

此外，并购交易是健康的资本主义一个极为重要的组成部分，即便是涉及大公司的交易。微软收购动视暴雪有望通过发展新兴的订阅服务和云游戏市场来挑战游戏产业的现有格局，加大其竞争。

监管机构只盯规模的后果正开始显现。几乎所有涉及大型科技公司的并购案都受到严格审查。律师们称之为“往并购的齿轮里扔沙子”，这种操作扼杀了一些原本有价值的交易，因为公司管理者宁可避开因交易遇阻而损害声誉的风险或合规的麻烦。与过去五年相比，尽管今年并购案总数只是略有下降，但平均交易额缩减了约40%，表明更大型的并购受到抑制。自2020年以来，涉及五大科技巨头的并购案占比减少了一半。

监管机构应遵循两条原则。首先，单是规模不应引起过度警觉。不必要的审查会耗费监管机构的资源，损害其信誉和工作人员的士气。在美国，有许多行业一直是高利润低创新，包括医院及其中介机构，还有信用卡公司，这些才是值得关注的。近年来，FTC叫停了一些医院并购案，这是正确的，也得到了法院的认同。但仍有更多工作要做。

第二条原则是承认反垄断的局限性。两年前，美国总统拜登指出，阻止并购及打击反竞争行为只是解决问题的一个方面。这个正确的观点已被遗忘。土地使用及职业许可方面的限制仍然根深蒂固。贸易壁垒不断加大，受庇护的企业免受挑战。相比瞄准大宗并购案，这些事情没那么夺人眼球。但解决它们至少可以促进竞争。 ■



The big distraction

American trustbusters are losing their focus

An obsession with technology and size distracts from truly harmful market power

IN RECENT YEARS trustbusters have made no secret of their distaste for big firms and big deals. Lina Khan, the head of America's Federal Trade Commission (FTC), came to office after saying that the agencies had failed for decades to do enough proper policing. In addition to suing Amazon and Google for abusing their market power, regulators sought to block Microsoft's \$69bn acquisition of Activision Blizzard and are holding up the purchase of Horizon Therapeutics by Amgen, a health-care firm. The activist approach has been mirrored in Europe. Britain's trustbusters have been conspicuously aggressive, and on July 12th the European Commission slapped a €432m (\$480m) fine on Illumina, a biotech giant, for buying Grail, a cancer-screening firm.

This expansive agenda raises questions of whether regulators have become overambitious. On July 11th a district court halted the FTC's attempt to stop Microsoft buying Activision. The FTC will appeal, but Britain's trustbusters, which had previously blocked the deal, abruptly signalled that they would be open to negotiations. Almost 18 months have passed since the deal was launched. Even if it eventually succeeds, that would be enough to chill future dealmaking. And all the while, the obsession with size may have distracted policymakers from tackling genuine hurdles to competition, to the detriment of consumers.

In principle trustbusters' zeal is welcome, because vigorous competition is essential in any free-market economy. After the 1980s, deference to business curbed regulators and courts in America. From the 1990s to the 2010s, the average number of mergers investigated yearly by the Department of Justice

fell from 180 to 70. Corporate profits are a sign of market power and, depending on how they are measured, they have been 20-40% higher in the past decade than in the three decades before that. Mergers such as the one between Whirlpool and Maytag in 2006 led to higher prices. The past 20 years have seen nearly 2,000 hospital mergers; on average, prices have risen while the quality of care has stagnated.

Yet, as the Activision saga shows, bigness need not be bad. The five largest tech firms pay for a quarter of all research and development in America. True, corporate concentration has risen across the decades in both America and much of Europe. But this expansion appears to have been caused mainly by growing economies of scale from technology, not market power.

Moreover dealmaking, even involving big firms, is a vital part of healthy capitalism. Microsoft's purchase of Activision promises to make gaming more competitive, by developing the nascent subscription and cloud-gaming markets that could challenge the status quo.

The consequences of regulators' emphasis on size are starting to be felt. Nearly any deal involving a large tech firm is scrutinised. Adding "sand to the gears of M&A", as lawyers put it, sabotages the launch of some worthy bids, because managers choose to avoid the reputational risk of being barred or the headache of compliance. Although the overall volume of deals has fallen only a little, their average value has shrunk by about 40% this year compared with the past half-decade, suggesting that larger deals are being deterred. Since 2020, the share of deals involving the five largest tech giants has been cut in half.

Two principles should guide the regulators. The first is that size alone should not warrant alarm. Needless scrutiny uses up regulators' resources and damages their credibility and the morale of their staff. Plenty of industries in America with persistently high profits and low innovation

deserve attention, including hospitals and their intermediaries, and credit-card firms. The FTC has rightly blocked a handful of hospital mergers in recent years, and courts have agreed with it. It has more work to do.

The second principle is to acknowledge the limits of antitrust. Two years ago President Joe Biden rightly pointed out that blocking deals and anti-competitive practices was just one piece of the puzzle. That idea has been forgotten. Land-use and occupational-licensing restrictions are still entrenched. Firms are being protected by rising barriers to trade. Such things win fewer headlines than targeting blockbuster deals. But tackling them would at least boost competition. ■



经济学人视频

加密货币的未来 - 下

如果隐私安全问题能被解决，代币的未来可能完全超越金融领域，而是在于互联网的下一次迭代。



The Economist Film

The future of Crypto - 2

If these lingering privacy issues can be fixed, crypto's future might not lie in finance at all, but in the next iteration of the internet.



偷窃的艺术

关于一个世界顶级艺术大盗的精彩故事

斯特凡·布雷特维瑟窃取了200多幅作品，总价值超过10亿美元【《雅贼》书评】

《雅贼》。迈克尔·芬克尔著。克诺夫出版社；240页；28美元。西蒙和舒斯特出版社；16.99英镑。

他用“直击心脏”来形容这种感觉。站在一件艺术品前，斯特凡·布雷特维瑟（Stéphane Breitwieser）欣喜若狂。先是手上生出一股刺刺麻麻的感觉，进而席卷全身。不一会儿，他就开始卸除将他和心仪之物阻隔开来的螺丝或封条。一旦得手，他通常会将这些东西藏在外套里、裤子上或女朋友的手提包里。布雷特维瑟接着会把战利品运回位于法国东部米卢斯（Mulhouse）的他母亲房子里的阁楼上，事情败露前他仍住在那里。

这种贪婪的冲动屡屡俘虏他的身心。1994年至2001年间，他从七个国家的博物馆偷走的藏品远超200件。他的女友安妮-凯瑟琳·克莱因克劳斯（Anne-Catherine Kleinklaus）通常负责望风。尽管布雷特维瑟偏爱弗拉芒制品或文艺复兴晚期的艺术品，比如里昂的高乃依（Corneille de Lyon）画的玛德琳·德·弗朗斯（Madeleine de France）的肖像（如图），但他的喜好不拘一格。除了布歇（Boucher）、老扬·勃鲁盖尔（Jan Brueghel the Elder）、克拉纳赫（Cranach）、杜勒（Dürer）和华托（Watteau）的作品外，他的收藏还包括象牙雕塑、挂毯、祭坛装饰品、乐器、烟草盒和武器。专家估计，这些赃物的总价值在10亿至20亿美元之间。

正如迈克尔·芬克尔（Michael Finkel）在《雅贼》（The Art Thief）一书中所述，布雷特维瑟是一个非同一般的罪犯，这不仅仅是因为他极其“高产”。（七年间，他平均每12天就能得手一次。）他的抢劫路数并不是集结一个抢劫团伙在夜色的掩护下行动。他并不提前几个月准备周密的计划。他突如其来窃取某件艺术品的灵感“迸发于冲动和简单的交汇点”，芬

克尔写道。他的盗窃哲学是：“不要把事情复杂化。”

布雷特维瑟会走进一间博物馆或拍卖行，找出安保漏洞，机会来到眼前时就一把抓住。他知道如何熟练地切开粘连起展示柜的硅胶，以及如何将一幅画从画框中一点点蹭出来。在做这些事的时候，举止正常很重要：在某个地方逗留太久，或者跑着离开博物馆，就肯定会引起怀疑。有时，他和克莱因克劳斯会跟着讲解员游览，或在突袭后留下来吃个午饭。这就提供了掩护，因为“窃贼绝对不会故意带着偷来的赃物待在博物馆里”，也不会“为了吃饭而暂停打劫”。

他的动机和手法一样不同寻常。大多数窃贼偷窃艺术品是为了钱：他们希望把艺术品卖给道德败坏的交易商，从博物馆或保险公司勒索钱财，或者把艺术品转移到地下，充当可疑交易的抵押品（贩运艺术品是最赚钱的犯罪活动之一）。布雷特维瑟声称他只偷自己喜欢的东西。按他的讲述，他患上了“司汤达综合征”，其特征是面对瑰丽的艺术会产生强烈的躯体反应。他觉得博物馆不是欣赏作品的好地方。他更喜欢在母亲阁楼上的天鹅绒四柱床上欣赏它们。

最终，博物馆官员和警察明白了发生了什么。布雷特维瑟变得马虎大意起来。他先是被发现偷了一幅画，后又被抓包偷了一支镀金军号。2002年，他供认窃取了大量物品。（其中有很多在他在押期间被扔进了一条运河，可能是他母亲所为。她声称已经烧掉了他的绘画收藏。）布雷特维瑟被处以罚款，并被判处四年监禁。他的母亲在监狱里待了几个月，克莱因克劳斯只被关了一个晚上。

作者对这一卑鄙行径的记述扣人心弦，对后续调查的描写读来就有些索然无味了。芬克尔对他进行了详细的采访，在很大程度上同情他的主人公，暗指双亲离婚带来的创伤和他自身的反社会倾向可能导致了他的行为。但芬克尔认为，他对美的追求也很自私。他告诫说：“作为公共遗产的艺术作品通常都富有精神意义和地方感，应该向所有人开放、供所有人观赏。”布雷特维瑟和克莱因克劳斯的所作所为是“公共利益的毒瘤”。

布雷特维瑟是致使无价的艺术瑰宝遭受无妄之灾的罪魁祸首。与此同时，他竟又以他异乎寻常的方式从这个惊人的故事中洗尽铅华，成了个悲剧人物。出狱后，他曾考虑成为一名安保顾问，但他故态复萌，手脚又不干不净起来。他失去了女朋友，还和母亲闹翻了。他整个人都被对偷窃的酷爱吞噬。“从前我是宇宙的主宰，”布雷特维瑟说，“现在我什么都不是。”■



The art of theft

The amazing tale of one of the world's most prolific art thieves

Stéphane Breitwieser stole well over 200 works—with a total value of more than \$1bn

The Art Thief. By Michael Finkel. Knopf; 240 pages; \$28. Simon and Schuster; £16.99

HE CALLED THE sensation a coup de cœur: a blow to the heart. When he stood in front of an artwork, Stéphane Breitwieser felt exhilarated. A tingling sensation would flood his body, starting in his hands, and before long he would get to work on the screws or seals that kept him from the object of his desire. Once liberated, the item would usually be sequestered inside his coat, down his trousers or in his girlfriend's handbag. Mr Breitwieser would then transport his loot back to the attic of his mother's house in Mulhouse, in eastern France, where he still lived.

That covetous compulsion struck him a lot. Between 1994 and 2001 he stole well over 200 items from museums in seven countries; Anne-Catherine Kleinklaus, his girlfriend, often kept watch. Though his preference was for Flemish goods or art of the late Renaissance—such as Corneille de Lyon's portrait of Madeleine de France (pictured)—Mr Breitwieser's tastes ranged widely. As well as pieces by Boucher, Jan Brueghel the Elder, Cranach, Dürer and Watteau, his collection included ivory sculptures, tapestries, altarpieces, musical instruments, tobacco boxes and weaponry. Experts value the haul at somewhere between \$1bn and \$2bn.

As Michael Finkel recounts in “The Art Thief”, Mr Breitwieser was an extraordinary criminal, and not just because he was extremely prolific. (He managed, on average, a theft every 12 days for seven years.) His heists did not involve a squadron of marauders working under the cover of night.

He did not prepare sophisticated plans months in advance. His art-stealing epiphanies “emerge from the spot where spontaneity and simplicity meet”, Mr Finkel writes. His larcenous philosophy was: “Don’t complicate things.”

Mr Breitwieser would walk into a museum or auction house, work out the security weaknesses and take advantage of opportunities presented to him. He knew how to slice deftly through the silicon glue that held display cases together and how to wriggle a painting out of its frame. It was important to behave normally while the deed was being done: lingering too long at a particular spot, or running out of a museum, would be bound to arouse suspicion. Sometimes he and Ms Kleinklaus would take a guided tour or stay for lunch after they swooped. This provided cover, for surely “a thief would never purposely remain inside a museum with stolen loot”, nor “pause a heist to dine”.

His motives were as unusual as his methods. Most thieves pinch artworks for money: they hope to sell them to a corrupt dealer, extort payment from a museum or insurance firm or take the piece underground to use as collateral in dodgy deals (trafficking art is one of the most lucrative criminal enterprises). Mr Breitwieser claimed he purloined only pieces he liked. In his telling he experienced Stendhal syndrome, a condition characterised by an intense physical response to beautiful art. Museums were lousy places to appreciate a work, he thought. He preferred to admire it from the velvet-draped four-poster bed in his mother’s attic.

Eventually museum officials and police grasped what was happening. Mr Breitwieser got sloppy. He was caught stealing a painting, then a gold-plated bugle. In 2002 he confessed to taking scores of objects. (Many had been dumped in a canal, probably by his mother, while he was in custody; she claimed to have burned his collection of paintings.) Mr Breitwieser was fined and sentenced to four years in prison. His mother spent a few months behind bars, Ms Kleinklaus a single night.

The author's account of the skulduggery is thrilling; the description of the subsequent investigation less so. Mr Finkel is largely sympathetic to his subject, whom he interviewed at length, suggesting that the trauma of Mr Breitwieser's parents' divorce and his anti-social tendencies may have contributed to his behaviour. But he was also selfish in his pursuit of beauty, Mr Finkel argues. "Works of communal heritage, often suffused with spiritual significance and a sense of place, should be open and accessible to all," he admonishes. Mr Breitwieser's and Ms Kleinklaus's actions were a "cancer on this public good".

Mr Breitwieser was responsible for the needless destruction of priceless artworks; at the same time, and in his own eccentric way, he emerges from this astonishing tale as a tragic figure. After serving his sentence, he considered launching a career as a security consultant, but his light fingers took over once again. He lost his girlfriend and fell out with his mother. His passion for thieving became all-consuming. "I was a master of the universe," Mr Breitwieser says. "Now I'm nothing." ■



梧桐

万物皆泡沫，何物能戳破？

事实证明，风险资产面对威胁的抗跌性极强

对于某一类投资者而言，去年是一种解脱。的确，损失相当惨重。但至少市场开始能让人看得懂了。过去十年里，各国央行疯狂印钱购债。利率被维持在异常低位，甚至是负值。其结果就是“万物皆泡沫”，在这场投机狂潮中，从股票到房地产，再到烧脑的加密资产，一切估值都在飙升。这注定不会有好结果，而2022年终于崩盘：通胀消灭了廉价资金；万物的泡沫被戳破；资产价格暴跌。一些资产价格甚至开始回归理性。市场似乎又将回到令人安心的枯燥无味的投资方式——基于基本面而非炒作热点。

如果这听起来耳熟，而且你也是这些松了一口气的投资者之一，那么过去几个月的事态发展可能让你措手不及。美国和全球股市齐升，距离历史高位仅一步之遥，而上涨的不仅仅是股票。事实证明，所有风险资产对看似灾难性的消息也表现出惊人的韧性。美国银行编制的美国高收益（即“垃圾”）债券指数在2022年从波峰落到波谷，下跌了 15%。自那以来，它已经收复了半数失地。欧洲一个类似的垃圾债券指数也是如此。全球房价在此前牛市中创下最高涨速记录后从峰值仅下跌了3%（经通胀调整后为8%到10%），但即便是这样的小幅下滑已经显现出止步的迹象。

最让人惊讶的是，甚至更具投机性的资产也表现坚挺。比特币曾是廉价资金时代的象征，被许多人视为一种没有内在价值的数字代币，但它证明了自己坚不可摧。任何在2021年前买入并一直持有比特币的人现在仍坐享浮盈，即便收益远远低于两年前。即使是非同质化代币（NFT，代表数字媒体作品的记录），其在2022年的销售额也比2020年高出70倍，达到15亿美元。

换言之，风险资产中的万物皆泡沫似乎经受住了通胀回归、利率上升、欧洲战争和衰退威胁。还有什么东西能把它戳破？

一样常被提及的东西是流动性，目前正被从金融体系中抽走。流失的主要出口是美联储和美国财政部。美联储持有的部分国债和抵押担保证券到期后不做再投资，每月抽走950亿美元。据一项估计，在华盛顿就债务上限问题陷入僵局后，财政部必须在夏季出售1万亿美元的新债才能重建其现金缓冲。

最明显的结果是，此举增加了美债供应，美联储也不再每月买债，从而使美债价格承压。（政府债券是唯一没有从去年的颓势中有所复原的资产类别，就很能说明问题。）“安全”的美国国债收益率提高，这使得较高风险资产的吸引力相对降低。这也意味着，更多原本无此打算的投资者最终会持有美债，而缩减他们对风险资产的需求，即使其价格下跌。因此，崩盘（而且是严重崩盘）的可能性正在悄悄攀升。

显然，目前市场上并没有对这种崩盘的预期。事实上，衡量股价预期波动的VIX指数（常被称为华尔街的“恐慌指标”）今年已跌至新冠疫情前以来的最低水平。但瑞银的分析师指出，这乍看之下让人安心，实则不然。他们发现该指数下跌的主要原因是股票之间的相关性异常之低，意味着它们各自的行情变动相互抵消。而一旦股价变化开始步调一致，波动性就可能骤然上升，在历史上这种情况在低相关性消失之后常常发生。

与此同时，正如在任何泡沫中一样，资产估值之高已经极不合理。美国股市就是最大胆的一例，追踪大型公司的标普500指数的收益率现在与美联储的无风险利率大致持平。但它并非特例。瑞银团队分析了信贷、大宗商品、股票和货币的价格，倒推出的隐含假设是世界经济的年增速达到3.6%。这略高于全球长期增长率，大约是当前增速的两倍。是不是该押注市场回调了？这种想法很诱人，但也许这是愚蠢而非勇敢。从最近的经验看，万物皆泡沫的局面能维持非常之久。 ■



Buttonwood

Can anything pop the everything bubble?

Risky assets are proving extraordinarily resilient to threats

FOR A CERTAIN type of investor, last year came as a relief. True, the losses were grim. But at least markets were starting to make sense. Over the previous decade, central banks had pumped out floods of new money to buy bonds. Interest rates were kept unnaturally low, or even negative. The result was an “everything bubble”, a speculative mania in which valuations surged everywhere from stocks to housing to baffling crypto assets. It was never going to end well, and in 2022 it didn’t: inflation killed off cheap money; the everything bubble popped; asset prices plunged. Some were even approaching rationality. A return to reassuringly dull investing—based on fundamentals, not hype—beckoned.

If this sounds familiar, and you were one of these relieved investors, you may have found yourself wrong-footed by developments over the past few months. It is not just stockmarkets, though both in America and globally they have risen to within striking distance of all-time highs. It is that risky assets across the board have proved astonishingly resilient to seemingly disastrous news. An index of American high-yield (or “junk”) bonds compiled by Bank of America suffered a peak-to-trough loss of 15% in 2022. It has since recovered half that loss. So has a similar index for junk bonds in Europe. The housing slump already shows signs of petering out, even though global prices have fallen by just 3% from their peak, or 8-10% adjusting for inflation, after a boom in which they rose at their fastest rate ever.

The biggest surprise is how well even more speculative assets have held up. Bitcoin—once an emblem of the cheap-money era, seen by many as a

digital token with no intrinsic value—has proved indestructible. Anyone who bought it before 2021 and held on is once again sitting on a profit, albeit just a fraction of that which they could have booked two years ago. Even sales of non-fungible tokens, records that represent pieces of digital media, were 70 times higher in 2022 than in 2020, at \$1.5bn.

In other words, the everything bubble in risky assets seems to have survived the return of inflation, rising interest rates, war in Europe and the threat of recession. Can anything pop it?

One oft-mentioned candidate is liquidity, which is being drained from the financial system. The main exit pipes run to the Federal Reserve and America's Treasury department. The Fed is sucking out \$95bn a month by allowing some of its portfolio of Treasuries and mortgage-backed securities to mature without reinvesting the proceeds. The Treasury, by one estimate, must sell \$1trn of new debt in the summer to rebuild its cash buffers after Washington's debt-ceiling stand-off.

Most obviously, this depresses Treasury prices by increasing supply and removing the Fed as a monthly buyer. (Tellingly, government bonds are the one asset class to have barely recovered from last year's shellacking.) By raising “safe” Treasury yields, this makes riskier assets relatively less attractive. It also means that more investors end up holding Treasuries than otherwise would have been the case, reducing their appetite to buy riskier assets, even if prices fall. The likelihood of a crash, and of it being severe, is therefore creeping up.

Such a crash is certainly not what markets are betting on. In fact, the VIX, a measure of expected stock-price volatility, often dubbed Wall Street's “fear gauge”, has this year fallen to its lowest since before the covid-19 pandemic. Yet analysts at UBS, a Swiss bank, point out that this is less reassuring than it might appear at first glance. They find that the VIX has fallen mainly

because correlations between stocks are unusually low, meaning their movements cancel each other out. Should they start moving in lockstep, volatility could suddenly jump, which is what has tended to happen after past spells of low correlation.

Meanwhile, as in any bubble, asset valuations have become maddeningly hard to justify. America's stockmarket, where the earnings yield of the S&P 500 index of major firms is now roughly level with the Fed's risk-free rate, is the most audacious example. But it is not alone. The UBS team analysed prices across credit, commodities, stocks and currencies, backing out an implicit assumption that the world economy would grow at 3.6% per year. That is a little more than its long-term growth rate, and around double its present one. Time to bet on a correction? Tempting, but perhaps more foolish than brave. Based on recent experience, everything bubbles can survive for an awfully long time. ■



熊彼特

一份搭建AI路径的乐高说明书

如何让传统公司用像素复刻砖块，实现数字时代转型

伦敦设计博物馆正在举办中国艺术家艾未未的作品展，其中有一件长达15米、名为《睡莲#1》（Water Lilies #1）的展品，是对莫奈三联画的重新演绎。走近看会发现，这幅作品是由乐高积木制作而成，总共用了65万块。它将莫奈的印象主义融入艾未未所说的“数字化、像素化的语言”之中。这对乐高公司本身来说是一个很好的类比。这家丹麦玩具制造商一直在推进的一项长期任务就是数字化和像素化它独家的人类创造力源泉：塑料积木。

由管理咨询公司麦肯锡的三位数字化专家合著的新书《换线转型》（Rewired）概述了企业在数字化时代重塑自我的注意事项，其中就介绍了乐高的转型。请注意：讲述数字化转型的语言可不能按日常用语理解。这些词听起来更像是企业的瑜伽修行法，而不是软件开发的马拉松。高管要正位，团队是平衡球，要轻快敏捷，界定你的面向下域。麦肯锡吸取了200家公司的经验教训，尽管使用这套含混晦涩的仪式化语言，仍然为企业提供了清晰的思路。不过，为了让大家不致听得云里雾里，本文将以乐高为指南，来帮助阐明麦肯锡的一些见解。姑且称之为通向生成式AI的积木大道。

首先，这条道路漫长而艰难，到处是失败案例。乐高是个少有的成功故事。它的旅程始于2003年一场险死还生的经历——随着电子游戏的兴起，它陷入了恐慌，于是狂乱地创新，几乎破产。为了解决供应链混乱这一主要问题之一，它在全球范围内引入了统一的企业软件系统。该系统今天仍在发挥作用，并随着乐高进入中国等新市场、开拓电子商务等新业态以及建设美国和越南等地的新工厂而不断扩大升级。为了迎接像素化兴起的世界，乐高推出了《星球大战》主题的数字游戏，并开发了自己的《旋风忍者》（Ninjago）和《神兽传奇》（Chima）等产品系列，其电子游戏、

电影和电视节目大受欢迎。

2019年，乐高推出了新的五年转型计划，旨在适应一个直接面向消费者销售、在线零售与大型卖场竞争、以及屏幕时代转向数字化的世界。这个时机选得如有神助。转型开始后不久，全球就因疫情陷入封锁，有没有数字化战略成了生死攸关的问题。成果很快就显现出来。尽管很难确定数字化转型的具体贡献有多大，但自2018年以来，乐高的销售额几乎翻了一番，突破90亿美元，增速超过了其主要竞争对手美泰（Mattel）和孩之宝（Hasbro）。2022年，其门户网站的访问量增长了38%。它还与电子游戏公司Epic合作，探索元宇宙。

尽管如此，这一旅程仍非坦途。难题之一是如何衡量成功。过去的标准是看每家门店的销售额，如今则要根据公司的全球在线销售情况、在谷歌和亚马逊上的排名以及软件的有效性来判断。麦肯锡的三位作者在书中第一页就强调了此类挑战。他们称，根据麦肯锡最近的一项调查，大约90%的公司都制定了某种数字化战略，但它们获得的收入增长还不到预期的三分之一。此外，行业内部的成功率差距更甚于行业之间。最好的零售商的数字化生产率可能比一般的高科技公司还高，而最差的零售商可能和最差的政府机构一样糟糕。

要取得成功，就需要学习第二点经验，即麦肯锡所说的自上而下的战略和路线图（或者用乐高术语来说，就是清晰的说明手册）。乐高这个家族企业长期以来一直采用命令与控制式的管理方法，这很有帮助。其数字化战略就只有一套计划，由100多人的高管团队制定并经董事会批准，覆盖整个组织。麦肯锡指出，转型项目停滞不前通常是因为高管之间沟通不畅、有各自热衷的项目、投资过于分散，或者如作者之一罗德尼·泽梅尔（Rodney Zemmel）所言，“飞行员比一艘航空母舰上的还要多”。转型战略还需要有足够的雄心来产生动力，并不断衡量财务业绩。麦肯锡的经验法则是，数字化转型的目标应该是将息税折旧摊销前利润提升20%或更多。

第三个经验是新的数字基础设施是应该自建还是购买。答案大多是自建。

六块八颗粒的乐高积木可以有9.15亿种组合方式，同样地，市场上的众多软件应用也可以组合起来创建专有系统。但软件的组织和协调工作不应该外包。以乐高为例，它刚刚启动最近这次数字化转型时，工程师比例不到员工的30%。自那时起，系统和软件工程师的数量增加了150%。泽梅尔指出，五年前的趋势是从硅谷招聘工程师。这“是改变公司的着装规范的好方法，但未必能改变公司文化”。从那以后，越来越多的公司开始对现有的技术员工进行再培训，并把他们安排到公司各种部门更接近一线的岗位上。

这些经验教训有一些适用于生成式AI。泽梅尔表示，利用某些生成式AI技术进行试点相对容易，比如能像人一样对话的ChatGPT。问题在于如何安全、无偏倚地将AI模型嵌入整个组织中。这需要一个自上而下的策略。至于这类模型是自建还是购买，泽梅尔表示，既然软件行业本来就在做专有模型，自己构建可能是“浪费时间”。关键是要自己做那些能让公司在市场上获得决定性优势的工作。乐高的AI时代还未到来，尽管一些乐高粉已经在使用类似ChatGPT的程序来寻找搭积木的新方法。它们大多数都失败了，但有朝一日，或许任何人都可以复制出一幅莫奈画作来。积木大道没有尽头。 ■



Schumpeter

A Lego-lover's guide to preparing for the AI age

How to transform companies for the digital era, brick by pixel

IN LONDON'S DESIGN MUSEUM, an exhibition currently on display by Ai Weiwei, a Chinese artist, includes a 15-metre-long work called "Water Lilies #1" based on the triptych by Claude Monet. Look closely and it is made of 650,000 Lego bricks—which integrates Monet's impressionism into what Mr Ai calls a "digitised and pixelated language". That is a good analogy for Lego itself. The Danish toymaker is on a long-term mission to digitise and pixelate its own fount of human creativity: the plastic brick.

Three digital experts from McKinsey, a management consultancy, profile Lego's transformation as part of their new book, "Rewired", which outlines the dos and don'ts for businesses rebuilding themselves for the age of digitisation. Beware: the language of digital transformation is treachery to common English. It sounds more like corporate yoga than a marathon of software development. Executives need to be aligned. Teams are pods. Be agile. Define your downward-facing domains. McKinsey, drawing lessons from 200 firms, provides clarity despite the mumbo jumbo. But to make it easier on the ear, Schumpeter will use Lego as a guide to help illustrate some of McKinsey's insights. Call it the yellow-brick road to generative artificial intelligence (AI).

First, it is a long hard road, littered with failures. Lego is a rare success story. Its journey started in 2003 with a near-death experience when, amid the rise of video-gaming, it panicked and went on a madcap innovation spree that almost bankrupted it. To fix one of the main problems, chaos in the supply chain, it introduced a single enterprise-software system globally. The system survives to this day, scaling up as Lego expands into new

markets, such as China, new formats, such as e-commerce, and new factory locations, such as America and Vietnam. To prepare for a world of pixelated play, Lego launched digital games on the “Star Wars” theme and developed franchises of its own, such as Ninjago and Chima, with video games, films and TV shows that turned into hits.

In 2019 Lego launched a new five-year transformation drive aimed at adapting to a world of direct-to-consumer sales, online versus big-box retailing, and digital play in the screen age. The timing was inspired. It started shortly before the world went into lockdown as a result of the covid-19 pandemic, when having a digital strategy became a matter of life and death. It quickly produced results. Although it is hard to strip out the exact contribution of digitisation, since 2018 Lego’s sales have almost doubled, to more than \$9bn, outpacing those of Mattel and Hasbro, its main rivals. In 2022 visits to its online portal rose by 38%. It has teamed up with Epic, a video-gaming firm, to explore the metaverse.

Yet the journey is still a hard one. The difficulties include moving from a system where success is measured by sales store-by-store to one judged by how good the company is at selling online across the globe, how it is ranked on Google and Amazon, and how effective its software is. The McKinsey authors emphasise such challenges on the first page. In a recent McKinsey survey, they say, about 90% of companies had some kind of digital strategy, but they captured less than a third of the revenue gains they had anticipated. Moreover, the success rate is more uneven within industries than it is between them. The best retailer may be more digitally productive than an average high-tech firm, and the worst retailer may be as bad as the worst government entity.

To make a success of it requires learning the second lesson: what McKinsey calls having a top-down strategy and a road map (or in Lego terms, a clear instruction manual). For Lego, it helped that the family-owned business

had long had a command-and-control approach to management. Its digital strategy involved a single plan, created by a 100-strong executive team and approved by the board, that encompassed the whole organisation. McKinsey notes that when transformations stall, it is often because executives talk past each other, have pet projects, spread investments too thin or have “more pilots than there are on an aircraft-carrier”, as Rodney Zemmel, one of the authors, puts it. It also needs to be ambitious enough to generate momentum, with financial results measured constantly. McKinsey’s rule of thumb is that a digital transformation should aim to increase earnings before interest, tax, depreciation and amortisation by 20% or more.

Third comes the question of whether to build a new digital infrastructure or buy it. The answer is mostly to build. Rather like Lego’s eight-studded bricks—six of which can be combined 915m ways—there are many software applications on the market that can be combined to create proprietary systems. But the job of orchestrating them should not be outsourced. Take Lego: it started its latest digital transformation with engineers making up less than 30% of staff. Since then it has increased the number of systems and software engineers by 150%. Mr Zemmel notes that five years ago, the trend was to hire from Silicon Valley. That was “a good way to change the company dress code, but not a great way to change the company culture”. Since then more companies have been retraining their existing tech workers and embedding them throughout the organisations in more front-line roles.

Some of these lessons apply to generative AI. Mr Zemmel says it is relatively easy to launch pilots with the technology, such as the humanlike ChatGPT. The problem is embedding the AI models across the organisation in a safe, unbiased way. It needs a top-down strategy. As for building or buying, Mr Zemmel says it may be a “waste of time” to build proprietary models when the software industry is doing that anyway. The key is to work in-house on the things that give you a decisive advantage in the market. For Lego, AI is

still in the future, though some of its brick enthusiasts are already using ChatGPT-like programs to come up with new ways of building things. Mostly they fail, but one day anyone may be able to create a Monet. The yellow-brick road is unending. ■



登峰造极

一次巨大的山体滑坡显示高山增高有极限

从喜马拉雅山脉一座山峰上掉落的岩石足以掩埋整个巴黎直至埃菲尔铁塔的高度【新知】

跟商业不同，在地质学里，没什么是大到不能倒的。山脉就是最壮观的例子。构造板块碰撞后，由于地壳的挤压，理论上它们几乎可以无穷无尽地增高。实际上，它们并没有。在一系列的地质过程的侵蚀下——包括冰川的磨蚀、雨水和缓的冲刷，以及水的冻融造成的强力涨裂——它们还变小了。

在《自然》杂志上发表的一篇论文中，洛林大学（University of Lorraine）的地质学家杰罗姆·拉维（Jérôme Lavé）描述的另一种作用机制场面要大得多。拉维收集的证据表明，大约在1190年，一场巨大的山体滑坡把喜马拉雅山脉的安纳普尔纳四号峰（Annapurna IV）的高度削掉了大约500米，如今它大约有7500米高。如果他是对的，这将是有记录以来最大的山体滑坡之一。山顶崩塌跌落的岩石体积可能达27立方千米——差不多足以掩埋整个曼哈顿直到帝国大厦没顶。

当碎石崩落时，释放的能量应该相当于沙皇炸弹的六倍左右，沙皇炸弹是有史以来引爆的最大的核武器。“我觉得我都想象不出那会是怎样的声响。”安·罗文（Ann Rowan）说。她是卑尔根大学（University of Bergen）的地质学家，没有参与拉维的研究。

拉维的猜想是他在2012年在尼泊尔恒河平原进行田野调查时产生的。他注意到脚下土地的构成成分不同寻常。从岩石中钻出的50米岩心显示，石灰岩的平均浓度约为10%。但在一段四米的岩心中，浓度上升到近50%，他认为“这太高了，完全不正常”。

这提示这些岩石是从数百公里外的安纳普尔纳群峰到达恒河平原的。这反过来又暗示近期（地理意义上的）发生了一次大规模山体滑坡。拉维查看

了这些山峰的卫星图像，并乘坐直升机亲眼探看，然后他发现了一大片碎石堆，看起来可能是由同一起事件造成的。因此，他次年到访这片碎石堆，成为已知第二位抵达这里的地质学家，并采集了一些样本。在检查周围的悬崖是否有崩塌过的迹象时，他注意到一个被称为安纳普尔纳四号峰的山峰有一个相对光滑、陡峭的表面，看起来正好吻合。

回国后，他把从碎石场、岩心和山体滑坡可能的经行路径上采集来的样本送去做年代测定。如果它们的年头大致一致，就可能表明它们与同一事件有关。他的同事们通过测量氯-36（一种放射性同位素，在地表岩石中积累，一旦岩石被埋就会衰变）和碳-14（另一种放射性同位素，在生物物质中积累，在生物死亡后衰变）的丰度，将这些样本的年代定在了12世纪晚期，彼此相差不到二三十年。这处于年代测定技术本身的精度范围内。

除了揭示从前未知的大灾难之外，拉维的研究工作还可能填补关于山脉停止生长的主流解释的一个漏洞。这种解释就是“冰川圆锯”（glacial buzzsaw）假说，其模型显示，抑制山脉生长的主要原因是冰川，它们能极其有效地切削山体。

罗文说，这种理论的问题在于，有些山峰成功躲过了冰川的侵蚀效应，然后变得十分之陡峭，以至于冰川再也不能牢牢扒在山侧。“问题是，”她问道，“是什么阻止了这些山脉变得更大呢？”

山体滑坡很可能是一种答案。虽然尚不清楚引发安纳普尔纳山崩的确切原因，但拉维的想法是，在没有任何东西能把岩石从山尖上削掉的情况下，非常高的山脉只会继续生长，直到仍会受侵蚀的较低的山坡无法再承受这样的重量。

要想确切地知道如何以及何时达到临界点，还需要研究其他类似的岩石滑坡事件。遗憾的是，在冰川和季风季节河流暴涨的作用下，安纳普尔纳山塌方而来的碎石正在迅速消失。拉维估计，现在只有大约10%的崩落岩石仍留在原址。年代更久远的岩石滑坡事件（假设有的话）可能已经无法采样追溯了。■



Hitting peak peak

A gigantic landslide shows the limit to how high mountains can grow

Enough rock fell off a Himalayan peak to bury Paris to the height of the Eiffel Tower

IN GEOLOGY, UNLIKE business, nothing is too big to fail. Mountains offer the most spectacular example. Pushed up by the crumpling of Earth's crust following the collision of tectonic plates, they could in theory keep rising almost indefinitely. In practice, they do not. A suite of geological processes—including the grinding of glaciers, the gentle impact of rain, and forcible cracking by freezing and thawing of water—erode them down to size.

In a paper published in *Nature* Jérôme Lavé, a geologist at the University of Lorraine, describes another, much more spectacular mechanism. Dr Lavé has collected evidence suggesting that, in around 1190, an enormous landslide slashed perhaps 500 metres from the height of Annapurna IV, a mountain in the Himalayas that stands about 7,500 metres high today. If he is right, it would be one of the biggest landslips ever recorded. The falling mountain top would have displaced up to 27 cubic kilometres of rock—roughly enough to bury the entirety of Manhattan to about the height of the Empire State Building.

As the rubble crashed down, the energy released would have been equivalent to around six times that of the Tsar Bomba, the biggest nuclear weapon ever detonated. “I don’t think I could imagine what it would sound like,” says Ann Rowan, a geologist at the University of Bergen who was not involved in Dr Lavé’s work.

Dr Lavé’s suspicions were aroused while doing fieldwork in the Ganga plain in Nepal in 2012. He noticed that the ground beneath his feet had an unusual

composition. A 50-metre core drilled out of the rock showed an average concentration of limestone of around 10%. But for one 4-metre stretch the concentration rose to nearly 50%, “which is enormous, and completely abnormal”, he says.

This suggested that the rocks in question had made their way to the Ganga plain from the Annapurna massif, hundreds of kilometres away. That, in turn, hinted at a massive landslide in the (geologically) recent past. After examining satellite images of the massif, and taking a helicopter ride to have a look for himself, Dr Lavé spotted a large rubble field which looked like it could have been caused by the same event. So he visited the site the following year, becoming only the second geologist known to have done so, and took some samples. Examining the surrounding cliffs for signs of a collapse, he noticed that a peak known as Annapurna IV offered a relatively smooth, steep face which seemed to fit.

Back home, he sent samples from the rubble field, the rock core and others from the path the landslide might have taken for dating. Should their ages roughly correspond, that would suggest they were linked to the same event. By measuring the abundance of chlorine-36 (a radioactive isotope which accumulates in surface rocks and decays once they are buried), and carbon-14 (another which accumulates in living matter and decays after death), his colleagues dated the samples to the late 12th century, and to within a couple of decades of each other. That is within the accuracy limits of the dating techniques themselves.

Besides shedding light on a previously unknown cataclysm, Dr Lavé’s work could plug a gap in the dominant explanation for why mountains stop growing, which is known as the “glacial buzzsaw” hypothesis. Under this model, it is glaciers, which are extremely effective at carving scoops out of mountains, that are mostly responsible for curbing their growth.

The problem with that theory, says Dr Rowan, is that there are some peaks that manage to escape the erosive effect of glaciers, and then grow so steeply that glaciers can no longer stick to their sides. “The question is,” she asks, “what stops these mountains getting bigger?”

Landslides could well be one answer. While the exact trigger for the Annapurna landslide is unknown, Dr Lavé’s idea is that, with nothing to shave rock off their tips, very high mountains simply keep growing until their weight is too much for their lower slopes—which do still experience erosion—to support.

Working out exactly how and when the tipping point is reached will require examining other such rockslides. Unfortunately, due to the actions of both glaciers and swollen rivers during the monsoon season, the rubble from the Annapurna landslip is vanishing fast. Dr Lavé reckons that only about 10% of the dislodged material now remains in place. Older rockslides, assuming there were any, may already be impossible to reconstruct. ■



公共广场上的约架

马斯克和扎克伯格的社交媒体格斗

借推特陷入困境之机，Meta想用仿品*Threads*取而代之

笼子的一角是扎克伯格：39岁，五英尺七英寸，如果他的自拍可信的话，应该是位柔术高手。另一角是马斯克：比对手大13岁、高六英寸，也重得多，擅长名为“海象”的特别招式（“我就躺在对手身上，什么都不做”）。这两位亿万富翁已经答应展开一场八角笼格斗，马斯克在6月29日表示地点可能在罗马斗兽场。

这场约架在罗马上演的可能性不大。意大利政府和马斯克的母亲似乎都不支持。但是，这两位新媒体大亨还在为一场更重要的对战摩拳擦掌。7月5日，扎克伯格的公司Meta为其社交媒体帝国新添了一款应用：*Threads*，这个以文本为主的社交网络看起来很像推特（去年10月被马斯克以440亿美元收购）。一场声势浩大的社交媒体对决即将拉开帷幕。

马斯克入主推特后，很多相关方都已被擦撞得鼻青脸肿。为削减成本，他接手时的近8000名员工约八成被解雇。研究公司eMarketer指出，推特频出故障，用户已经开始流失（见图表）。7月1日它推出付费墙，不支付8美元月费的用户可阅读的推文数量受限，这可能劝退更多用户。广告主已经在撤离：eMarketer预测今年推特的广告销售额将比去年低28%。金融服务公司富达（Fidelity）在5月估计，自马斯克同意收购以来，推特已损失了约三分之二的价值。

从这场混乱中得益最多的显然是扎克伯格。2021年，他的公司成了不实信息和仇恨言论的代名词。随后，他利用自己在公司至高无上的地位，投入数十亿美元开发元宇宙，这个全凭激情、缺乏验证的项目的盈利之日貌似遥遥无期，令投资者恼怒。两年前的7月4日，他发布了一段自己手举美国国旗冲浪的视频，这番自以为是的作秀惹来一片嘲笑。在硅谷，没有谁的声誉比他更两极化。

如今，马斯克古怪任性地打理推特，在他的衬托下，扎克伯格对Meta的管理几乎成了良好企业治理的典范。此外，虽然推特在内容审查方面无所顾忌的新举措受到一些保守派的欢迎，比如佛罗里达州州长罗恩·德桑蒂斯（Ron DeSantis，他在推特上通过音频直播宣布将竞选总统，结果技术故障不断），但自由派越来越难以忍受。YouGov的民意调查显示，美国人仍然更待见马斯克甚于扎克伯格（也更看好马斯克在八角笼约架中的胜算）。但随着推特争议不断，加上政客们转而炮轰另一个社交应用——中资所有的TikTok，扎克伯格的支持率现在升至三年多来的最高位。

Meta还想取得一场商业格斗的胜利。各种创业公司都想趁推特的颓势抢占市场，但表现都乏善可陈。只有一名员工的去中心化社交网络Mastodon表示，去年从马斯克完成收购推特到11月，它新增了200多万用户。但人们觉得它很难用；据另一家数据公司Sensor Tower估计，到今年6月，它的用户比11月的高峰减少了61%。特朗普自创的保守派社交网络Truth Social也动静不大，特别是在马斯克让推特转向右倾后。最新一个挑战者Bluesky同样无法达到临界规模。

Meta新推出的Threads胜算更大。克隆对手是Meta最擅长的。2016年，随着Snapchat阅后即焚的“stories”流行起来，扎克伯格推出了类似的产品“Instagram Stories”，帮助Instagram保持了领先地位。去年，面对TikTok短视频构成的威胁，Meta在Instagram和Facebook中推出了形式几乎与TikTok短视频一模一样的Reels。今年4月，扎克伯格表示Reels使得用户在Instagram上停留的时间增加了近四分之一。

Threads还有一个优势。不像Reels，它是一款独立应用。但它接受Instagram用户使用已有账号登录，还可以一键关注所有在Instagram上已关注的用户。研究公司DataReportal的数据显示，约87%的推特用户已在使用Instagram。现在有这么一个几乎能毫无障碍地替代推特的产品，他们会改换门庭吗？正如Meta的首席产品官最近所说，对一些人来说，有一个“理性运营”的社交网络可能就够了。在Threads推出的前几天，马斯克宣布给推特设置付费墙，可能是帮了别人一把。

以Meta的标准来看，推特的业务规模很小，用户数仅为全球最大社交网络Facebook的八分之一。2021年，相比Meta1160亿美元的收入，推特的收入仅为51亿美元。而这点可怜的收入却带来了大问题。很少有平台像推特那样吸引了那么多愤怒的怪人异类。近期，Meta已开始减少推送新闻这类引发政治争议又不大能让用户开心的内容。而新闻是推特的一项主要功能。

那为什么扎克伯格还认为值得在Threads上花费心力呢？广告是原因之一。推特从未在用户身上赚到过很多钱，因为它所掌握的用户信息不多。据DataReportal的西蒙·坎普（Simon Kemp）估计，看推文的人有一半到三分之二并非登录用户。许多注册用户长期“潜水”，只看别人的推文，很少参与讨论。Meta从自家的其他应用中掌握了很多用户信息，可以在用户使用Threads的第一天就精准投放广告。Facebook和Instagram主打直效广告，在推特上效果很好的那类品牌推广广告可以作为它们的补充。

Meta的另一个动机可能与人工智能（AI）有关。ChatGPT等聊天机器人应用背后的模型让海量文本备受重视。Reddit等在线论坛争相把自己所存储的数十亿文字变现。马斯克称，推特的付费墙是对AI公司“极限搜刮数据”的回应。在Facebook和Instagram的视觉信息流以外再建立一个基于文本的社交网络，Meta可以获得丰富的语言数据来源。坎普表示，Threads远不只是一个广告平台，“扎克这是在玩AI内容信息流的游戏”。无论Meta是把数据授权他人使用还是用于自己的AI项目，这都是可以讲给投资者的新增长故事。

新推出一个社交网络平台不容易。即使拥有38亿现有用户，Meta也曾屡屡碰壁：Facebook的约会应用Dating仍然乏人问津，Meta的游戏和购物项目也没激起多少水花。但随着推特流失用户和广告商，加上马斯克的管理层继续行事乖僻，机会正在变大。无论“八角笼格斗”最终谁胜谁负，扎克伯格都可能带着战利品离开。 ■



Punch-up in the public square

The Musk-Zuckerberg social-media smackdown

With Threads, a copycat app, Meta hopes to capitalise on Twitter's travails

IN ONE CORNER is Mark Zuckerberg: 39 years old, five foot seven inches and, if his selfies are to be believed, a wizard at jiu-jitsu. In the other corner stands Elon Musk: 13 years older, six inches taller and considerably heavier, with a special move known as the walrus ("I just lie on top of my opponent & do nothing"). The two billionaires have agreed to a cage fight, with Mr Musk saying on June 29th that it might take place at the Roman Colosseum.

The rumble in Rome may not happen. Neither the Italian government nor Mr Musk's mother seems keen. But the new-media moguls are also limbering up for a more consequential fight. On July 5th Meta, Mr Zuckerberg's firm, added a new app to its social-media empire. Threads, a text-based network, looks a lot like Twitter, the app Mr Musk bought last October for \$44bn. An almighty social-media smackdown is about to begin.

Mr Musk's tenure at Twitter has been bruising for many parties. About 80% of the nearly 8,000 employees he inherited have been laid off, to cut costs. Amid a glitchy service, users have started to drift away, believes eMarketer, a research firm (see chart). The introduction on July 1st of a paywall, limiting the number of tweets that can be seen by those who do not cough up \$8 a month, may repel more. Advertisers have fled: Twitter's ad sales this year will be 28% lower than last, forecasts eMarketer. In May Fidelity, a financial-services firm, estimated that the company had lost about two-thirds of its value since Mr Musk agreed to buy it.

From this chaos, the clearest winner is Mr Zuckerberg. By 2021 his business had become synonymous with misinformation and bile. He then irked

investors by using his all-powerful position at the firm to pour billions into the metaverse, an unproven passion project that looks years away from making money. On July 4th two years ago he drew ridicule after posting a video of himself vaingloriously surfing a hydrofoil holding an American flag. No one in Silicon Valley was more polarising.

Today Mr Musk's erratic handling of Twitter makes Mr Zuckerberg's stewardship of Meta look like a model of good corporate governance. And although Twitter's new freewheeling approach to content moderation has delighted some conservatives—including Ron DeSantis, governor of Florida, who launched his presidential bid in a glitch-filled live audio session on the app—liberals find it increasingly hard to stomach. Mr Musk remains more popular than Mr Zuckerberg among Americans (who also fancy his odds in the cage), according to polls from YouGov. But as the controversies at Twitter rumble on, and as politicians turn their fire on another social app, the Chinese-owned TikTok, Mr Zuckerberg's approval rating is now the highest it has been in over three years.

Meta eyes another, commercial victory. Various startups have tried to capitalise on Twitter's travails, with little success. Mastodon, a decentralised social network with a single employee, said that by November it had added more than 2m members since the Twitter deal closed. But people found it fiddly; by June it had 61% fewer users than at its November peak, estimates Sensor Tower, another data firm. Truth Social, Donald Trump's conservative social network, has failed to gain traction, especially since Mr Musk steered Twitter rightwards. The latest pretender, Bluesky, faces the same struggle to achieve critical mass.

Meta's effort, Threads, has a better shot. Cloning rivals is what Meta does best. In 2016, as Snapchat's disappearing "stories" became popular, Mr Zuckerberg unveiled Instagram Stories, a similar product which helped to keep Instagram on top. Last year, as TikTok's short videos became a threat,

Meta rolled out Reels, a near-identical format that lives within Instagram and Facebook. In April Mr Zuckerberg said Reels had helped to increase the time spent on Instagram by nearly a quarter.

Threads also has a head start. Unlike Reels, it is its own app. But it lets Instagrammers use their existing login details and follow all the same people with one click. Some 87% of Twitter users already use Instagram, according to DataReportal, a research firm; they now have a near-frictionless alternative to Twitter. Will they switch? For some, it may be enough to have a network that is “sanely run”, as Meta’s chief product officer put it recently. Mr Musk may have provided a shove to the others by announcing a paywall days before Threads’ launch.

By Meta’s standards, Twitter’s business is tiny, with one-eighth as many users as Facebook, the world’s largest social network. In 2021 Twitter’s revenue was \$5.1bn, against Meta’s \$116bn. And those meagre earnings bring big problems. Few platforms attract as many angry oddballs as Twitter. Lately Meta has shied away from promoting news, which brings political controversy and seems not to delight users. News is a big part of what Twitter does.

Why, then, does Mr Zuckerberg think Threads is worth the headache? One reason is advertising. Twitter has never made much money out of its users because it knows little about them. Between half and two-thirds of those who read tweets are not logged in, estimates Simon Kemp of DataReportal. Many registered users are “lurkers”, who view others’ feeds but seldom engage. Meta, which knows a lot about its users from its other apps, can hit them with well-targeted ads in Threads from day one. And the brand-focused adverts that work best on Twitter would complement the direct-response ads that Facebook and Instagram specialise in.

Meta’s other possible motive relates to artificial intelligence (AI). Models

behind human-sounding apps like ChatGPT place a premium on big troves of text. Online forums like Reddit are scrambling to monetise the billions of words that they hold. Mr Musk has said that Twitter's paywall is a response to "EXTREME levels of data scraping" by AI firms. In setting up a text-based network alongside the visual feeds of Facebook and Instagram, Meta gets a source of rich language data. Threads is much more than an ad platform, says Mr Kemp. "Zuck is playing the AI content-feeding game." Whether Meta licensed the data to others or used it in its own AI projects, it would be a new growth story to tell investors.

Launching a social network is hard. Even with its 3.8bn existing users Meta has had its share of failures: Facebook Dating remains unloved and the company's gaming and shopping initiatives have yet to take off. But as Twitter bleeds users and advertisers, and as Mr Musk's management continues on its eccentric path, the opportunity is becoming bigger. Regardless of who prevails in the cage, Mr Zuckerberg may come away with the spoils. ■



ChatGPT公司

本刊的早期采用者指数考查了美国企业界应用AI的进展

各种各样的公司都在使用这项技术【深度】

科技股正在迎来丰收年。尽管近期有所波动，但以同等权重的股票篮子衡量，Alphabet、亚马逊、苹果、Meta和微软这五大公司的股价自今年1月以来已经上涨了60%。大型芯片制造商英伟达的股价大涨了两倍，另一家芯片制造商AMD的股价也几乎翻了一番。它们的市盈率（市场对一家公司的估值与其收益之比）是标普500指数中位数公司的十倍。

股价如此暴涨的主要原因是人们看好人工智能（AI）的前景。自去年11月AI聊天机器人ChatGPT推出以来，对于能够像人类一样创作诗歌、短视频、代码等各种内容的新技术浪潮，投资者的兴致日益高涨。这种“生成式AI”以大语言模型为基础，这些模型用互联网的大块内容训练。许多人认为，这项技术可能整个地重塑某些行业，对商业和社会的影响将不亚于智能手机或云计算。在他们看来，能够充分利用这一技术的公司将能提高利润率并赢得市场份额。

老板们都在竭力展示自家公司对AI的应用。4月4日，摩根大通老板杰米·戴蒙（Jamie Dimon）表示，他的银行有600名机器学习工程师，并且已将AI运用到300多种不同的内部应用上。制药巨头礼来（Eli Lilly）的老板戴文睿（David Ricks）表示，公司目前有100多个在研项目使用了AI。

对公司个案的研究只能揭示整体图景的一小部分。为了更全面地了解哪些公司和行业正在采用AI，本刊研究了标普500指数所有公司的相关数据。我们考查了五项指标：提到AI的已发布专利的占比、针对AI公司的风险投资活动、对AI公司的并购、提及AI的招聘启事，以及财报电话会议上谈到AI的次数等。因为其他类型的AI同样可以为企业带来好处，所以我们的分析报告考虑的是所有类型的AI，而不仅仅是生成式AI浪潮。结果表明，即便在科技圈以外，各种公司对AI的兴趣也在快速增长。而且已经出现了明

显的领先者和落后者。

AI专业技能似乎已经在蔓延开来（见图表）。研究公司PredictLeads表示，在过去三年中，约有三分之二的标普500指数公司曾经发布提到AI技能的招聘广告。在这些公司目前列出的职位空缺中，有5.3%提到了AI，而这一比例在过去三年的平均数为2.5%。这样的增长在某些行业更为突出。比如，这一比例在零售公司中从3%上升到11%；在芯片制造商中从9%上升到19%。

斯坦福大学的阿米特·塞鲁（Amit Seru）提供的数据显示，2020年至2022年期间，与AI相关的专利注册数量呈上升趋势。另一家研究公司PitchBook指出，2023年，标普500指数公司的风险投资交易约有25%涉及AI创业公司，而2021年这一比例为19%。还有一家研究公司GlobalData发现，自2021年以来，约有一半的受调查公司在财报电话会议上谈到了AI；而在今年第一季度，AI在美国公司的财报电话会议上被提及的次数比上一季度增加了一倍多。在2020年至2022年期间，大约一半的标普500指数公司获得了与AI相关的专利。

生成式AI可能最终会比其他类型的AI更常用。这是因为它擅长许多对公司经营来说很重要的工作。咨询公司麦肯锡的一份报告指出，在生成式AI有望创造的价值中，四分之三将来自四大业务职能——研发、软件工程、营销和客户服务。在某种程度上，它们全都处于大多数大企业业务的核心。此外，任何一家拥有为员工提供指导的内部数据库的大公司都将发现AI聊天机器人的用武之地。摩根士丹利正在创建一款AI助手，帮助其理财经理从庞大的内部数据库中找寻并总结答案。油田服务公司SLB也开发了一个类似的助手来辅助其服务工程师的工作。

虽然许多公司都在采用AI，但有些公司更为积极。根据每项指标对所有公司进行排名，然后取平均值，就生成了一个简单的评分系统。名列前茅的公司似乎正在赢得投资者的青睐。自今年年初以来，排名前100位的企业股价中位数上涨了11%；而得分后五分之一的企业股价中位数没有任何上涨。

毫不意外，前列的队伍由硅谷统霸。从广义上讲，标普500指数包含82家科技公司，其中将近有50家进入了前100名。英伟达得分最高。根据PredictLeads的数据，在过去的三年里，英伟达三分之一的招聘启事都提到了AI。过去一年里，英伟达在其财报电话会议上近200次谈到AI，超过了其他所有公司。其他排名靠前的科技公司包括Alphabet（第3名）、微软（第12名）和亚马逊（第34名）这样的云计算巨头。它们出售一系列AI工具服务，包括帮助训练复杂模型的服务、无需编写大量代码便能使用AI的软件等等。

除科技公司之外，采用AI行动最快的似乎是两类公司。第一类属于数据密集型行业，如保险公司、金融服务公司和制药公司等。它们约占我们榜单前100名的四分之一。数据库公司Databricks的阿里·戈德希（Ali Ghodsi）指出，这些公司往往拥有大量结构化数据集，比如贷款账簿、病历等，这就很便于应用AI。摩根大通目前约有一成招聘启事提到了AI。它不久前为一个提供投资建议的AI聊天机器人IndexGPT申请了专利。吉利德科学（Gilead Sciences）和莫德纳（Moderna）等医疗保健公司利用AI来研发新药。雅培（Abbott）和爱齐科技（Align Technology）等公司也在开发AI医疗设备。去年有97款这样的AI医疗设备获得了美国食品药品监督管理局（FDA）的批准，而2017年有26款。

第二类属于已经被科技颠覆的行业，包括汽车制造、电信、媒体和零售等。榜单前100名里有13家来自这些行业的公司，如福特、通用汽车和特斯拉等。电动汽车的兴起以及自动驾驶的发展前景激励了汽车制造商投资于技术。今年3月，福特成立了自动驾驶子公司Latitude AI，它有朝一日或许能与通用汽车的Cruise相匹敌。4月，马斯克告诉分析师，特斯拉正在购买AI专用芯片，并“非常专注于”提升其AI能力，以改进特斯拉的自动驾驶技术。

零售商正在使用AI来增强自己的核心业务。2021年，运动服饰巨头耐克为一个可以生成运动鞋三维计算机模型的系统申请了专利。数据库提供商Snowflake的克里斯蒂安·克莱曼（Christian Kleinerman）指出，零售商也在通过收集更多的客户数据来利用电子商务的发展。这能让营销活动的定

位更加精准。有些公司可能会在个性化方面更进一步。2021年，消费品巨头宝洁公司为一个基于AI的系统申请了专利，该系统可以根据照片分析用户的皮肤和头发状况，并推荐相应的护理产品。

不同行业之所以在使用AI方面存在差异，可能是工作性质造成的。加州大学的安德里亚·艾斯菲尔德（Andrea Eisfeldt）主持的一篇工作论文研究了企业的AI敞口。研究人员评估了公司正在开展的工作任务，以及ChatGPT对这些工作的完成质量如何。敞口最大的是科技公司，主要因为AI聊天机器人擅长编码。AI敞口最小的行业往往依赖于体力劳动，比如农业、建筑业等。

各行业内部也出现了明显的领先者和落后者。标普500指数中有约70家公司没有在我们的五项指标中的任何一项上有所动作。这其中包括保险公司等来自AI密集型行业的企业。大量未被纳入标普500指数的较小公司对AI可能就更不热心了。行业内部一个突出的因素可能是投资。在我们的榜单中，前100家公司的研发费用占公司收入比例的中位数为11%。而后100家公司这一比例的中位数为零。

波士顿咨询公司（BCG）的弗拉德·卢基奇（Vlad Lukic）指出，甚至同一家公司内部都存在很大差异。他回忆起自己曾经访问过的一家中型跨国公司的两个部门。其中一个部门还没有使用过AI。另一个部门比较先进，它当时使用创业公司OpenAI（开发了ChatGPT的底层技术）的一个试行版AI已经有两年了。

在早期AI采用者中，许多非科技公司对AI的应用正变得日益先进复杂。塞鲁的数据显示，大约有80家非科技公司拥有被其他专利引用的AI相关专利，这表明这些专利有一定技术价值。标普500指数中约有45家非科技公司在最近发布的招聘广告中提到了模型训练，包括波音、联合健康（United Health）和道富银行（State Street）等。这表明它们可能正在建构自己的模型，而不是使用OpenAI等公司提供的现成AI技术。这种做法的好处是可以打造出更精准的AI，从而比竞争对手拥有更大的优势。

然而，把模型训练转到公司内部暗示了一个风险：安全性。今年5月，三星发现有员工把敏感代码上传到了ChatGPT上。人们担忧的是，这些信息可能被存储在微软、Alphabet等运行这些模型的公司的外部服务器上。据说三星现在正在训练自己的模型。苹果和摩根大通等越来越多的公司已禁止或限制使用ChatGPT，三星也加入了其中。

还有很多其他风险。包括OpenAI在内的模型开发商因为使用互联网数据来训练自己的模型而被状告违反了著作权法。一些大公司认为，如果使用OpenAI的技术，自己可能也会连带着背上法律责任。此外，模型很容易编造信息。之前有过这样一件事：纽约一位律师使用ChatGPT撰写了一份动议，没想到ChatGPT把虚构的判例法也拿来用了，最后律师被法院罚款。

但所有这些风险都必须与潜在的好处放在一起权衡，而好处可能非常之大。技术浪潮经常彻底变革行业。随着生成式AI的应用在经济中扩散，不难想象它也会产生颠覆性的影响。卢基奇表示，公司面临的最大风险可能是落后于人。从美国公司竞相让“AI武装一切”的势头来看，许多老板和投资者都会同意他的观点。 ■



ChatGPT Inc

Our early-adopters index examines how corporate America is deploying AI

Companies of all stripes are using the technology

TECHNOLOGY STOCKS are having a bumper year. Despite a recent wobble, the share price of the Big Five—Alphabet, Amazon, Apple, Meta and Microsoft—has jumped by 60% since January, when measured in an equally weighted basket. The price of shares in one big chipmaker, Nvidia, has tripled and in another, AMD, almost doubled. Their price-to-earnings ratios (which measure how much the markets think a company is worth relative to its profits) are ten times that of the median firm in the S&P 500.

The main reason for the surge is the promise of artificial intelligence (AI). Since the launch in November of ChatGPT, an AI-powered chatbot, investors have grown ever more excited about a new wave of technology that can create human-like content, from poems and video footage to lines of code. This “generative AI” relies on large language models which are trained on big chunks of the internet. Many think the technology could reshape whole industries, and have as much impact on business and society as smartphones or cloud computing. Firms that can make the best use of the technology, the thinking goes, will be able to expand profit margins and gain market share.

Corporate bosses are at pains to demonstrate how they are adopting AI. On April 4th Jamie Dimon, JPMorgan Chase’s boss, said his bank had 600 machine-learning engineers and had put AI to work on more than 300 different internal applications. David Ricks, the boss of Eli Lilly, has said that the pharmaceutical giant has more than 100 projects on the go using AI.

Company case studies reveal only part of the picture. To get a broader sense

of which companies and industries are adopting AI. The Economist examined data on all the firms in the S&P 500. We looked at five measures: the share of issued patents that mention AI; venture-capital (VC) activity targeting AI firms; acquisitions of AI firms; job listings citing AI; and mentions of the technology on earnings calls. Because other types of AI could bring benefits for business, our analysis captures activity for all AI, not just the generative wave. The results show that even beyond tech firms the interest in AI is growing fast. Moreover, clear leaders and laggards are already emerging.

AI expertise already seems to be spreading (see chart). About two-thirds of the firms in our universe have placed a job ad mentioning AI skills in the past three years, says PredictLeads, a research firm. Of those that did, today 5.3% of their listed vacancies mention AI, up from a three-year average of 2.5%. In some industries the rise is more dramatic. In retail firms that share has jumped from 3% to 11%, while among chipmakers that proportion grew from 9% to 19%.

The number of AI-related patents being registered trended upwards between 2020 and 2022, according to data provided by Amit Seru of Stanford University. PitchBook, another research firm, concludes that in 2023 some 25% of venture deals by S&P 500 firms involved AI startups, up from 19% in 2021. GlobalData, also a research firm, finds that about half the firms scrutinised have talked about AI in earnings calls since 2021, and that in the first quarter of this year the number of times AI was mentioned in the earnings calls of America Inc more than doubled compared with the previous quarter. Roughly half have been granted a patent relating to the technology between 2020 and 2022.

The use of generative AI may eventually become even more common than other sorts of AI. That is because it is good at lots of tasks essential to running a firm. A report by McKinsey, a consultancy, argues that three-

quarters of the expected value created by generative AI will come in four business functions—research and development, software engineering, marketing and customer service. To some extent, all these operations are at the core of most big businesses. Moreover, any large company with internal databases used to guide employees could find a use for an AI-powered chatbot. Morgan Stanley, a bank, is building an AI assistant that will help its wealth managers find and summarise answers from a huge internal database. SLB, an oil-services company, has built a similar assistant to help service engineers.

While the adoption of AI is happening in many firms, some are more enthusiastic than others. Ranking all the companies using each metric and then taking an average produces a simple scoring system. Those at the top seem to be winning over investors. Since the start of the year, the median share price of the top 100 has risen by 11%; for the lowest-scoring quintile it has not moved at all.

The top spots are unsurprisingly dominated by Silicon Valley. On a broad definition, the S&P 500 contains 82 tech firms. Almost 50 of them make the top 100. Nvidia is the highest-scoring firm. According to data from PredictLeads, over the past three years a third of its job listings have mentioned AI. In the past year the firm has mentioned AI in its earnings calls almost 200 times, more than any other company. Other high-ranking tech firms include the cloud-computing giants—Alphabet (3rd), Microsoft (12th) and Amazon (34th). They sell access to a range of AI tools, from services that help train sophisticated models to software that allows the use of AI without having to write reams of code.

Beyond tech, two types of firms seem to be adopting AI the quickest. One is data-intensive industries, such as insurers, financial-services firms and pharmaceutical companies. They account for about a quarter of our top 100. These firms tend to have lots of structured datasets, such as loan books or

patient files, which makes it easier to use AI, notes Ali Ghodsi of Databricks, a database firm. Around a tenth of JPMorgan Chase's current job listings mention AI. The firm recently filed a patent for IndexGPT, an AI-infused chatbot that gives investment advice. Health-care firms like Gilead Sciences and Moderna use AI to discover new drugs. Others, such as Abbott and Align Technology, are building AI-powered medical devices. America's Food and Drug Administration approved 97 such machines last year, up from 26 in 2017.

A second group is industries that are already being disrupted by technology, including carmaking, telecoms, media and retail. Thirteen firms from these industries make the high-scoring 100, including Ford, General Motors and Tesla. The rise of electric vehicles and the prospect of self-driving cars has encouraged vehicle manufacturers to invest in technology. In March Ford established Latitude AI, a self-driving car subsidiary that might one day rival GM's Cruise. In April Elon Musk told analysts that Tesla was buying specialised AI chips and was "very focused" on improving their AI capabilities in an effort to improve his firm's self-driving efforts.

Retailers are using AI to bolster their core business. Nike, a sportswear giant, filed an application for a patent in 2021 for a system that can generate three-dimensional computer models of trainers. Christian Kleinerman of Snowflake, a database provider, notes that retailers are also taking advantage of the growth of e-commerce by collecting more data on customers. That allows more accurate targeting of marketing campaigns. Some may take personalisation a step further. In 2021 Procter & Gamble, a consumer-goods giant, applied for a patent for an AI-based system which analyses users' skin and hair conditions based on photos, and recommends products to treat them.

One source of variation in AI use across industries may be a result of the type of work undertaken. A working paper led by Andrea Eisfeldt of the

University of California looked at how exposed firms are to AI. The researchers assessed which tasks took place in a firm and how well ChatGPT could perform them. The most exposed were tech firms, largely because AI chatbots are good at coding. Those industries least exposed, such as agriculture and construction, tended to rely on manual labour.

Clear leaders and laggards are emerging within industries, too. About 70 firms in the S&P 500 show no sign on any of our metrics of focusing on AI. That includes firms in AI-heavy industries, such as insurers. The mass of smaller firms not included in the S&P 500 may be even less keen. One distinguishing factor within industries may be investment. For the top 100 firms in our ranking, the median R&D expenditure as a share of revenue was 11%. For those in the lowest 100 it was zero.

Vlad Lukic of BCG, a consultancy, notes that there is even a lot of variation within companies. He recalls visiting two divisions of the same medium-sized multinational. One had no experience working with AI. The other was advanced; it had been using a pilot version of the technology from OpenAI, the startup behind ChatGPT, for two years.

Among early adopters, many non-tech companies' AI use is growing more sophisticated. Mr Seru's data reveal that about 80 non-tech firms have had AI-related patents issued which were cited by another patent, suggesting that they have some technological value. Some 45 non-tech companies in the S&P 500 have recently placed ads which mention model training, including Boeing, United Health and State Street. That suggests they may be building their own models rather than using off-the-shelf technology from the likes of OpenAI. The advantage of this approach is that it can produce more-accurate AI, giving a greater edge over rivals.

However, a shift to in-house training hints at one of the risks: security. In May Samsung discovered that staff had uploaded sensitive code to ChatGPT.

The concern is that this information may be stored on external servers of the firms which run the models, such as Microsoft and Alphabet. Now Samsung is said to be training its own models. The firm also joined the growing list of companies that have banned or limited the use of ChatGPT, which includes Apple and JPMorgan Chase.

Other risks abound. Model-makers, including OpenAI, are being sued for violating copyright laws over their use of internet data to train their models. Some large corporations think that they could be left liable if they use OpenAI's technology. Moreover, models are prone to make up information. In one incident a New York lawyer used ChatGPT to write a motion. The chatbot included fictional case-law and the lawyer was fined by the court.

But all this must be weighed against the potential benefits, which could be vast. Waves of technology frequently turn industries on their head. As generative AI diffuses into the economy, it is not hard to imagine it doing the same thing. Mr Lukic says that the biggest risk for companies may be falling behind. Judged by the scramble in America Inc for all things AI, many bosses and investors would agree. ■



【首文】一个由来已久错误

“贪婪通胀”纯属无稽之谈

通胀的根源是经济政策失误和战争，而非企业贪得无厌

通货膨胀居高不下，人们正在寻找始作俑者。在欧洲，最新的怀疑对象是牟取暴利的企业。在美国，认为贪婪的公司应对此负责的观点已经不大站得住脚，因为在消费者价格继续过快上涨的同时，公司利润正在下降。但这并没有妨碍这种观点在大西洋对岸生根发芽。国际货币基金组织发现，在欧元区的通胀升幅中“有近一半”源自利润上涨，而欧洲央行行长克里斯蒂娜·拉加德（Christine Lagarde）有时似乎也认同这种观点。在英国，政府要求监管机构查找哄抬物价的证据；7月3日，英国竞争监管机构发现超市在2019年至2022年期间出售汽油的利润率上升，这更是火上浇油。

“贪婪通胀”理论一定程度上是在反对有关通胀的另一种常见解释：它由快速增长的工资推动。央行官员们都活在对工资-物价螺旋的忧惧中。去年，英国央行行长安德鲁·贝利（Andrew Bailey）呼吁工人在要求加薪前“三思”。此言激起了民愤，因为自2021年以来困扰发达国家的通货膨胀基本上让工人的生活变得愈发拮据。工资并没有推动物价上涨，而是跑不过物价。

然而，就此认为企业须为通胀负责是混淆了因果关系。美国在新冠疫情期间推出了大规模财政刺激，相当于GDP的25%以上，其中包括直接发放给大多数家庭的三轮支票。此后，非金融公司的利润率飙升。向经济注入现金——美联储选择不做加息以免抵消其效果——引发了一场消费者支出热潮，导致因新冠而承压的全球供应链更加不堪重负，扰乱了其他经济体的秩序。由于过多的现金追逐过少的商品，公司必然会赚到更多的钱。再后来，俄罗斯入侵乌克兰之后，能源或食品制造商也发现自家的产品供不应求。它们的价格和利润直线上升。

欧洲经济变得过热的速度和程度都不及美国。但是近年来，欧元区在能源

补贴上的支出占到其GDP的3.3%，而其利率相对于潜在通胀率仍然过低。如今，它又故态复萌：核心通胀率高，利润高，在劳动力市场吃紧的情况下工资水平飙升。欧元区的利润率看起来很可能跟随美国而下跌，分析人士预计今年上市公司的利润将下降。

无论如何，企业在供应短缺时涨价的做法不仅有正当性，也是可取的。如果不利用价格机制来调节供求平衡，那就只能采取定量配给或排队发放等更糟糕的办法。尽管可能存在投机或反竞争的行为，却不太可能造成实质性影响。英国超市将每升汽油的利润提高了6便士（0.08美元，目前每升汽油的价格为1.46英镑），但当时燃料的年化通胀率达到了129%的历史最高值。以恰当的指标衡量，整个英国经济的利润率并没有大幅上升。

拉加德已经表示，欧元区的利润率如果能下降将会非常理想。她是对的；这样的下降会抑制通胀，恢复工人从经济蛋糕中分得的那一块。但这并不意味着需要打击企业的贪婪。货币和财政政策制定者需要做的是，通过加息和收紧财政政策来继续纠正过度刺激的错误。

我们应该从过去两年里吸取的教训不是企业变得更贪婪了，而是当政策制定者任由通胀失控，劳动者会日子难过。简而言之，我们更有理由首先关注价格稳定了。■



An enduring error

“Greedflation” is a nonsense idea

Inflation is the result of economic policy mistakes and war, not corporate avarice

INFLATION IS HIGH, and the search is on for the culprit. The latest in the frame in Europe is profiteering businesses. The idea that greedy companies were to blame has taken a knock in America, where corporate profits are falling even as consumer prices continue to rise too fast. But that has not stopped the notion taking hold across the Atlantic. The IMF has found that higher profits “account for almost half the increase” in the euro zone’s inflation and Christine Lagarde, the president of the European Central Bank, has at times seemed sympathetic to the argument. In Britain the government has asked regulators to look for evidence of price gouging; on July 3rd the competition watchdog added fuel to the fire with a finding that supermarkets had increased their margins on petrol between 2019 and 2022.

The “greedflation” thesis is in part a reaction against another common explanation for inflation: that it is driven by fast-growing wages. Central bankers live in fear of wage-price spirals. Last year Andrew Bailey, governor of the Bank of England, asked workers to “think and reflect” before asking for pay rises. The remark was incendiary because the inflation that has troubled the rich world since 2021 has largely left workers worse off. Wages have not driven prices up but lagged behind them.

Yet to argue that companies must therefore be to blame is to confuse cause and effect. In America the profit margins of non-financial corporations surged after vast fiscal stimulus during the pandemic, which amounted to more than 25% of GDP and included three rounds of cheques sent directly to most households. The infusion of cash into the economy—which the Federal Reserve chose not to offset with higher interest rates—set off a

consumer-spending boom that overwhelmed the world's covid-strained supply chains, disrupting other economies. With too much cash chasing too few goods, it was inevitable that companies would make more money. Then, after Russia invaded Ukraine, companies producing energy or food also found themselves selling into a shortage. Their prices and profits shot up.

Europe's economy has not overheated as quickly or to the same extent as America's. But the euro zone has recently spent 3.3% of GDP subsidising energy bills and its interest rates are still too low given the underlying rate of inflation. Today it is displaying familiar symptoms: high core inflation, high profits and wages that are surging in a tight labour market. It seems likely that profit margins there will also follow America's downwards; analysts expect the profits of listed companies to decline this year.

Regardless, the fact that companies raise their prices in response to shortages is not only defensible but desirable. The alternative to letting the price mechanism bring supply and demand into line is to rely on something worse, such as rationing or queues. Though there may be examples of opportunistic or anti-competitive behaviour, the effects are unlikely to have been material. British supermarkets increased their profits by 6p (\$0.08) on a litre of petrol, which today costs £1.46, but they did so at a time when the peak rate of annual fuel inflation was 129%. Properly measured, economy-wide profit margins have not surged in Britain.

Ms Lagarde has said that it would be desirable for profit margins in the euro zone to fall. She is right; such a decline would be disinflationary and would restore workers' share of the economic pie. But that does not mean that a crackdown on corporate greed is needed. Instead, monetary and fiscal policymakers need to continue to correct the error of excessive stimulus by raising interest rates and tightening fiscal policy.

The right lesson to draw from the past two years is not that companies have got greedier, but that workers suffer when policymakers let inflation run out of control. All the more reason, in short, to care about price stability in the first place. ■



麻烦成堆

全球垃圾问题迅速扩大

奥利弗·富兰克林-沃利斯勾勒出问题的规模【《垃圾场》书评】

《垃圾场》，奥利弗·富兰克林-沃利斯著。阿歇特出版社；400页；30美元。西蒙与舒斯特出版社；20英镑。

狄更斯在他完成的最后一部小说《我们共同的朋友》（Our Mutual Friend）中写道，四散的纸“在每片树丛上悬挂，在每棵树木的枝稍上飘扬，被电线在空中钩住，在每一处篱墙下游荡”。自这些文字在19世纪60年代发表以来，世界上的垃圾问题在规模和构成上都发生了变化。如今，各种形式的塑料散布路边和沿岸，阻塞河流，在海洋里形成巨大的垃圾环流。微小的纳米塑料已随着风和潮汐流转渗透到各种水生生态系统中，抵达地球的两极和最高的山峰，给地球带来的后果仍不确知。

为本刊撰稿的英国记者奥利弗·富兰克林-沃利斯（Oliver Franklin-Wallis）对“一次性消费”文化造成的污染感到担忧，他去了几个最能体现这种浪费的地方。在《垃圾场》（Wasteland）一书中，他参观了印度的一个垃圾填埋场，那里的垃圾堆得几乎和德里著名的顾特卜尖塔（Qutub Minar）一样高；加纳最大的二手服装市场，每周处理据信1500万件衣服；美国从前的一个矿区，被废弃的铅、锌和镉污染侵蚀；还有英格兰西北部一座废弃的核电站，与附近湖区（Lake District）的自然美景形成刺眼的对比。他认为这些地方证明了人类对地球的脆弱和资源有限是多么地短视。

作者指出，垃圾往往堆积在“边缘和被边缘化的地方”。他解释了“有毒殖民主义”的概念——即富裕国家把垃圾运到穷国——并用特写镜头近距离展示了其有害影响。但他也承认，垃圾贸易有时对接收一方的人们可能有好处：一个人认为无用的东西，对另一个人来说是潜在的收入来源。

在描述满目疮痍的景象和工业焚化炉的过程中，富兰克林-沃利斯谴责了“计划报废”的做法，即营销很快就需要更换的产品。20世纪早期一个臭名

昭著的例子是“灯泡卡特尔”，各大厂商共谋缩短了灯丝的使用寿命。如今，从“快时尚”服饰到无线耳塞，很多东西很快就会被扔掉或遗忘在抽屉里。

这本书对人物和地点的描写十分生动。英格兰南部的一位造纸厂工人“秃顶、鹰钩鼻，一副苦行僧样，微弓着背如一株缺水的郁金香”。英格兰北部的一位零浪费狂热分子的外表“介于和蔼可亲的气候活动家和游走于节日庆典的毒贩之间”。他用简短而生动的句子勾勒出加纳首都阿克拉一个赶集日的多彩和喧嚣，以及俄克拉何马州一个废弃小镇上尘土遍地的衰败景象。所幸，富兰克林-沃利斯以生花妙笔描写了丑陋的事物：在一个垃圾焚烧场，起重机“如一柄悬顶之剑，慢慢移动，发出低沉的隆隆声”；在一家垃圾处理厂，垃圾流动“永不停歇，如芭蕾舞般缤纷绚烂”。

《垃圾场》收集了大量事实，其中许多有趣又发人深省。全世界每秒钟售出两万个塑料瓶。2016年，全球产生了20亿吨固体废物，到2050年，这一数字将上升到33亿吨。但成堆的数字有时也会让人读来身心疲惫。每到这种时候，读者可能会不由地感慨，作者在开篇时承认垃圾不是“最吸引人的写书题材”，真是所言不虚。

不过，总的来说他还是消除了这种印象。《垃圾场》并没有为垃圾问题提供新颖的解决方案。富兰克林-沃利斯希望大家少购买，多重复使用，并呼吁打击“漂绿”行为（公司夸大自己的环保成绩）。但他成功地描绘出了所面对挑战之庞大。他的这本书理应引发董事会和议会的认真讨论。■



Heaps of trouble

The world's waste problem is growing fast

Oliver Franklin-Wallis sketches its dimensions in “Wasteland”

Wasteland. By Oliver Franklin-Wallis. Hachette Books; 400 pages; \$30. Simon & Schuster; £20

IN “OUR MUTUAL FRIEND”, Charles Dickens’s last complete novel, stray paper “hangs on every bush, flutters in every tree, is caught flying by the electric wires, haunts every enclosure”. Since those words were published in the 1860s, the world’s waste problem has changed in both scale and composition. These days plastic in one form or another is strewn on verges, clogs rivers and swirls around oceans in vast gyres. Circulated by winds and tides, tiny nanoplastics have penetrated all manner of watery ecosystems, reaching both the Earth’s poles and its highest peaks, with unknown consequences for the planet.

Worried by the pollution caused by a throwaway culture, Oliver Franklin-Wallis—a British journalist who has written for *The Economist*—heads to places that best illustrate this profligacy. In “Wasteland” he visits an Indian landfill that is piled almost as high as the Qutub Minar, a well-known minaret in Delhi; Ghana’s largest second-hand clothes market, through which 15m garments are thought to pass every week; a former mining area in America that is blighted by dumped lead, zinc and cadmium; and a defunct nuclear-power plant in the north-west of England, which contrasts starkly with the natural beauty of the nearby Lake District. He sees these places as evidence of human myopia about the Earth’s fragility and the finitude of its resources.

Rubbish, the author notes, is often deposited “on the margins, and on the

marginalised". He explains the concept of "toxic colonialism", whereby trash is shipped by wealthier countries to poorer ones, and shows its detrimental effects up close. But he also acknowledges that the waste trade can sometimes be beneficial to communities on the receiving end: what one person deems useless, another sees as a potential source of income.

Throughout his tour of disfigured landscapes and industrial incinerators, Mr Franklin-Wallis decries the tactic of "planned obsolescence": ie, the marketing of products that quickly need to be replaced. A notorious early-20th-century example was the "light-bulb cartel", who conspired to slash the lifespan of their filaments. These days items ranging from "fast fashion" to wireless earbuds are liable to be thrown away or forgotten in a drawer before long.

The book comes alive in its descriptions of people and places. A paper-mill worker in southern England is "bald and aquiline, monkish, with the gentle stoop of an under-watered tulip". The appearance of a zero-waste zealot in the north of England is "somewhere between affable climate activist and festival drug-dealer". The colours and buzz of a market day in Accra are sketched in short, lively sentences, as is the dusty decay of an abandoned town in Oklahoma. Happily, Mr Franklin-Wallis writes stylishly about ugly things: cranes at a site for burning garbage "move slowly, Damoclesian, their noise a deep rumble"; the flow of rubbish at a waste plant is "relentless, the choreography balletic".

"Wasteland" is heavy on facts, many of them interesting and sobering. Twenty thousand plastic bottles are sold around the world every second. The world produced 2bn tonnes of solid waste in 2016, a figure that will rise to 3.3bn tonnes by 2050. But the piles of numbers can occasionally be a strain. At such moments, readers may find themselves agreeing that waste is "not the most appealing subject" for a book, as the author himself admits near the beginning of his.

Overall, however, he dispels that impression. “Wasteland” does not offer novel solutions to the problem of waste. Mr Franklin-Wallis wants you to buy less and recycle more, along with a crackdown on “greenwashing” (whereby companies make exaggerated claims about their environmental credentials). But he succeeds in outlining the size of the challenge. His book should prompt serious discussion in boardrooms and parliaments. ■



自由交流

居家办公的迷梦褪色

毕竟，它并不比在办公室里工作效率更高

从Zoom转向会议室，一股反向迁徙渐成气候。在要求员工到办公室上班这一点上，态度最强硬的向来是华尔街的公司，但最近几个月，连苹果、谷歌、Meta等许多科技巨头也要求员工每周至少到办公室三天。对于居家办公的信徒来说，这看起来像是臭脾气的企业老顽固们的报复。新冠疫情期间不是冒出来一大堆研究，说远程工作往往比在办公室里埋头苦干更有效率吗？

这些信徒要感到遗憾了，因为新研究得出的结论大多与之前的相悖——办公室尽管存在种种缺陷，但仍然不可或缺。先来看一篇在2020年发表时受到广泛关注的工作论文，作者是当时在哈佛大学攻读博士学位的娜塔莉亚·伊曼纽尔（Natalia Emanuel）和艾玛·哈林顿（Emma Harrington）。她们发现，一家在线零售商的员工从办公室办公转为居家办公后，每小时处理的电话数量增加了8%。纽约联储今年5月发表了这篇论文的修订版，引起的关注却要少得多。修订版称，效率实则是下降了4%。

研究人员并没有出什么错。她们只是获取了更精确的数据，包括详细的工作时间表。远程办公时不仅员工接听的电话减少了，通话的质量也大打折扣。他们让顾客等待的时间更长。客户回电也更多，说明问题并没有解决。

在此之前，其他研究也得出了类似的结论。麻省理工学院的戴维·阿特金（David Atkin）和安托瓦内特·舒瓦（Antoinette Schoar）以及加州大学洛杉矶分校的苏米特·欣德（Sumit Shinde）将印度的数据录入员随机分配到家中或办公室工作。居家办公的人比在办公室工作的人效率低18%。芝加哥大学的迈克尔·吉布斯（Michael Gibbs）、埃塞克斯大学的弗里德里克·孟格尔（Friederike Mengel）和克里斯托夫·斯姆罗斯（Christoph

Siemroth) 发现，相对于之前在办公室的表现，一家大型亚洲IT公司的员工在远程工作时的生产率下降了19%之多。另一项研究表明，即使是国际象棋专业棋手，在网上比赛的表现也不如当面对战好。还有一项研究通过实验室实验证明，视频会议抑制了创造性思维。

对于这几年大多时间在家里餐桌上办公的人来说，这些发现背后的原因可能并不会让他们感到意外。居家办公时人们更难协作。在纽约联储的研究中，接受调查的员工表示他们想念“旁边有人可以求助”的状态。其他研究人员查看了微软近6.2万名员工的通信记录后发现，公司内部的职业网络变得更加静态和孤立。远程会议是对面对面会议的苍白模仿：例如，哈佛商学院的研究人员得出结论，许多公司在疫情期间推出的“虚拟茶水间”往往挤占了繁忙的日程安排，而用处有限。借用专门研究公司结构的经济学家罗纳德·科斯（Ronald Coase）的说法，所有这些问题都增加了协调成本，让企业组织更加笨拙，运转不灵。

随着人们逐渐习惯，远程工作的某些协调成本想来可能会下降。自2020年以来，许多人已经能熟练使用Zoom、Webex、Teams或Slack。但随着时间的推移，另一项成本可能会上升：人力资本发展不足。在4月发表的一项针对软件工程师的研究中，伊曼纽尔和哈林顿以及同样来自哈佛大学的阿曼达·帕莱斯（Amanda Pallais）发现，在转向远程工作后，同事之间的交流反馈急剧减少。阿特金、舒瓦和欣德记录了居家办公者学习成效相对下降的情况。那些在办公室工作的人更快地学到了技能。

与上述发现相反的认为远程工作能提高生产率的观点可以追溯到疫情暴发近10年前的一项实验，该实验的结果由斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）等人在2013年发表。在远程工作时，中国在线旅行社携程的呼叫中心的工作人员的业绩提高了13%——这一数据至今仍在媒体报道中出现。但有两大问题往往被忽视：首先，超过三分之二的业绩改善源于员工延长了工作时间，而不是提高了工作效率；其次，这家中国公司最终停止了远程办公，因为不坐班的员工很难得到晋升。2022年，布鲁姆再次到访携程网，这次是为了调查一项混合工作实验的效果。这个实验的结果不那么引人注目：它对生产率的影响可以忽略不计，不过员工在办公

室时工作时间更长，写的代码也更多。

工作（还有生活）的意义不仅在于生产率。也许远程工作最大的优点是它能提升员工的幸福感。人们花在通勤上的时间减少了，从他们的视角来看可能会觉得生产率提高了，即使传统的测量方式无法检测到这一点。他们更容易安排接送孩子上学和预约看医生的时间，更不用说偶尔睡个懒觉或是在上午慢跑。而且有些任务——特别是那些需要长时间不间断集中注意力的任务——在家中往往比在开放式办公室里更容易顺畅完成。所有这些都解释了为什么有这么多员工不喜欢去办公室。

事实上，有些调查发现，员工宁愿接受减薪也想选择居家办公。反过来，对企业管理者来说，以略低的工资让员工满意可能是一笔划算的买卖。因此，对许多人来说，未来的工作仍将是混合型的。尽管如此，工作周的天平很可能会向办公室倾斜回去而偏离居家办公——并不是因为老板们是喜欢早晚高峰堵车的施虐狂，而是因为往这个方向走有更高的生产率。■



Free exchange

The working-from-home illusion fades

It is not more productive than being in an office, after all

A GRADUAL REVERSE migration is under way, from Zoom to the conference room. Wall Street firms have been among the most forceful in summoning workers to their offices, but in recent months even many tech titans—Apple, Google, Meta and more—have demanded staff show up to the office at least three days a week. For work-from-home believers, it looks like the revenge of corporate curmudgeons. Didn't a spate of studies during the covid-19 pandemic demonstrate that remote work was often more productive than toiling in the office?

Unfortunately for the believers, new research mostly runs counter to this, showing that offices, for all their flaws, remain essential. A good starting point is a working paper that received much attention when it was published in 2020 by Natalia Emanuel and Emma Harrington, then both doctoral students at Harvard University. They found an 8% increase in the number of calls handled per hour by employees of an online retailer that had shifted from offices to homes. Far less noticed was a revised version of their paper, published in May by the Federal Reserve Bank of New York. The boost to efficiency had instead become a 4% decline.

The researchers had not made a mistake. Rather, they received more precise data, including detailed work schedules. Not only did employees answer fewer calls when remote, the quality of their interactions suffered. They put customers on hold for longer. More also phoned back, an indication of unresolved problems.

The revision comes hot on the tails of other studies that have reached

similar conclusions. David Atkin and Antoinette Schoar, both of the Massachusetts Institute of Technology, and Sumit Shinde of the University of California, Los Angeles, randomly assigned data-entry workers in India to labour either from home or the office. Those working at home were 18% less productive than their peers in the office. Michael Gibbs of the University of Chicago and Friederike Mengel and Christoph Siemroth, both of the University of Essex, found a productivity shortfall, relative to prior in-office performance, of as much as 19% for the remote employees of a large Asian IT firm. Another study determined that even chess professionals play less well in online matches than face-to-face tilts. Yet another used a laboratory experiment to show that video conferences inhibit creative thinking.

The reasons for the findings will probably not surprise anyone who has spent much of the past few years working from a dining-room table. It is harder for people to collaborate from home. Workers in the Fed study spoke of missing their “neighbours to turn to for assistance”. Other researchers who looked at the communication records of nearly 62,000 employees at Microsoft observed that professional networks within the company become more static and isolated. Teleconferencing is a pale imitation of in-the-flesh meetings: researchers at Harvard Business School, for example, concluded that “virtual water coolers”—rolled out by many companies during the pandemic—often encroached on crowded schedules with limited benefits. To use the terminology of Ronald Coase, an economist who focused on the structure of companies, all these problems represent an increase in co-ordination costs, making collective enterprise more unwieldy.

Some of the co-ordination costs of remote work might reasonably be expected to fall as people get used to it. Since 2020, many will have become adept at using Zoom, Webex, Teams or Slack. But another cost may rise over time: the underdevelopment of human capital. In a study of software engineers published in April, Drs Emanuel and Harrington, along with Amanda Pallais, also of Harvard, found that feedback exchanged between

colleagues dropped sharply after the move to remote work. Drs Atkin, Schoar and Shinde documented a relative decline in learning for workers at home. Those in offices picked up skills more quickly.

The origins of the view that, contrary to the above, remote working boosts productivity can be traced to an experiment nearly a decade before the pandemic, which was reported by Nicholas Bloom of Stanford and others in 2013. Call-centre workers for a Chinese online travel agency now known as Trip.com increased their performance by 13% when remote—a figure that continues to appear in media coverage today. But two big wrinkles are often neglected: first, more than two-thirds of the improved performance came from employees working longer hours, not more efficiently; second, the Chinese firm eventually halted remote work because off-site employees struggled to get promoted. In 2022 Dr Bloom visited Trip.com again, this time to investigate the effects of a hybrid-working trial. The outcomes of this experiment were less striking: it had a negligible impact on productivity, though workers put in longer days and wrote more code when in the office.

There is more to work (and life) than productivity. Perhaps the greatest virtue of remote work is that it leads to happier employees. People spend less time commuting, which from their vantage-point might feel like an increase in productivity, even if conventional measures fail to detect it. They can more easily fit in school pickups and doctor appointments, not to mention the occasional lie-in or midmorning jog. And some tasks—notably, those requiring unbroken concentration for long periods—can often be done more smoothly from home than in open-plan offices. All this explains why so many workers have become so office-shy.

Indeed, several surveys have found employees are willing to accept pay cuts for the option of working from home. Having satisfied employees on slightly lower pay, in turn, might be a good deal for corporate managers. For

many people, then, the future of work will remain hybrid. Nevertheless, the balance of the work week is likely to tilt back to the office and away from home—not because bosses are sadomasochists with a kink for rush-hour traffic, but because better productivity lies in that direction. ■



熊彼特

来会会世上最爱“撩”的主权财富基金

但沙特阿拉伯的PIF并没有看上去那么放荡

二〇一六年笔者在利雅得时，王储穆罕默德·本·萨勒曼（Muhammad bin Salman）穿着长袍和凉鞋宣布了他的“2030愿景”，其目标是让沙特戒掉他所说的石油瘾。作为沙特阿拉伯事实上的统治者，他谈到要出售世界最大的石油公司沙特阿美（Saudi Aramco）的股份，用资金支持一个价值2万亿美元的巨型主权财富基金，投资石油以外的各种行业。他将成为基金的主席、金主和主脑。这听起来令人兴奋沉醉，尽管有些构想放在沙特阿拉伯这样一个保守的专制国家显得有些神智错乱。最令人震惊的事情还在后头：一位王室官员邀请笔者去了一家咖啡馆，不戴头巾的年轻男女坐在那里公开调情。打破规则的氛围让人激动。

如今，名为公共投资基金（Public Investment Fund，以下简称PIF）的沙特主权财富基金正成为王储穆罕默德梦想中的那种巨人。其资产价值已膨胀至7000亿美元，有1400多名员工，在全球日益知名，而且就像那些泡咖啡馆的年轻人一样，它也发现了公开调情的乐趣。无论是改革高尔夫，收购欧洲知名足球俱乐部，押注明星电子游戏公司，从无到有地打造航空公司，或是让阿斯顿马丁（Aston Martin）走向电动化，PIF策划着一个接一个备受关注的交易，根本停不下来。位于华盛顿特区的智库阿拉伯海湾国家研究所（Arab Gulf States Institute）的罗伯特·莫吉尼基（Robert Mogielnicki）说，它以一种“无所不包、无处不在、万箭齐发的投资方式”，“咆哮着登上舞台”。然而，它也许并不像听起来那么轻佻浪荡。仔细观察会发现，其投资方式并不是只有愣头青的冲动鲁莽。

这要从PIF的使命说起。与许多主权财富基金一样，它的目标是将该国的石油财富转为全球资产，以实现长期增长。但它也必须在国内培育多元化的经济，以防石油需求下降。它有积极的扩张计划，目标是到2025年管理的资产规模超过1万亿美元，到2030年至少再翻一番，成为全球最大

的主权财富基金。大部分增长不太可能来自投资回报，尤其是因为超过三分之二的资产都位于沙特国内。相反，它将需要更多的公共出资，例如在4月接收了沙特阿美4%的股份，价值近800亿美元。可获得的资金有多少取决于油价，当前油价远低于去年高位。

它不只是依赖石油。莫吉尼基指出，如果PIF能够在其沙特项目中吸引合作投资者，它的资产价值也可能增加。这就是其国内与国外战略相契合的地方。它已经持有四支沙特足球队75%的股份，如果将这些球队私有化，可能会吸引更多投资，推高其价值。他认为，随着时间的推移，共同投资也许还可以增加一些特大型产业和旅游项目的价值，例如Neom新城项目，PIF希望将它建设为乌托邦式的沙漠城市。要将愿景变为现实，沙特需要吸引访客——既包括出手阔绰的游客，也包括财力雄厚的投资者。为此，PIF必须要让沙特名扬四方。

在追求这一目标的过程中，最引人瞩目的策略便是体育。无论沙特能否成功完成高尔夫运动的世纪大合并，它都已是体育界不可忽视的名字。收购英超俱乐部纽卡斯尔联队只不过是更大野心的前奏：将沙特王国变成足球强国。C罗先前以2亿美元的薪水为一支沙特球队效力，吸引这样的球员也是这一战略的一部分。如果沙特利用这些显赫人物来为它争取2030年世界杯的举办权背书，那也不足为奇。

这样的投资引发了“体育洗白”的指责，即利用知名的品牌大使去掩盖骇人听闻的侵犯人权行为，例如出生于沙特的《华盛顿邮报》专栏记者贾迈勒·卡舒吉（Jamal Khashoggi）在2018年被谋杀案的事件。然而，形象洗白的背后也有经济逻辑。瑞银的马克斯·卡斯泰利（Max Castelli）提到不计经济回报举办大型赛事总会有“声望因素”，卡塔尔去年举办世界杯就展示了这种因素的价值。对PIF而言，投资体育的成本不算高，却噱头十足，能在全球市场引起广泛关注。

PIF还在进行其他战略投资，虽然没有搅起那么大的喧嚣，但仍会在国内产生影响。其中两个值得注意的领域是游戏和清洁能源。PIF的游戏资产中已经有了动视暴雪（Activision Blizzard）和艺电（Electronic Arts），

今年2月它又成为日本游戏公司任天堂（Nintendo）的最大外国股东。它希望将Neom变为一个游戏开发中心。在脱碳方面，它最大的海外投资之一是对Lucid的投资，这是一家总部位于加州的电动汽车制造商。6月26日，Lucid赢得了英国豪华汽车制造商阿斯顿马丁（PIF也是该公司的大股东）的电动机和电池系统供货合同。难怪Lucid正在沙特建设其第一个海外工厂。

PIF的电动汽车投资体现了它的美好梦想，也反映了不那么乐观的现实。它的一些最大赌注表现惨淡。其中包括了Lucid、通过软银的愿景基金进行的风险投资，以及所持有的网约车公司优步的股份。它在国内的光芒也受了折损。作为其最大的持股权资产之一，沙特国家银行（Saudi National Bank）对瑞士银行瑞信不合时宜的投资在3月损失惨重。像Neom这样的特大型项目已经变得太过浮夸而可能沦为人们眼里的闹剧（Neom项目还因对当地的豪伊塔特[Howeitat]部落的做法而受到人权分子的审视）。如果投资者被吸引过来，那也是为了回报的承诺，而不是为了那些让人眼花缭乱的面子工程。

不过，PIF的一大优势是它的公开性。数据收集平台Global SWF的老板迭戈·洛佩斯（Diego Lopez）表示，没有哪个主权基金会把自己的雄心如此公开示人。毫无疑问，这种方式宣扬了王储穆罕默德的胆魄。而这也给PIF带来了额外的压力，务必要确保他的愿景不会悉数落空。 ■



Schumpeter

Meet the world's most flirtatious sovereign-wealth fund

But Saudi Arabia's PIF is less promiscuous than it looks

YOUR COLUMNIST was in Riyadh in 2016 when Muhammad bin Salman, wearing robes and sandals, announced his Vision 2030, aimed at ending what the crown prince described as the kingdom's addiction to oil. Saudi Arabia's de facto ruler talked of selling shares in Saudi Aramco, the world's biggest oil company, to fund a giant sovereign-wealth fund (SWF), worth \$2trn, to invest in diverse non-oil industries. He would be its chairman, benefactor and mastermind. It was heady stuff, even if some of it sounded unhinged in a hidebound autocracy like Saudi Arabia. The most striking thing occurred later when a palace official invited Schumpeter to a café. Young men and women sat without head coverings, flirting openly. The rule-breaking atmosphere was electric.

Today, the Saudi SWF, called the Public Investment Fund (PIF), is becoming the goliath Prince Muhammad dreamed about. The value of its assets has ballooned to \$700bn, it has over 1,400 employees and a rising global profile, and, like those youthful café-dwellers, it has discovered the joys of public flirtation. Whether revolutionising golf, buying Europe's football glitterati, betting on star video-gaming companies, building an airline from scratch or turning Aston Martin electric, the PIF cannot stop orchestrating one headline-grabbing deal after another. It has come "screaming onto the scene" with an "everything, everywhere, all-at-once investment approach", says Robert Mogielnicki of the Arab Gulf States Institute, a think-tank based in Washington, DC. Yet it may not be as promiscuous as it sounds. Look carefully and there is more than adolescent impetuousness to its investment approach.

It starts with the PIF's mandate. Like many SWFs, one aim is to redirect the country's oil wealth into global assets for long-term growth. But it is also required to nurture a diversified economy at home in case demand for oil drops. It has aggressive expansion plans. It wants to amass over \$1trn in assets under management by 2025 and at least to double that by 2030, making it the biggest SWF on Earth. It is unlikely that much of that growth will come from investment returns, not least because over two-thirds of its assets are in Saudi Arabia. Instead it will require more public disbursements, such as the 4% of Aramco shares, at a value of almost \$80bn, that it received in April. How much money is available will depend on oil prices, which are well below the highs of last year.

It is not only reliant on oil. Mr Mogielnicki notes that the PIF's asset values could increase if it attracts co-investors into its Saudi projects. That is where its domestic strategy dovetails with its foreign one. It has taken a 75% stake in four Saudi sports teams, which may attract more investment if they are privatised, pushing up their value. He believes that over time, co-investment could also increase the worth of some of its industrial and tourist megaprojects, such as Neom, which the PIF is aiming to turn into a desert-city Utopia. The kingdom needs visitors—both well-heeled tourists and deep-pocketed investors—to turn vision into reality. For that, the PIF needs to put Saudi Arabia on the map.

Its most eye-catching gambit in that pursuit is sport. Whether or not it pulls off the golfing megamerger of the century, it is already now a name to be reckoned with. Its purchase of Newcastle United, an English Premier League club, was a down-payment for a bigger ambition; to turn the kingdom into a football powerhouse. Luring players like Cristiano Ronaldo, who recently trousered a \$200m salary to play for a Saudi team, is part of that strategy. Don't be surprised if such influencers are used as character references to secure the rights to host the FIFA World Cup in 2030.

Such investment has led to accusations of “sportswashing”, ie, using prominent brand ambassadors to obscure appalling human-rights abuses, such as the murder in 2018 of Jamal Khashoggi, a Saudi-born columnist for the Washington Post. Yet image laundering also has economic logic. Qatar showed with last year’s World Cup the value of what Max Castelli of UBS, a bank, calls the “prestige element” of hosting big events, regardless of financial returns. Sport costs the PIF relatively little. Yet it provides a lot of bang for buck in the global market for attention.

The PIF is making other strategic investments that attract less hullabaloo, but also have domestic ramifications. Two of note are gaming and clean energy. In February the PIF became the biggest foreign shareholder in Nintendo, a Japanese gaming company, to add to a collection of assets including Activision Blizzard and Electronic Arts. It hopes to turn Neom into a gaming-development hub. As for decarbonisation, one of its biggest foreign investments is in Lucid, a California-based electric-vehicle (EV) maker. On June 26th Lucid won a contract to provide electric motors and battery systems to Aston Martin, a British luxury carmaker, in which the PIF is also a big shareholder. Unsurprisingly, Lucid is building its first overseas factory in Saudi Arabia.

The PIF’s EV investment illustrates both its dreams and a less silver-lined reality. Some of its biggest bets have seriously underperformed. That includes Lucid, venture-capital investments via SoftBank’s Vision Fund, and its stake in Uber, a ride-hailing firm. At home, its record is also tarnished. Saudi National Bank, one of its biggest holdings, lost a fortune in March on an ill-timed investment in Credit Suisse, a Swiss bank. Megaprojects such as Neom have become so grandiose, they risk looking farcical (and Neom is under human-rights scrutiny over treatment of the Howeitat tribe that lived on the land). If investors are seduced, it will be by the promise of returns, not by the razzle-dazzle of Potemkin villages.

Yet one big thing that the PIF has in its favour is its openness. According to Diego Lopez, boss of Global SWF, a data gatherer, no sovereign fund advertises its ambitions so publicly. That no doubt is a way of enhancing Prince Muhammad's reputation for boldness. It also puts the PIF under extra pressure to make sure his vision does not all go horribly wrong. ■



劲道川味

如何摆脱中国的房地产危机

一个繁荣城市的经验

要进锦江赋略有点难度。想要到这个位于成都市中心的豪华楼盘看房得先预约，否则进不了那富丽堂皇的四米高大门。就连要在这座1600万人口的西南大都市里打探些关于这个楼盘的信息都不大容易。开发商对于房子能卖出去信心十足，甚至不屑做广告。这种信心并非没有道理。成都有一种独特的悠闲氛围，这里的茶园就是最佳体现，客人们在里面喝茶采耳，一坐就是几个小时。这种闲适的生活节奏加之麻辣鲜香的美食在近年吸引了大批年轻一辈的中国人，锦江赋的销售张晓军（音译）说。其中许多人在这里买房安家。

在中国房地产市场久久走不出低迷之际，成都成了例外。从房价和新房销售等多项指标来看，成都的楼市比国内几乎其他任何地方都要好。在国家层面，中央政府针对不断加深的房地产危机采取了多项举措，包括6月13日宣布的降息，但都效果不佳。中国基准股指自5月初触及今年顶峰以来已经下跌了8%，而那时中国似乎仍在朝着疫情后全面复苏的方向飞驰。现在，投资者担心将有更多开发商开始出现资金短缺，并在此过程中拖欠美元债务。专家们都想知道地方性措施能在多大程度上促进增长。成都是一个寻找答案的好地方。

成都楼市透着一点不真实感。投行麦格理（Macquarie）的胡伟俊指出，4月至6月的新房销量比2019年同期（即疫情爆发前一年）高出近三分之一。相比之下，中国最大的30个城市的销量下降了四分之一。与此同时，5月成都房价同比上涨了8%，涨幅居大城市之首，并已连续17个月环比上涨。中国许多城市正在努力消化大量已建成但未售出的住宅库存。如果保持目前的销售速度，南方城市珠海将需要12年多的时间才能卖完已竣工或仍在建的住宅，而成都只需要三年多。

这种成功要怎么解释呢？自2016年以来，中国每个城市的官员都能够独立制定措施让当地楼市降温或升温。所采用的数措施大多都是限制购房资格和购房套数，以及调节首付比例。在大多数大城市，只有拥有当地户口或居住证的人才有购房资格。在成都，总体上仍在执行限购。但官员设法吸引家庭迁入，以扩大城市规模和增加住房需求。例如，二孩或更多孩子的家庭可额外多购房，本地户口家庭最多可以买三套。即使没有户口的家庭也可以买两套。自今年起，搬到成都投靠成年子女入户的父母也可以购买一套住房。

其他城市也尝试过类似的政策，但成效要小得多。毗邻香港的科技中心深圳放松了一些限购政策，但房价仍同比下跌了1.8%。一种解释是深圳科技行业的大规模裁员。另一种解释是，成都的政策之所以更有效，是因为配合实施了吸引高素质人才的改革，帮助促进了增长。研究公司CreditSights的桑德拉·周（Sandra Chow，音译）指出，自2017年以来，当地政府开始向移居成都、在其快速发展的产业基地工作的人才提供购房补贴和现金奖励。

去年，成都官员在应对席卷全国的房地产信任危机方面也表现更佳。随着开发商接连破产，许多住宅项目未能完工。成千上万的购房者暂停偿还房贷。更多的人推迟购买新房。桑德拉·周表示，成都官员为开发商疏通现金流，竭尽全力确保楼盘顺利交付。即使是违约的开发商也设法完成了楼盘的建设。与去年同期相比，2023年前两个月竣工的住宅建筑面积增加了约40%。这可能鼓励了犹豫不决的买家冒险一试。其他地区可能也想效仿，但缺乏资金。2022年上半年，成都所在的四川省的市政土地出让增长最为强劲，这将能释放资金，保证建筑商继续开工。

成都还受益于其他一些因素，这些因素在其他地方很难复制，甚至可能在成都本地都难以再现。从2011年到2021年，该市人口增加了700多万，是世界上人口增长最快的城镇区域之一。研究公司易居中国的严跃进表示，这些迁入人口是住房需求最大的推动力。但此后人口向城市迁移的速度已经放缓。中国没有足够的人口来实现又一次城市人口激增。成都地处西南，这也意味着在过去的房地产繁荣时期这里的房价并没有快速上涨。此

外，期间它不断扩大的制造业继续提高居民收入。因此，正如另一家研究公司牛津经济研究院（Oxford Economics）的卢姿蕙指出的那样，成都是少数几个房价相对于当地收入没有快速上涨的二线城市之一。

如果势头开始萎靡，成都官员还有一些手段可采用。例如，他们尚未大幅放松限购，让有购房资格的人数大增。成都市房地产开发企业协会的郭洁表示，市场观察人士都在等待这样的动向，因为这将表明市场动力在耗尽，即使是准备最充分的城市也卷入了危机。中国其他地方的决策者也将盯牢成都。 ■



Sichuan pep

How to escape China's property crisis

Lessons from a city that is flourishing

GETTING INTO Jinjiang Ode is a little difficult. The luxurious property development in central Chengdu will not allow potential buyers through its four-metre-high palatial gates without an appointment. Even finding out about the project in the south-western metropolis, home to 16m people, is tricky. The company behind it is so confident of demand that it does not deign to advertise the flats—a confidence which is not unjustified. Chengdu has a distinct, laid-back atmosphere epitomised by its public tea gardens, in which patrons spend hours sipping hot beverages and having their ears cleaned. The leisurely pace of life and tongue-numbing local cuisine appeal to younger Chinese people, who have come in droves in recent years, says Zhang Xiaojun, a sales agent at the development. Many of them buy homes.

As a prolonged downturn in China's property market takes hold, Chengdu is an exception. By several metrics, including house prices and sales of new homes, it is faring better than almost anywhere in the country. At a national level, the central government's response to the deepening property crisis, including an interest-rate cut announced on June 13th, has underwhelmed. China's benchmark stock index has fallen by 8% since peaking this year in early May, when the country still appeared to be rocketing towards a full post-covid recovery. Now investors fear more developers will start to fall short of cash, defaulting on dollar debts in the process. Experts are asking how much local measures can pump up growth. Chengdu is a good place to search for answers.

There is a faint air of unreality about the local market. New home sales between April and June were nearly a third higher than in the same period

in 2019, the year before the covid-19 pandemic struck, notes Larry Hu of Macquarie, an investment bank. In contrast, across China's 30 largest cities, sales have fallen by a quarter. Meanwhile, in May home prices in Chengdu rose by 8% compared with the previous year, the most of any large city. It has notched month-on-month rises for 17 straight months. Many Chinese municipalities are working through vast inventories of flats that have been built but not sold: it will take the southern city of Zhuhai more than 12 years to sell homes that have been completed or are still under construction if sales stay at the current pace. Chengdu will sell such flats in just over three years.

What explains this success? Since 2016 officials in every Chinese city have been able to devise their own measures for cooling or heating local property markets. Most of the rules employed are restrictions on who can buy a flat, how many they may purchase and the size of the downpayment required. In most large cities, only people with local hukou, or residence permits, are allowed to buy homes. In Chengdu, high-level purchase controls remain in place. But officials have sought to attract families as a way of expanding the city and increasing demand for homes. Residents with two or more children are, for instance, allowed to buy additional homes, and local hukou-holders may buy up to three. Even those without a hukou may buy two. Since the start of the year, elderly parents who move to Chengdu to join their adult children may also purchase a flat.

Other cities have experimented with similar policies, but enjoyed much less success. Shenzhen, the technology hub across the border from Hong Kong, has relaxed some of its restrictions. Yet property prices are still down 1.8% year-on-year. One explanation for this is sweeping lay-offs in the city's tech sector. Another is that Chengdu's policies are more effective because they are paired with reforms to attract educated workers, which have helped boost growth. Since 2017 local authorities have handed out housing subsidies and cash rewards to talented people who move to the city in order

to work in its rapidly growing industrial base, points out Sandra Chow of CreditSights, a research firm.

Chengdu's officials also did a better job of tackling the crisis of confidence that spread across the country last year. As developers went bust, many failed to finish flats. Thousands of homebuyers responded by halting mortgage payments. Many more delayed buying new homes. Officials in Chengdu went to great lengths to ensure homes were handed over, funnelling cash to developers, says Ms Chow. Even defaulting developers managed to complete homes. About 40% more apartment floorspace was finished in the first two months of 2023 compared with the same period the year before. This probably encouraged wavering buyers to take the plunge. Other regions may have wanted to follow suit, but lacked the cash. Sichuan, where Chengdu sits, notched up the strongest growth in municipal land sales of any province in the first half of 2022, which will have freed up funds to keep builders at work.

Chengdu benefited from some other factors that will be difficult, if not impossible, to replicate elsewhere, and perhaps even in the city itself. Its population rose by more than 7m from 2011 to 2021, making it one of the fastest-growing urban areas anywhere in the world. These inflows have been the biggest driver of housing demand, says Yan Yuejin of E-House China, a research firm. But urban migration has since slowed. There are simply not enough people in China for another population boom. Chengdu's location in the south-west also meant it did not see rapid rises in prices in past housing booms. Moreover, its growing manufacturing industry continued to lift incomes. As Louise Loo of Oxford Economics, another research firm, notes, it is thus one of a few second-tier cities that have not seen rapid price increases relative to local incomes.

A few levers remain for Chengdu's officials should things start to look peaky. For instance, they have yet to drastically ease restrictions to allow many

more people to buy homes. Market-watchers are waiting for such a development, says Guo Jie of the Local Association of Real Estate Enterprises, an industry group, for it would indicate that steam is running out and that even the best-prepared cities are being swept into the crisis. Policymakers elsewhere in the country will be watching closely, too. ■



【首文】印度教育50分

印度能否教育好它庞大的劳动人口？

差劲的学校威胁经济繁荣前景

印度总理莫迪在6月底访问白宫，他的出访名号是全球增长最快的大型经济体之一的领导人。印度正以6%的年增速扩张，GDP全球排名第五。其科技产业正蓬勃发展，绿色企业像铺地毯般大举铺设太阳能电池板。跨国公司纷至沓来，高盛最近在印度举行了一次董事会议。

随着富裕世界和中国的人口老龄化，印度庞大的青年人口（20岁以下人口约为五亿）应该会充当额外的推进剂。但本刊发现，尽管印度聪明的精英们拿下了许多学历证书，但大多数印度人所受的教育仍然是失败的。缺乏技能的失业年轻人可能导致印度的经济发展过早停步。

印度在为穷人提供服务上取得了一些进展。政府的数字化项目简化了使用银行服务和发放福利款项。在教育方面，它大举投资打造基础设施。十年前，只有三分之一的公立学校有洗手设施，大约仅一半接通了电力；现在约90%的学校这两样都不缺。自2014年以来，印度开办了近400所大学。高等教育入学率上升了五分之一。

然而，改善校舍设施和扩大招生的成效不过尔尔。在确保挤进教室的青少年能掌握基本技能这方面，印度的表现依然很糟糕。疫情前，印度的10岁儿童只有不到一半能读懂简单的故事（在美国该比例为96%），尽管他们大多数已经在课桌后乖乖坐了好几年。疫情爆发后，学校关闭了两年多，情况变得更糟。

对此有许多解释。课程设置繁杂，分配给数学和识字等基础课程的时间太少。未能掌握这些基本知识的学童也就没法学好其他东西。对教师的培训不足，管理差劲：一项针对农村学校的大型调查发现四分之一的教职员缺勤。官员们有时会让教师完成与教学无关的工作，比如管理选举活动、在疫情期间监督人们保持社交距离等。

这些问题促使许多家庭选择把孩子送入私立学校。印度约有50%的儿童就读于私校。这些学校在俭省方面可谓出类拔萃，教育效果倒是往往并没有更好。近年来出现的希望是印度的科技产业能彻底变革教育。然而，只依赖科技是有风险的。近期，印度最大的教育科技公司Byju's（自称在全球为1.5亿人提供教育，估值一度达220亿美元）因爆发财务问题而估值大跌。

这一切令改善公立学校变得更加紧迫。印度应加大教育支出。去年它在这方面的支出仅占GDP的2.9%，以国际标准衡量过低。但它还需要借鉴亚洲其他发展中地区的模式，改革教育系统的运作。

如本刊报道，近十年来，越南学生在国际测试中的表现优于一些富裕国家的青少年。越南孩子花在学业上的时间比印度孩子少，算上家庭作业和其他补习依然如此。而且前者的班级人数也更多。不同的是，越南的教师备课更好，更有经验，也更有可能因学生学业不合格而被问责。

领导得当的话，印度也可以跟上。它应该从更好地收集关于学生实际学到多少的信息开始。这就要求政客们停止质疑那些没法给他们的政策唱赞歌的数据。执政的印度人民党也应该停止试图从教科书中删除进化论等观点或惹怒印度教本土主义者的历史内容。这么做只是在延误解决真正的问题，有害无益。印度忙着大兴土木，修建公路、科技园区、机场和工厂，它还需要构筑好自己的人力资本。 ■



Half-marks for Indian education

Can India educate its vast workforce?

Poor schools put the economic boom at risk

WHEN NARENDRA MODI, India's prime minister, visited the White House in late June, he did so as the leader of one of the world's fastest-growing big economies. India is expanding at an annual rate of 6% and its GDP ranks fifth in the global pecking order. Its tech industry is flourishing and green firms are laying solar panels like carpets. Many multinationals are drawn there: this week Goldman Sachs held a board meeting in India.

As the rich world and China grow older, India's huge youth bulge—some 500m of its people are under 20—should be an additional propellant. Yet as we report, although India's brainy elite hoovers up qualifications, education for most Indians is still a bust. Unskilled, jobless youngsters risk bringing India's economic development to a premature stop.

India has made some strides in improving the provision of services to poor people. Government digital schemes have simplified access to banking and the distribution of welfare payments. Regarding education, there has been a splurge on infrastructure. A decade ago only a third of government schools had handwashing facilities and only about half had electricity; now around 90% have both. Since 2014 India has opened nearly 400 universities. Enrolment in higher education has risen by a fifth.

Yet improving school buildings and expanding places only gets you so far. India is still doing a terrible job of making sure that the youngsters who throng its classrooms pick up essential skills. Before the pandemic less than half of India's ten-year-olds could read a simple story, even though most of them had spent years sitting obediently behind school desks (the share in

America was 96%). School closures that lasted more than two years have since made this worse.

There are lots of explanations. Jam-packed curriculums afford too little time for basic lessons in maths and literacy. Children who fail to grasp these never learn much else. Teachers are poorly trained and badly supervised: one big survey of rural schools found a quarter of staff were absent. Officials sometimes hand teachers unrelated duties, from administering elections to policing social-distancing rules during the pandemic.

Such problems have led many families to send their children to private schools instead. These educate about 50% of all India's children. They are impressively frugal, but do not often produce better results. Recently, there have been hopes that the country's technology industry might revolutionise education. Yet relying on it alone is risky. In recent weeks India's biggest ed-tech firm, Byju's, which says it educates over 150m people worldwide and was once worth \$22bn, has seen its valuation slashed because of financial troubles.

All this makes fixing government schools even more urgent. India should spend more on education. Last year the outlays were just 2.9% of GDP, low by international standards. But it also needs to reform how the system works by taking inspiration from models elsewhere in developing Asia.

As we report, in international tests pupils in Vietnam have been trouncing youngsters from much richer countries for a decade. Vietnam's children spend less time in lessons than Indian ones, even when you count homework and other cramming. They also put up with larger classes. The difference is that Vietnam's teachers are better prepared, more experienced and more likely to be held accountable if their pupils flunk.

With the right leadership, India could follow. It should start by collecting

better information about how much pupils are actually learning. That would require politicians to stop disputing data that do not show their policies in a good light. And the ruling Bharatiya Janata Party should also stop trying to strip textbooks of ideas such as evolution, or of history that irks Hindu nativists. That is a poisonous distraction from the real problems. India is busy constructing roads, tech campuses, airports and factories. It needs to build up its human capital, too. ■



宇宙中的涟漪

引力波新发现令天文学家雀跃不已

这可能揭开巨型黑洞甚至宇宙起源的面纱

二〇一七年的诺贝尔物理学奖表彰了科学家对101年前的一个预测的证实。爱因斯坦的狭义和广义相对论彻底改变了科学家对恒星和星系尺度上的物理规律的理解，他在1916年预言，在某些情况下，宇宙结构本身会摆动和弯曲。

起因就是引力波，它和引力的关系相当于无线电波或可见光之于电磁辐射。2015年，科学家首次直接观测到引力波。美国的激光干涉引力波天文台（以下简称LIGO，在美国西北的华盛顿州和东南的路易斯安那州设有观测站）检测到一对质量各约为太阳的30倍的黑洞相互碰撞产生的波。这在时空中形成了频率约150赫兹（即每秒周期数）的涟漪，波长约2000公里。

这一发现标志着引力波天文学时代开启，该学科通过引力研究宇宙，就像传统天文学利用来自可见光、无线电波和伽马射线的电磁辐射一样。6月29日，由美国、澳大利亚、中国和欧洲的研究人员主持的四个科研合作团队声称这门新兴研究取得了重大突破。他们宣布初步探测到新的超低频引力波，可能为了解宇宙中最深不可测的一些奥秘带来启示。

引力波探测器主要是干涉仪。这些仪器的工作原理是把一束光一分为二，分别射入一对互相垂直的测量长臂中，在末端被反射回源头，重新合并。如果在这一过程中没有受到干扰，返回的光束在重新合并时将相互抵消。如果没有相消，就表明两者在光路中受到了某种干扰，有时不过是轻微的地震震颤，但偶尔会是行经的引力波。

“狩猎”引力波需要大型仪器。LIGO的测量臂有四公里长；位于欧洲的室女座干涉仪（Virgo）的测量臂长三公里。想探测的引力波越低频，所需的探测仪就越大。例如，要探测到频率在一赫兹左右的引力波，探测仪得要

比地球还大。所以欧洲航天局正在建造名为激光干涉仪空间天线（LISA）的航天器，计划于2030年代末升空，它将用一系列空间激光器和镜子组合而成一条长达250万公里的测量“臂”。

但最新的突破涉及的是频率接近纳米赫兹的引力波，比上述频率还要低几十亿倍。为探测这些引力波，天文学家必须依靠大自然创造的光束，也就是由脉冲星发射的光脉冲。脉冲星是已坍塌并高速旋转的恒星，会像节拍器般规律地发射脉冲。如果有引力波经过，扭曲了脉冲星和地球之间的时空，部分光脉冲就会早于或晚于预期到达。监测脉冲星群就相当于创造出测量臂跨越星际的干涉仪。

现在已探测到了超低频扭曲。这殊为不易，需要极大的耐心等待来自各种天文台的观测结果历经多年涓滴成河。此次发布的研究包含的部分数据收集于25年前。

参与合作的四个科研团队都不认为自己已有足够的证据一锤定音。物理学家用“西格玛”（sigma）这一统计术语来衡量一个结果的显著性。黄金标准为五西格玛，即研究结果实为偶然产物的概率约为350万分之一。单独来看，这四个团队探测结果的西格玛值分别在2到4.6之间。但把它们的数据综合到一起，可能会在一年内跨过五西格玛的大关。“这真的只是时间的问题，我毫不怀疑这一点。”英国卡迪夫大学的天体物理学家维维安·雷蒙德（Vivien Raymond）说。他本人没有参与这项工作。

米兰比可卡大学（University of Milano Bicocca）的阿尔贝托·塞扎纳（Alberto Sesana）表示，波源最可能是一对超大质量黑洞，每一个的质量都相当于太阳的数百万倍。它们最常出现在星系的中心，被认为是在这些星系碰撞和合并时配对的。据预测，在几十亿年里，这种配对频繁发生，在宇宙中形成一种引力波的“嗡嗡”背景声。然而，塞扎纳说，“这将是第一个观察证据，证明超大质量黑洞对在自然界确实存在。”

还有另一种可能，几率小得多，但也令人兴奋得多。也许可以想象一下，探测到的新信号可能是人类有史以来首次窥见宇宙最早的历史，当时名为

宇宙暴胀（宇宙在短时间内迅速膨胀）的现象可能令时空产生了嗡鸣。

假如探测到的真是这种现象，很难想象还有什么东西能以更激动人心的方式展现引力天文学的力量。在诞生最初的38万年里，宇宙的温度和密度极高，被认为是电磁辐射无法穿透的。这意味着一般的天文望远镜（都靠探测各种波长的光）都无法探测到在此之前发生的任何事情的痕迹。引力望远镜则不受此限制。关注这个领域吧。或者说，关注这个时空吧。■



Ripples in the sky

A new gravitational-wave detection has excited astronomers

It could reveal giant black holes—or the beginnings of the universe

THE 2017 Nobel prize for physics was given for the confirmation of a prediction made 101 years earlier. In 1916 Albert Einstein, whose theories of special and general relativity revolutionised scientists' understanding of physics at the scale of stars and galaxies, predicted that, in certain circumstances, the fabric of the universe itself should wobble and flex.

The culprits are gravitational waves, which are to gravity as radio waves or visible light are to electromagnetism. In 2015 gravitational waves were directly observed for the first time. LIGO, an American observatory based in Washington state in that country's north-west, and Louisiana in the south-east, detected waves produced by a pair of colliding black holes, each about 30 times the mass of the sun. That produced ripples in spacetime with a frequency of about 150Hz, or cycles per second, and a wavelength of around 2,000km.

This detection marked the beginning of the era of gravitational-wave astronomy, which uses gravity to examine the universe in the same way that conventional astronomy uses electromagnetic radiation, from visible light to radio waves and gamma rays. On June 29th four collaborations led by researchers in America, Australia, China and Europe claimed to have pushed forward the state of that emerging art. They announced the tentative detection of new, ultra-low frequency gravitational waves which could offer insights into some of the hardest-to-study bits of the universe.

Most gravitational-wave detectors are interferometers. These work by splitting a beam of light in two, and sending each half down one of a pair

of long, perpendicular arms. At the end of the arms the light pulses are reflected back towards the source, where they are recombined. If that journey is uninterrupted, the returning beams will cancel each other out when they are put back together. If they do not, then that suggests some disturbance—sometimes a mere seismic tremor, but occasionally a passing gravitational wave—has disturbed them on their journey.

Hunting for gravitational waves requires big instruments. LIGO's arms are 4km long; those at Virgo, a European instrument, span 3km. And the lower the frequency of the waves you want to detect, the bigger you have to go. Waves with a frequency around 1Hz, for instance, require detectors bigger than Earth itself. That is why the European Space Agency is building a spacecraft called LISA, due to fly in the late 2030s. It will use a system of space-going lasers and mirrors to create “arms” that are 2.5m kilometres long.

But the latest result concerns waves with frequencies in the nanohertz range, billions of times lower still. To detect those, astronomers must rely on light pulses created by Mother Nature—specifically, by pulsars. These are collapsed, spinning stars that emit flashes of light with metronomic regularity. If a passing gravitational wave distorts a region of spacetime between the pulsar and Earth, then some pulses would arrive earlier or later than expected. Monitoring groups of pulsars can create, in effect, interferometers with arms of interstellar size.

And ultra-low frequency distortions have now been spotted. Doing so was not easy. A great deal of patience was required, as results from the various observatories trickled in over the years. Some of the data included in this week's research were collected over 25 years ago.

None of the collaborations believe they have quite enough evidence for a conclusive discovery just yet. Physicists measure the significance of a

result using a statistical term called sigma. A score of 5, the gold standard, indicates a roughly 1-in-3.5m chance that what seems like a result is instead the product of chance. Individually, the four detections have sigma values between 2 and 4.6. But combining their data could take them over the 5-sigma mark within a year. “I have no doubt it’s really just a matter of time,” says Vivien Raymond, an astrophysicist at Cardiff University, who was not involved in the work.

The most likely source of the waves, says Alberto Sesana at the University of Milano Bicocca, are pairs of supermassive black holes, each with a mass millions of times that of the sun. They are most commonly found at the centres of galaxies, and are thought to pair off when those galaxies collide and merge. Over billions of years, such pairings are predicted to be frequent, producing a background gravitational “hum” across the sky. Still, says Dr Sesana, “this would be the first observational proof that supermassive black hole binaries do indeed occur in nature.”

There is another possibility, much less likely but far more exciting. It is just about conceivable that the new signal could be the first-ever glimpse of the universe’s earliest history, when a phenomenon known as inflation—in which the size of the universe briefly increased rapidly—would have set spacetime ringing.

If that is indeed what has been detected, it is hard to think of a more dramatic demonstration of the power of gravitational astronomy. Because it was so hot and dense, the universe is thought to have been opaque to electromagnetic radiation for the first 380,000 years of its existence. That means that no standard telescope (all of which depend on detecting light of various wavelengths) can detect traces of anything that happened before that. That is not a limit to which gravitational telescopes are subject. Watch this space. Or spacetime. ■



无以为继

“越大越好”的AI之路快行不通了

AI要持续进步，就必须用更少的资源做更多的事

美国研究实验室OpenAI开发的大热聊天机器人ChatGPT的底层技术GPT属于“大语言模型”（LLM），这类模型的秘诀就在一个“大”字。现代AI系统由庞大的人工神经网络驱动，这些网络就是一个个非常粗略地模仿生物大脑的软件。2020年发布的大语言模型GPT-3是个庞然大物。它有1750亿个“参数”即这些神经元之间的模拟连接。对它的训练使用了数千个GPU（擅长AI工作的专用芯片）在短短几周内处理了数千亿字的文本。所有这些据信已经花费了至少460万美元。

然而，现代AI研究中一以贯之的结论却是，虽然大就是好，但越大越好。因此，模型一直在以惊人的速度变大。今年3月发布的GPT-4据信有大约一万亿个参数，是GPT-3的近六倍。OpenAI的老板山姆·阿尔特曼（Sam Altman）称它的开发成本突破了一亿美元。整个行业都存在着类似的趋势。研究公司Epoch AI曾在2022年估算，训练一个尖端模型所需的算力每六到十个月便会翻一番（见图表）。

这种“巨人症”正在成为一个问题。如果Epoch AI有关每十个月算力翻番的估算正确，那么到2026年，训练成本可能会超过十亿美元——假设模型没有先把数据消耗殆尽的话。去年10月发表的一项分析预测，用于训练的高质量文本的存量很可能也会在2026年前后耗尽。而且即使训练得以完成，生成的模型实际使用起来也可能很昂贵。模型越大，运行成本就越高。今年早些时候，摩根士丹利估计，如果谷歌把一半的搜索交给目前的类GPT程序处理，那么它每年可能会多花60亿。随着模型越来越大，这笔费用可能还会上升。

因此，业界许多人认为这种“越大越好”的方法快要行不通了。如果要继续改进AI模型——先别提实现眼下风靡科技业的那些与AI相关的梦想——它

们的开发者将需要解决如何以更少的资源实现更高性能的问题。正如阿尔特曼4月在回顾巨型AI的发展历程时所说：“我认为我们正处在一个时代的尽头。”

于是，研究人员开始把注意力转向让自己的模型更高效，而不是单纯更大。一种方法是做些取舍——减少参数的数量，但用更多的数据来训练模型。2022年，谷歌旗下DeepMind的研究人员借助1.4万亿个单词的语料库，训练了有700亿个参数的大语言模型Chinchilla。该模型的表现优于GPT-3——后者有1750亿个参数，使用3000亿个单词的语料训练。虽然给较小的大语言模型投喂更多的数据意味着需要更长的训练时间，但其结果是模型更小了，使用起来速度更快也更便宜。

另一个方法是降低数学运算的精度。对模型中的每个数字，保留更少的小数位——换句话说，就是四舍五入——可以大大降低对硬件的要求。今年3月，奥地利科技学院（Institute of Science and Technology）的研究人员指出，四舍五入可以压缩类似于GPT-3的模型所消耗的内存，让模型用一个、而不是五个高阶GPU就可以运行，只会有“微乎其微的精确度降低”。

一些用户会微调通用大语言模型来专门处理特定任务，比如生成法律文件或者检测假新闻等。这不像从头训练大语言模型那么麻烦，但仍可能费钱耗时。比如，对LLaMA（由Facebook母公司Meta构建的开源模型，有650亿个参数）做微调就需要多个GPU，耗时几小时到几天不等。

华盛顿大学的研究人员发明了一种更高效的方法，用一天时间便通过微调LLaMA在单个GPU上创建了新模型Guanaco，而性能相差无几。他们使用了一些技巧，其中一些类似奥地利研究人员使用的四舍五入法。不过他们同时还使用了一种叫做“低秩适应”的方法——冻结模型的现有参数，然后往它们之间添加一组数量更少的新参数。对模型的微调仅仅会改动这些新变量。这让事情好办了很多——即使智能手机等性能相对较弱的计算设备也可能胜任这项任务。如果现在运行在超大数据中心的大语言模型可以在用户的设备上运行，就可以更大程度地实现个性化以及保护隐私。

与此同时，谷歌的一个团队已经为那些小模型也基本够用的群体提供了一个新选择。这种方法的重点是把所需的知识从一个通用大模型提取到一个专用小模型中。大模型相当于老师，小模型是学生。研究人员让“老师”回答问题，并展示它的答题思路。答案和“老师”的推理过程都被用来训练“学生”模型。该团队仅用7.7亿个参数就可以训练出一个“学生”模型，它在一个专门推理任务中的表现超越了拥有5400亿个参数的“老师”。

另一种方法把注意力从模型做什么转向改变其创建方式。目前AI编程大量使用一种叫作Python的语言。它的设计初衷就是简便易用，让编程人员不必考虑自己的程序在芯片上具体如何运行。不过，不考虑这些细节的后果便是程序运行速度缓慢。更关注这些实施细节可以带来很大的好处。这是“目前本行业的一大块工作”，开源AI公司Hugging Face的首席科学官托马斯·沃尔夫（Thomas Wolf）表示。

例如，斯坦福大学的研究人员去年发布了“注意力算法”的修订版，它让大语言模型可以学习词语和思想之间的联系。其思路是修改代码，把代码在芯片上的运行情况考虑进来，特别是要了解什么时候需要查找或存储特定信息。这种算法能够将GPT-2（一个更老版本的大语言模型）的训练速度提高两倍，还让它能够处理较长的查询。

更好的工具也可以带来更流畅的代码。今年早些时候，Meta发布了AI编程框架PyTorch的升级版。通过让编程人员更多思考如何在芯片上安排计算指令，只需加入一行代码就可以把模型的训练速度提高一倍。由多名苹果和谷歌前工程师创建的创业公司Modular在5月发布了一种以Python为基础的新AI编程语言Mojo，同样让编程人员能够掌控过去被隐藏的各种细节。在某些情况下，用Mojo编写的代码的运行速度要比用Python快好几千倍。

最后一个方法是改进运行代码的芯片。GPU原本是用来给现代电子游戏做绚丽的图像渲染的，它们擅长运行AI软件只是个意外收获。Meta的一名硬件研究人员表示，GPU尤其并不完美适用于“推理”工作（即在模型完成训练后对模型的实际运行）。因此，一些公司正在设计更专门化的自研硬

件。谷歌大部分的AI项目都是在自家的“TPU”芯片上运行的。拥有MTIA芯片的Meta和拥有Inferentia芯片的亚马逊走的差不多也是同样的路子。

只需做一些相对简单的改变，比如四舍五入或者换一种编程语言，便能把性能提高这么多，似乎不可思议。但它反映了大语言模型惊人的发展速度。多年来它们都属于研究项目，只要好用就行，简练高效与否并不那么重要。直到最近它们才发展为商业化的大众市场产品。大多数专家认为仍有很大的改进空间。正如斯坦福大学的计算机科学家克里斯·曼宁（Chris Manning）所说：“绝对没有理由认为.....这就是终极版的神经架构，我们再也找不到更好的了。” ■



Anything that can't continue, won't

The bigger-is-better approach to AI is running out of road

If AI is to keep getting better, it will have to do more with less

WHEN IT COMES to “large language models” (LLMs) such as GPT—which powers ChatGPT, a popular chatbot made by OpenAI, an American research lab—the clue is in the name. Modern AI systems are powered by vast artificial neural networks, bits of software modelled, very loosely, on biological brains. GPT-3, an LLM released in 2020, was a behemoth. It had 175bn “parameters”, as the simulated connections between those neurons are called. It was trained by having thousands of GPUs (specialised chips that excel at AI work) crunch through hundreds of billions of words of text over the course of several weeks. All that is thought to have cost at least \$4.6m.

But the most consistent result from modern AI research is that, while big is good, bigger is better. Models have therefore been growing at a blistering pace. GPT-4, released in March, is thought to have around 1trn parameters—nearly six times as many as its predecessor. Sam Altman, the firm’s boss, put its development costs at more than \$100m. Similar trends exist across the industry. Epoch AI, a research firm, estimated in 2022 that the computing power necessary to train a cutting-edge model was doubling every six to ten months (see chart).

This gigantism is becoming a problem. If Epoch AI’s ten-monthly doubling figure is right, then training costs could exceed a billion dollars by 2026—assuming, that is, models do not run out of data first. An analysis published in October 2022 forecast that the stock of high-quality text for training may well be exhausted around the same time. And even once the training is complete, actually using the resulting model can be expensive as

well. The bigger the model, the more it costs to run. Earlier this year Morgan Stanley, a bank, guessed that, were half of Google's searches to be handled by a current GPT-style program, it could cost the firm an additional \$6bn a year. As the models get bigger, that number will probably rise.

Many in the field therefore think the “bigger is better” approach is running out of road. If AI models are to carry on improving—never mind fulfilling the AI-related dreams currently sweeping the tech industry—their creators will need to work out how to get more performance out of fewer resources. As Mr Altman put it in April, reflecting on the history of giant-sized AI: “I think we’re at the end of an era.”

Instead, researchers are beginning to turn their attention to making their models more efficient, rather than simply bigger. One approach is to make trade-offs, cutting the number of parameters but training models with more data. In 2022 researchers at DeepMind, a division of Google, trained Chinchilla, an LLM with 70bn parameters, on a corpus of 1.4trn words. The model outperforms GPT-3, which has 175bn parameters trained on 300bn words. Feeding a smaller LLM more data means it takes longer to train. But the result is a smaller model that is faster and cheaper to use.

Another option is to make the maths fuzzier. Tracking fewer decimal places for each number in the model—rounding them off, in other words—can cut hardware requirements drastically. In March researchers at the Institute of Science and Technology in Austria showed that rounding could squash the amount of memory consumed by a model similar to GPT-3, allowing the model to run on one high-end GPU instead of five, and with only “negligible accuracy degradation”.

Some users fine-tune general-purpose LLMs to focus on a specific task such as generating legal documents or detecting fake news. That is not as cumbersome as training an LLM in the first place, but can still be costly

and slow. Fine-tuning LLaMA, an open-source model with 65bn parameters that was built by Meta, Facebook's corporate parent, takes multiple GPUs anywhere from several hours to a few days.

Researchers at the University of Washington have invented a more efficient method that allowed them to create a new model, Guanaco, from LLaMA on a single GPU in a day without sacrificing much, if any, performance. Part of the trick was to use a similar rounding technique to the Austrians. But they also used a technique called “low-rank adaptation”, which involves freezing a model’s existing parameters, then adding a new, smaller set of parameters in between. The fine-tuning is done by altering only those new variables. This simplifies things enough that even relatively feeble computers such as smartphones might be up to the task. Allowing LLMs to live on a user’s device, rather than in the giant data centres they currently inhabit, could allow for both greater personalisation and more privacy.

A team at Google, meanwhile, has come up with a different option for those who can get by with smaller models. This approach focuses on extracting the specific knowledge required from a big, general-purpose model into a smaller, specialised one. The big model acts as a teacher, and the smaller as a student. The researchers ask the teacher to answer questions and show how it comes to its conclusions. Both the answers and the teacher’s reasoning are used to train the student model. The team was able to train a student model with just 770m parameters, which outperformed its 540bn-parameter teacher on a specialised reasoning task.

Rather than focus on what the models are doing, another approach is to change how they are made. A great deal of AI programming is done in a language called Python. It is designed to be easy to use, freeing coders from the need to think about exactly how their programs will behave on the chips that run them. The price of abstracting such details away is slow code. Paying more attention to these implementation details can bring big

benefits. This is “a huge part of the game at the moment”, says Thomas Wolf, chief science officer of Hugging Face, an open-source AI company.

In 2022, for instance, researchers at Stanford University published a modified version of the “attention algorithm”, which allows LLMs to learn connections between words and ideas. The idea was to modify the code to take account of what is happening on the chip that is running it, and especially to keep track of when a given piece of information needs to be looked up or stored. Their algorithm was able to speed up the training of GPT-2, an older large language model, threefold. It also gave it the ability to respond to longer queries.

Sleeker code can also come from better tools. Earlier this year, Meta released an updated version of PyTorch, an AI-programming framework. By allowing coders to think more about how computations are arranged on the actual chip, it can double a model’s training speed by adding just one line of code. Modular, a startup founded by former engineers at Apple and Google, last month released a new AI-focused programming language called Mojo, which is based on Python. It too gives coders control over all sorts of fine details that were previously hidden. In some cases, code written in Mojo can run thousands of times faster than the same code in Python.

A final option is to improve the chips on which that code runs. GPUs are only accidentally good at running AI software—they were originally designed to process the fancy graphics in modern video games. In particular, says a hardware researcher at Meta, GPUs are imperfectly designed for “inference” work (ie, actually running a model once it has been trained). Some firms are therefore designing their own, more specialised hardware. Google already runs most of its AI projects on its in-house “TPU” chips. Meta, with its MTIAs, and Amazon, with its Inferentia chips, are pursuing a similar path.

That such big performance increases can be extracted from relatively simple changes like rounding numbers or switching programming languages might seem surprising. But it reflects the breakneck speed with which LLMs have been developed. For many years they were research projects, and simply getting them to work well was more important than making them elegant. Only recently have they graduated to commercial, mass-market products. Most experts think there remains plenty of room for improvement. As Chris Manning, a computer scientist at Stanford University, put it: “There’s absolutely no reason to believe...that this is the ultimate neural architecture, and we will never find anything better.” ■



经济学人视频

加密货币的未来 - 上

作为一项波动性极大的投资，加密货币为何会吸引人？



The Economist Film

The future of Crypto - 1

It's a volatile investment. So what's the attraction of crypto?



巴托比

《扩展人员》是一本教科书式的管理学著作

克莱尔·休斯·约翰逊重策略和实用性，轻胡扯

太多的管理学书籍都是在某个模糊的概念上大做文章穷尽言辞。从这些书的页边距的宽度就可看出，作者为凑出一本书得费多大的劲。它们的封面亮眼又活泼，书名要么包含像“奋斗”和“点燃”这样充满动感的词汇，要么生造出一些可怕的新合成词，比如“stressilience”（压韧）或“charismility”（魅力性）。它们决意要为老板们从任何地方采撷经验，像是白蚁、狩猎采集者、诺瓦克·德约科维奇（Novak Djokovic）和沙拉酱——但就是没有真实的商业场景。大多数管理学著作的潜规则似乎就是对真正的管理实践避而不谈。

因此，读到一本不落窠臼的书真是让人大松一口气。它读来掷地有声，令人心生敬畏。它的编排和内容都像一本教科书，里面有大量练习和模板。它讨论的重点也具有无可辩驳的实用性。这本《扩展人员》（Scaling People）的作者是克莱尔·休斯·约翰逊（Claire Hughes Johnson），她是一名科技行业资深人士，在谷歌工作了十多年后，于2014年加入数字支付独角兽公司Stripe，任首席运营官。到2021年她卸任时，这家公司的员工已经从160人增加到7000多人。在一个由程序员、创造者和远见者组成的世界里，她的工作就是让事情顺畅运转。

书中大部分内容就是一份用于创建休斯·约翰逊所说的操作系统的手册——一套文档、度量标准和流程，为决策和提升业绩提供了连贯一致的框架。书中有一个关于规划的小节，为设定恰当的目标、决定会议和总结回顾的步调提供了建议，这些都为公司设定了合适的节奏。还有一个关于招聘的小节，探讨了从建立人才储备到面试流程，再到带领新员工进入角色的种种。书中还有关于提高团队绩效和提供反馈的章节。

《扩展人员》是硅谷的产物。它设法解决超高速增长带来的种种问题，这

源自一个创始人、开发人员和产品团队的世界。对于高度受监管的行业内的老企业或公共官僚机构的雇员来说，规模扩大带来的问题似乎非常遥远。例如，Stripe早年决定举办一场名为“夺旗”的编程竞赛，帮助公司树立了优秀开发者向往之地的声誉。老牌公司用不着这样费力地在潜在候选人中间打开知名度，但若要打造出创新的美名，难度可能要更大些。

但是，这类操作所基于的洞见是相通的，比如在“夺旗”这个例子中，其想法是让求职者在申请过程中就把公司实际需要干的活干了，补充了备用人才库而不是等到有新职位了再找人。而且这本书的大部分内容都是在探讨困扰所有行业和公司的问题。

此外，休斯·约翰逊还传授了如何有效开会的小窍门。这些小技巧包括在会议开始时先来一轮“签到”（例如让每个人都说出他们想从会议中得到什么），这样就能让人们集中注意力，还能让团队中最内向的成员尽早参与进来。她还在其他事情上提供了建议，包括如何做绩效评估、哪些决策可以也应该交给其他人，以及如何避免高绩效员工精疲力竭。这一切都十分务实，令人耳目一新。

这些策略的背后有一个清晰的理念，那就是把秘而不宣的东西摆到明面上。这就意味着要阐明特定的决策将如何做出：是各方协商一致还是一言堂？也意味着要把事情落在纸面上：明确表达了自身的文化，Stripe就可以清楚地向可能想加入它的人传达它的规范是什么。还意味着要谈别人闭口不谈的事，尤其是那些会导致运转失灵的事情。

这也意味着要意识到自己的行为和偏好。休斯·约翰逊长期都保留着一份《与克莱尔共事》的文件，向她团队的新成员清楚地解释了他们该有怎样的心理预期：她喜欢怎样做决定、她回复消息的速度如何，以及她希望在一一对的会谈中从他们那里得到什么。

她的建议并不适合所有人。对于有些企业文化来说，这本书过于强调流程了。但每个老板都能从中得到一些省思。堆在你床头柜上的那些书可能会教你从德约科维奇身上学习领导力，或通过蛋黄酱吸取经验教训，但这本

书试图教给你的事情却有原创性也有用得多：让你成为一个更好的管理者。 ■



Bartleby

“Scaling People” is a textbook piece of management writing

Claire Hughes Johnson has gone long on tactics and pragmatism, short on guff

TOO MANY management books rest on a vague idea that has been stretched to breaking point. You can tell from the depth of the margins just how hard an author has had to work to draw the thesis out. Their covers are bright and zingy. Their titles either contain action-packed words like “strive” and “ignite” or give birth to some ghastly new portmanteau like “stressilience” or “charismility”. They are determined to take lessons for bosses from anywhere but an actual business: termites, hunter-gatherers, Novak Djokovic, salad dressing. The unspoken rule of most management titles, it seems, is to avoid the actual practice of management.

What a relief, then, to read a book that breaks the mould. It lands with an intimidating thud. It looks and feels like a textbook. It is full of exercises and templates. And it is unapologetically practical in its focus. “Scaling People” is written by Claire Hughes Johnson, a tech-industry veteran who spent more than a decade at Google before joining Stripe, a digital-payments unicorn, as its chief operating officer in 2014. By the time she left that role in 2021, the firm had gone from 160 employees to over 7,000. In a world of coders, creators and visionaries, her work was to make things work.

Much of the book is a manual for creating what Ms Hughes Johnson calls an operating system—the set of documents, metrics and processes that produces a consistent framework for making decisions and improving performance. There is a section on planning, with advice on setting good goals and deciding on the cadence of meetings and reviews that sets the right drumbeat for a company. There is another on hiring people, from building a recruitment pipeline to the interview process and the task of

bringing new employees on board. There are chapters on improving team performance and on giving feedback.

“Scaling People” is a product of Silicon Valley. It grapples with the problems of very fast growth; its context is one of founders, developers and product teams. For incumbents in highly regulated industries or employees in public-sector bureaucracies, the problems of scaling up may seem very remote. Stripe’s early decision to run a programming competition called “Capture the Flag”, for instance, helped build its reputation as a place for talented developers to go to. Established firms need to work less hard to create awareness among potential candidates but may have a tougher time building a name for innovation.

But the insights on which such practices are founded—in this instance, getting candidates to do actual work as part of an application process and filling a hiring pipeline rather than waiting for jobs to open up—are transferable. And most of the book is devoted to problems that bedevil all industries and companies.

Among other things, Ms Hughes Johnson gives tips on how to run an effective meeting; these include having a round of “check-ins” at the start (getting everyone to say what they want from the meeting, for instance) so that people are focused and so that the quietest members of the group participate early. She offers advice on how to do performance reviews, which decisions you can and should delegate to other people, and how to save high-performing employees from burnout. It is all refreshingly pragmatic.

Behind the tactics lies a clear philosophy, which is to make the implicit explicit. That means being clear about how specific decisions are going to get taken: is this a consensual process or an autocratic one? It means writing things down: by articulating Stripe’s culture, the startup can be clear to

prospective joiners what the company's norms are. It means saying things that other people are not saying, especially if those things are causing dysfunction.

It also means being aware of your own behaviour and preferences. Ms Hughes Johnson has long kept a "Working with Claire" document that spells out to new members of her team what they can expect: how she likes to take decisions, how quickly she will respond to messages, what she wants from them in a one-to-one meeting.

Her advice will not suit everyone. There will be too much emphasis on process for some corporate cultures. But there is something thought-provoking for every boss. Your bedside table may groan with books on what Mr Djokovic can teach you about leadership or the lessons to be learned from mayonnaise. This book is trying to do something far more original and useful: turn you into a better manager. ■



高坐云端

甲骨文让拉里·埃里森晋身全球第三大富豪

这家软件巨头的连胜势头能否持续？

商业软件公司甲骨文的联合创始人兼董事长拉里·埃里森（Larry Ellison）现年78岁，但依然精力充沛。在6月12日最近一次甲骨文的季度财报电话会议上，这位古稀老人就人工智能（AI）和最新的云计算技术侃侃而谈。他大有理由雀跃兴奋。据追踪全球富豪身家的《福布斯》杂志报道，过去一年，随着甲骨文股价飙升，埃里森的财富暴涨至超过1500亿美元。如今，他已超越亚马逊创始人贝索斯，成为全球第三大富豪。

与埃里森一样，甲骨文可能同被视为美国科技界的“活化石”。这家公司成立于1977年，最初开发数据库软件，后来扩展到财务、销售和供应链管理等业务功能方面的应用。但作为云计算领域的后来者，甲骨文在其核心企业产品上的市场份额近年被积极拓展商业软件产品的亚马逊、谷歌和微软这三家云计算巨头大肆抢夺。根据研究公司高德纳（Gartner）的数据，甲骨文在仍是其主打业务的数据库软件市场的份额从2012年的43%跌到了2022年的19%。

但现在，甲骨文似乎开始扭转颓势。为追赶对手，甲骨文一直大力投资云计算。过去12个月的资本支出达87亿美元，占销售额的17%，而两年前该比例仅为5%。去年，该公司以280亿美元的价格收购了基于云计算的电子病历公司Cerner。这番努力令甲骨文的云产品销售大增，最新一季度同比增长33%，在计入Cerner后增长55%。其销售增速远高于亚马逊、谷歌和微软的云计算部门。甲骨文还棋高一着，抢到了托管TikTok（千百万年轻人爱不释手的中资短视频应用）美国业务的云服务合同。

投资者很满意眼前的成绩。甲骨文的股价在过去12个月上涨了73%，遥遥领先于以科技股为主的纳斯达克指数（见图表）。该公司的市值达到了3300亿美元，成为全球价值第四高的商业软件公司，仅次于微软、谷歌母

公司Alphabet和亚马逊。

甲骨文现在希望在最新的科技热潮中分得一杯羹：支撑ChatGPT及其他内容创作机器人的生成式AI。今年3月，该公司成为首家提供DGX云服务接入的云供应商，DGX云是专门用于训练AI模型的超级计算机，由美国芯片制造商英伟达设计。在最新的财报电话会议上，埃里森宣布，甲骨文还将与它最近入股的AI创业公司Cohere合作推出一项新服务，帮助客户使用自己的数据建立专用生成式AI模型。同时，甲骨文也在逐步把生成式AI功能嵌入自家的各种企业应用中。

但有一个隐患。过去五年，甲骨文通过股票回购向股东返还了1000亿美元现金，令其股本减少了约三分之一。埃里森一直握着自己的那些股份，成为最大受益者之一——在此期间他在甲骨文的股份从28%跃升至42%。为回购股票和投资云计算，公司借下巨额债务，当前净债务已是息税折旧摊销前利润的四倍多（三倍以上被视为存在风险）。实际上，甲骨文的债务现在超过了其资产账面价值，资产负债表上的股东权益为负，这是杠杆过高的危险信号。

目前来看，甲骨文还有时间应对。它的债务为固定利息，意味着基准利率上升对其影响不大。它的公司债券在市场上的收益率为5.7%，但需支付的票息仅为3.8%。而且，其债务中只有五分之一将在未来三年内到期。在最近几个季度，甲骨文已放慢了股票回购，并开始偿还积压的债务。

希望在于过去两年所做的大举投资能给甲骨文带来足够的增长以摆脱债务风险。如果成功，埃里森在世界富豪榜上的排名可能继续攀升。无论如何，甲骨文还不会灭绝。 ■



Ahead in the clouds

Oracle is making Larry Ellison the world's third-richest man

Can the software giant's winning streak last?

AT 78 LARRY ELLISON, co-founder and chairman of Oracle, is still brimming with energy. During the business-software firm's latest quarterly earnings call on June 12th the septuagenarian rhapsodised about artificial intelligence (AI) and the latest cloud-computing technology. He has good reason to be in high spirits. Over the past year Mr Ellison's wealth has rocketed to more than \$150bn, according to Forbes, a magazine that tracks such things, on the back of Oracle's soaring share price. Mr Ellison has now edged past Jeff Bezos, the founder of Amazon, as the world's third-richest man.

Like Mr Ellison, Oracle might be regarded as a dinosaur of American tech. It began life in 1977 as a database-software business, later expanding into applications for business functions such as finance, sales and supply-chain management. As a latecomer to the cloud, however, Oracle has in recent years ceded market share in its core enterprise products to Amazon, Google and Microsoft, three cloud giants that have aggressively expanded their business-software offerings. Oracle's slice of the database-software market, which remains its bread and butter, fell from 43% in 2012 to 19% in 2022, according to Gartner, a research firm.

Now the business seems to be turning a corner. To catch up with rivals, Oracle has been investing heavily in cloud computing. Capital expenditures in the past 12 months added up to \$8.7bn, or 17% of sales, up from just 5% two years ago. Last year it acquired Cerner, a cloud-based health-records business, for \$28bn. The upshot has been significant growth in sales of its cloud-based products, which were up by 33% year on year in the most

recent quarter, or 55% after including the Cerner acquisition. These sales have grown much faster than the cloud divisions of Amazon, Google and Microsoft. Oracle also outwitted them to snatch the cloud contract to host the American operations of TikTok, a Chinese-owned short-video app to which millions of youngsters are glued.

Investors like what they see. Oracle's share price has risen by 73% in the past 12 months, well ahead of the tech-heavy NASDAQ index (see chart). The company's market value is \$330bn, making it the world's fourth-most-valuable business-software provider, behind only Microsoft, Alphabet (Google's corporate parent) and Amazon.

Mr Ellison's company is now hoping to cash in on the latest craze in tech: generative AI of the sort that powers ChatGPT and other content-creating bots. In March it became the first cloud provider to offer access to the DGX Cloud, a supercomputer designed by Nvidia, an American chipmaker, specially for training AI models. During the latest earnings call Mr Ellison announced that Oracle will also be launching a new service with Cohere, an AI startup in which it recently took a stake, to help clients use their own data to build specialised generative-AI models. Meanwhile, the firm is embedding generative-AI features into its various business applications.

There is one potential snag. Over the past five years Oracle has returned \$100bn in cash to shareholders through share buy-backs, reducing its share count by around a third. Mr Ellison, who has held onto his shares, has been among the biggest beneficiaries—his slice of the company jumped from 28% to 42% in the period. To fund those repurchases, and its cloud investments, the company has taken on hefty debts. Its net debt is now more than four times its earnings before interest, tax, depreciation and amortisation (a figure above three is considered risky). Indeed, the firm's debts now exceed the book value of its assets, leaving it with negative shareholder equity on its balance-sheet, a telltale sign of dangerously high

leverage.

For now, the company has time on its hands. Fixed interest on its debts means it has suffered little from rising benchmark rates. Its corporate bonds are priced by the market at a yield of 5.7%, but require coupon payments of only 3.8%. And just one-fifth of its debt will mature in the next three years. In recent quarters it has slowed share repurchases and started to chip away at its debt mountain.

The hope will be that the heavy investments made in the past two years will allow the company to grow out of its debt. If it pays off, Mr Ellison may continue his climb up the world's rich list. Either way, Oracle is not about to go extinct. ■



外展规训

美国计划审查对华投资

美国政府以国家安全为由考虑收紧对外投资的监管

关于美国公司对华投资的监管规则蒙上了一层迷幻色彩：总是呼之欲出，又总是引而不发。近几个月来，对这一话题的讨论变得紧锣密鼓起来。3月，美国财政部和商务部提交了规则草案的报告。4月，总统拜登的国家安全顾问杰克·沙利文（Jake Sullivan）在一次演讲中对该政策的出台发出了预告。预计接下来拜登将发布一项行政令。美国的盟友也在酝酿类似的限制措施。6月20日，欧盟委员会宣布（尽管言辞含糊）计划于年底前提出一项议案。

拜登的行政令如果真的落地，很可能聚焦于对三项“威力倍增型”技术的投资：先进半导体、人工智能（AI）和量子计算。禁令和通报义务的具体安排尚不清楚，但这些规定只会影响美国对中国公司投资（截至2021年底总规模超过1万亿美元）的一小部分。根据研究公司荣鼎咨询（Rhodium Group）的数据，在过去十年中，美国公司在中国的外国直接投资为1200亿美元，风险投资为620亿美元（见图表）。

因地缘政治对美国资本踩刹车并不是全新的想法。与中国军方有关联的部分公司已经被划为投资者的禁区，而《芯片法案》（CHIPS Act）规定，接受法案补贴的公司不得做出可能有利于中国半导体行业的投资。支持者表示，对外投资规则是美国分散的贸易限制措施的必要延伸：如果出口管制不允许中国公司购买某些军民两用技术，而对外来投资的审查又不允许中国公司收购拥有这些技术的美国公司，那么也不应该允许美国资本为中国芯片技术的发展提供资金。

为踏遍全球的美国投资者设限是有风险的。其一是制定的规则可能过于宽泛，限制了资本流动，在没有正当理由的情况下给投资者造成负担。美国财政部官员保罗·罗森（Paul Rosen）5月表示，新规将关注“那些伴有技术

诀窍和专长的投资”。欧洲领导人表示，有必要采取限制措施以防“技术诀窍泄露”。但要弄清楚哪些投资会泄密是件棘手的事。如果一家科技巨头打算在中国扩大其先进的计算业务，那想来会违反这一标准，但如果是一家投资公司（以及其最终投资人），事情就没那么简单明了了。私募股权基金收购一家公司时未必会提供任何运营优势，而一笔小额风险投资却可能附带值得保护的技术专长。

根据智库安全与新兴技术中心（Center for Security and Emerging Technology）的数据，2015至2021年，包括芯片制造商英特尔和高通的风投部门在内的美国投资者参与了中国AI公司的几轮融资，占这些公司1100亿美元融资总额的37%。追求回报的美国养老基金也成为此类投资的受益者。例如纪源资本（GGV Capital），PitchBook的数据显示该公司是中国AI公司最活跃的美国投资者之一。我们对公开披露信息的分析表明，过去十年里，总资产超过6000亿美元的六家美国养老基金和捐赠基金向纪源资本的基金出资约20亿美元。

这类投资带来的国家安全风险尚无定论。而如果美国投资者受到限制，中国投资者是否无论如何也会替代它们出资也同样没有答案。资产管理公司和养老基金通常持有数百个全球投资基金的敞口，一些人认为，在要求它们在其投资组合中查找中国科技公司的踪迹之前，拜登政府应该给出更确定的答案。

另一个危险是使命偏离。在拜登政府的领导下，经济政策和国家安全政策变得越来越难以区分。作为美国外来投资的监管机构，美国外国投资委员会（CFIUS）近年来积压的案件数量激增。而去年，拜登指示CFIUS在审查中考虑更多因素，包括供应链韧性。根据宽泛的国家利益标准来审查对外投资可能会变得大而无当。出于对投资官僚化的担忧，一些人建议不如使用现有的制裁规则。

预计拜登最初的对外投资政策触角有限，远远称不上“反向CFIUS”，但白宫之外不乏鹰派人士，他们把对外投资审查视为一种产业政策工具。2021年，一批两党国会议员提出了一项要求排查对外投资的法案。该提案牵扯

广泛，据荣鼎咨询估计可能会影响美国超过40%的对华投资。今年5月该提案的一个更新版本发布，不仅要对先进技术领域的投资设限，还延伸至汽车制造和制药等行业，并赋予白宫扩大清单的权力。

贸易限制的激增并不止于美国境内。拜登行政令迟迟不出，有人认为这是由于在盟国之中难以形成对新规则的支持。七国集团的首脑峰会在5月召开后，在这个问题上只留下了无力的承诺。全球很少有国家限制对外投资，但对内投资的审查正在迅速增多。欧洲正在加强保护措施：欧盟27个成员国中有18个有此类规定，涵盖越来越多样化的“战略性”行业。欧盟委员会制定对外投资规则的计划可能会加剧繁冗的官僚程序。

西方在华投资所受到的影响取决于这些规定的最终范围。美国的投资水平已经在下降。流入中国的风险投资在2018年达到峰值，至今已骤减超过80%。随着中国商业环境的恶化，目前尚未出现逆转的迹象。6月，美国大型风投公司红杉资本（Sequoia）宣布将在2024年前剥离其中国业务。就目前而言，鹰派政策制定者可以放心，他们的工作正由中国代劳。■



Outward bound

America's plan to vet investments into China

Citing national security, America's government considers tighter rules on outbound capital

RULES TO POLICE investment by American firms in China have acquired a phantom quality: always imminent, always delayed. In recent months the steady beat of debate on the topic has quickened to a drumroll. In March America's Treasury and Commerce Departments delivered reports on potential rules. The next month Jake Sullivan, President Joe Biden's security adviser, trailed the policy in a speech. An executive order from Mr Biden is expected to follow. America's allies are mulling similar restrictions. On June 20th the European Commission announced plans, albeit vague ones, to propose an initiative by the end of the year.

When Mr Biden's executive order does appear, it is likely to focus on investments in three “force-multiplying” technologies: advanced semiconductors, artificial intelligence (AI) and quantum computing. The exact permutation of prohibitions and notification requirements remains unclear, but the rules will affect only a sliver of American investments in Chinese firms, which were worth more than \$1trn at the end of 2021. According to data from Rhodium Group, a research firm, American firms made \$120bn of foreign direct investment in China and \$62bn of venture-capital (VC) investment during the past decade (see chart).

Geopolitical brakes on American capital are not an entirely new idea. Some companies with ties to China's military are off-limits to investors and the CHIPS Act bars firms that receive its subsidies from making investments that could benefit China's semiconductor industry. Advocates say outbound-investment rules are a necessary extension to America's

patchwork of trade restrictions: if export controls prevent Chinese firms from buying some dual-use technologies and inbound-investment screening stops them snapping up American firms that make them, American capital should not be allowed to fund the technology's development in China.

Placing limits on America's globetrotting investors comes with risks. One is writing over-broad rules which limit capital flows and burden investors without good reason. Paul Rosen, a Treasury official, said in May that the rules would focus on "investment dollars that come with know-how and expertise". European leaders say restrictions are needed to prevent "know-how leaking". But figuring out what sorts of investment are leaky is tricky. A tech giant hoping to expand its advanced-computing efforts in China would presumably fall foul of this standard, but the case of investment firms, and their ultimate investors, is less straightforward. A private-equity fund might acquire a company but offer no operational advantage, whereas a small VC investment could come with technical expertise worth protecting.

According to the Centre for Security and Emerging Technology, a think-tank, in 2015-21 American investors, including the VC arms of chipmakers Intel and Qualcomm, participated in funding rounds that accounted for 37% of the \$110bn raised by Chinese AI companies. American pension funds' appetite for returns has made them beneficiaries of such investments. Consider GGV Capital, one of the most active American investors in Chinese AI companies, according to data from PitchBook. Our analysis of public disclosures suggests that six American pension funds and endowments with combined assets exceeding \$600bn have committed around \$2bn to GGV Capital's funds in the past decade.

The national-security risk presented by such investments is an open question. So is that of whether Chinese investors could in any case replace the funding if American investors were restricted. Some feel the Biden

administration should provide firmer answers before it requires asset managers and pension funds, which are typically exposed to hundreds of global investment funds, to search for traces of Chinese tech companies in their portfolios.

Another danger is mission creep. Under Mr Biden, economic and national-security policy have become increasingly indistinguishable. Last year the president directed the Committee on Foreign Investment in the United States (CFIUS), the American inbound-investment watchdog, which has seen its caseload explode in recent years, to consider wider factors including supply-chain resilience. Scrutinising outbound investments on the basis of broad standards of national interest could become unwieldy. Fears of a growing investment bureaucracy have led some to suggest using existing sanctions rules instead.

Though Mr Biden's initial policy on outbound investment is expected to be narrower than anything that could be called a "reverse-CFIUS", there is no shortage of hawks outside the White House who imagine outbound-investment screening as a tool for industrial policy. In 2021 a bipartisan group of congressmen introduced a bill to screen outbound investment broad enough to have affected more than 40% of American investment in China, according to Rhodium Group. Last month an updated version of the bill was released. It would establish restrictions on investments not just in advanced technology but in industries including carmaking and pharmaceuticals, and give the White House the authority to expand the list.

The proliferation of trade restrictions does not stop at America's borders. Some attribute the delay in Mr Biden's executive order to trouble gathering support for new rules among allied countries. The Group of Seven (G7) jamboree of world leaders came and went in May with only a milquetoast commitment on the issue. Few countries globally place any restrictions on outbound investment, but screening of inbound investment is increasing

rapidly. Europe is beefing up its protections: 18 of the EU's 27 members have such rules, covering an increasingly diverse list of "strategic" sectors. The commission's plans for outbound-investment rules threaten a growing tangle of red tape.

The effect on Western investment in China depends on the eventual scope of any rules. American investment is already falling. VC flows to China have plummeted by more than 80% since their peak in 2018. As the business environment in China worsens, there is no sign of a reversal. Last month Sequoia, a big American VC firm, announced that it would split off its Chinese business by 2024. For now, hawkish policymakers can rest assured that China is doing their job for them. ■



生长的生意

瑞典想用木头建造一整座城市

现代木质建筑经济、环保，还防火【新知】

全球都在竞相建造最高的木质摩天大楼。挪威85米高的Mjostarnet大厦曾经把持这一纪录，它位于米约萨湖（Lake Mjosa）畔，内有公寓、一家酒店和一个游泳池。这一纪录被美国威斯康星州于2022年7月竣工的87米高的Ascent大楼刷新。不过纪录还是会被不断打破：加拿大安大略省计划建造一座90米高的木质大厦；瑞士计划造一座100米高的。（给个参照物：伦敦圣保罗大教堂的高度是110米。）

不过，近日一家瑞典公司宣布它要创造一项与众不同的纪录。它计划建造一座可能是世界上最大的木制城市——“斯德哥尔摩木城”（Stockholm Wood City）。它将在瑞典首都南部的斯卡拉（Sickla）区域建造，占地25万平方米，于2025年开建，预计工期十年。完工后的木城将拥有2000栋房屋、7000间办公室，还有餐馆和商店等。项目耗资120亿克朗（14亿美元），由瑞典城市开发公司Atrium Ljungberg牵头实施。

该公司老板安妮卡·阿纳斯（Annica Anäs）表示，通过使用木材，有望将该项目的碳足迹相比使用混凝土和钢材减少40%。木材是能从可再生的森林获取的可持续材料，而瑞典拥有丰富的森林资源。当用于建筑时，木材锁住了树木在生长过程中从大气中吸收的二氧化碳。与其他使用木材的现代建筑项目一样，木城在地基等地方仍会使用一些混凝土和钢材，但总量会大大减少。而由于木质建筑重量轻得多，需要的地基也可能更小。

和现有的木质摩天大楼一样，瑞典的木城也将使用大型预制构件——它们由所谓的“工程木材”制成。有别于普通的木材、刨花板或者胶合板，工程木材是一种复合木材，其中各层以特定的方式压合在一起。每一层的木纹方向都一致，可为建筑的独立部件（如地板、墙壁、交叉支撑和横梁等）提供极高的强度。由于这些部件可以在工厂制造，其公差比在建筑工地制

造的更小，也更容易保证品控，因此使用预制构件不仅能减少原材料的运输量，还能加快施工进度。

用木材建造建筑还有一个好处，就是施工时不会有使用混凝土和砖块那样大的噪音，阿纳斯补充道。这让木质建筑通常特别适合于城市改造，因为建造它们不太可能因动静太大而扰民。它也应该有利可图。阿纳斯希望获得20%或更高的投资回报率。“在木质建筑这一块，瑞典走在了前面，”她说，“但我想不到有什么原因让它在别的地方行不通。”

大多数人对木质建筑的最大担忧是起火风险。木城的每座建筑都会像混凝土或砖砌建筑那样配备好几个防火系统，比如喷淋装置和阻燃层等。

与此同时，研究人员认识到工程木材本身就具有极好的耐火性。为了让Ascent大楼获得建设许可，美国国家森林局（US Forest Service）曾对它将要使用的层压木柱做耐火测试。结果发现这些柱子结构依然完整，很难燃烧，认定它们具备出色的三小时耐火等级。

如果没有持续的热源，大块木材表层的炭化会保护其内部结构——不信的话，你可以试试能不能只用大根原木点燃篝火。在过去许多城市大火中，如1666年的伦敦大火，加剧火势的大多是充当了引火物的小块木材。因此，如果用木头盖房子，最好还是“大”字当头。■



Growing business

Sweden wants to build an entire city from wood

Modern timber buildings can be cheap, green and fireproof

THERE IS A global race to build the tallest wooden skyscraper. The record was held by Mjostarnet, an 85-metre tower on the shore of Lake Mjosa in Norway, which hosts flats, a hotel and a swimming pool—until Ascent, an 87-metre structure, was completed in Wisconsin in July 2022. And it will be put in the shade in turn by other buildings: a 90 metre tower is planned for Ontario, and a 100 metre one for Switzerland. (By way of comparison, St Paul's cathedral in London is 110 metres tall.)

This week, though, a Swedish firm announced it was going for a different sort of record. It unveiled plans to build what could be the world's biggest wooden city. Stockholm Wood City will be built in Sickla, an area in the south of the Swedish capital. Construction on the 250,000 square-metre site will begin in 2025. When complete, ten years later, it will contain 2,000 homes and 7,000 offices, along with restaurants and shops. The 12bn-krona (\$1.4bn) project is led by Atrium Ljungberg, a Swedish urban development company.

By using wood the company hopes to reduce the project's carbon footprint by up to 40%, compared with building in concrete and steel, says Annica Anäs, the company's boss. Wood is a sustainable material that can be produced from renewable forests, which Sweden has in plenty. When used for building, it locks up the carbon that the trees absorbed from the atmosphere while growing. As with other modern construction projects using timber, Wood City will still use some concrete and steel in places like the foundations, but the overall amounts will be greatly reduced. As wooden buildings are much lighter, their foundations can be smaller.

The Swedish project will, as existing wooden skyscrapers do, employ large prefabricated sections made from what is called “engineered timber”. Instead of ordinary lumber, chipboard or plywood, engineered timber is a composite in which layers of wood are laminated together in specific ways. The wood grains in each layer are aligned to provide individual components of the building, such as floors, walls, cross braces and beams, with extremely high levels of strength. And because these parts can be manufactured in a factory, where tolerances are finer and quality control is easier to maintain than on a building site, the use of prefabricated sections cuts down on the delivery of raw materials and allows construction to proceed more quickly.

Another advantage is that construction will not be as noisy as it would be if the town were built from concrete and bricks, adds Ms Anäs. This makes wooden buildings particularly suitable for urban redevelopment in general, since putting them up is less likely to annoy the neighbours. It should also be profitable. Ms Anäs is looking for a return on investment of 20% or better. “Sweden is progressive when it comes to wood construction,” she says. “But I don’t see any reason why it shouldn’t work elsewhere.”

The biggest concern most people have about wooden buildings is the risk of fire. The buildings in Wood City will be fitted with several fire-protection systems, such as sprinklers and flame-resistant layers, as would also be found on their concrete or brick counterparts.

At the same time, researchers are coming to believe that engineered timber is, by its nature, extremely fire resistant. To help win approval for the construction of the Ascent building, the US Forest Service carried out tests on the laminated timber columns it would use. After finding them difficult to burn, the columns were awarded an exemplary three-hour fire-resistance rating because they maintained their structural integrity.

Without a sustained heat source the charring of the outer layer of a big piece of timber protects the structure inside—try lighting a camp fire when you only have logs. Many of the large urban fires of old, like the Great Fire of London in 1666, were mostly fuelled by small sections of timber acting as kindling. So when it comes to building in wood, it is best to think big. ■



兜圈子

俄罗斯原油的买家正向西方出口成品油

限价令为中间商创造了机会

对俄罗斯石油工业实施制裁的西方国家不得不小心拿捏分寸。俄罗斯售出的每一桶石油都会帮助它支持在乌克兰的战争开支，但若出口大幅削减又将导致油价飙升，推高其剩余产出的价值。

为避免这种风险，由发达经济体组成的七国集团于去年9月宣布了一道限价令：在其司法辖区内的保险公司和海运公司只有在俄罗斯石油价格低于规定水平时才可以为之提供服务。这个“价格上限联盟”（包括欧盟和澳大利亚）内的公司构成全球海运服务的主力。该限价令于12月生效，价格上限为每桶原油60美元，比市场价格低30%。

2月5日，这些国家为柴油等价值高于原油的石油产品设定了每桶100美元的新价格上限，又把燃料油等较便宜产品的价格上限定为每桶45美元。欧盟也和其他西方国家一道，禁止从俄罗斯进口这类商品。

乍一看，这些规则似乎扰乱了俄乌战争爆发前的贸易路线，令中国和印度取代欧盟和七国集团成为俄罗斯海运石油的主要接收国。但智库能源与清洁空气研究中心（Centre for Research on Energy and Clean Air）近期的一份报告表明，实际变化并没有那么剧烈，因为新买家可能还是会把这些石油精炼后再卖给西方。

该报告点名中国、印度、新加坡、土耳其和阿联酋是俄罗斯石油的“洗衣店”。在俄乌战争的第一年，这些国家进口的俄罗斯原油比前一年增加了140%（7730万吨，价值500亿美元）。它们对限价国家的成品油出口量也上升了26%（1030万吨，价值195亿美元），而对其他地区的出口量仅上升了2%。

这些“洗衣店”不一定是在向西方出售由俄罗斯原油制成的产品。它们可以

轻易使用其他来源的石油制成成品油出口，从而弥补俄罗斯石油供应的不足。但总的来说，禁令和限价令并未阻止俄油为西方经济提供动力，却为中间商创造了机会。

这不意味着限价令没有用。只要能削减俄罗斯的利润，它就起到了作用。而新规则确实给俄罗斯带来了额外成本。把石油运往中国再运往欧洲，这个过程就要耗费大量石油。炼油厂要针对不同等级的原油调整生产。要规避限价令需要寻找非西方的油轮和保险公司提供服务，一切得重新谈，价格也可能较高。

然而，这些成本难以衡量。尽管数据追踪公司报告称，俄罗斯的乌拉尔原油售价比全球基准布伦特原油每桶低25至35美元，但俄罗斯对印度等国家的石油销售记录揭示的售价要高得多。俄罗斯还通过管道向中国输送石油，不受限价令的影响。

俄罗斯官方数据显示其石油产量比战前预测低8%，今年第一季度的收入同比下降40%。但一些交易俄罗斯石油的公司可能与俄政府有关联，它们的额外收入仍离普京不远。另外，假如全球油价反弹，60美元的价格上限将愈发难以执行。

图表资料来源：能源与清洁空气研究中心；Kpler；睿咨得能源；
bruegel.org ■



What goes around comes around

Buyers of Russian crude are exporting refined oil to the West

The price-cap scheme has created opportunities for middlemen

WESTERN COUNTRIES imposing sanctions on Russia's oil industry have had to thread a needle. Every barrel the country sells helps finance its war in Ukraine. But a sharp cut in Russian exports would send prices surging, raising the value of Russia's remaining output.

Seeking to avoid this risk, the G7 group of big economies in September announced a price cap. This lets insurers and shippers under their laws deal in Russian oil only if it is priced below a given level. Firms in the "price-cap coalition", which also includes the EU and Australia, make up the bulk of global maritime-services capacity. The cap took effect in December at \$60 a barrel of crude oil, 30% below the market price.

On February 5th the countries set new limits of \$100 for oil products worth more than crude, like diesel, and \$45 for those that are cheaper, like fuel oil. The EU, joining other Western countries, also banned imports of such goods from Russia.

At first glance, these rules seem to have scrambled pre-war trade routes, with China and India replacing the EU and G7 as the main recipients of Russia's seaborne oil. But a recent report by the Centre for Research on Energy and Clean Air, a think-tank, suggests that the real change is not so drastic, because the new buyers may still sell the oil to the West after refining it.

The report designates China, India, Singapore, Turkey and the United Arab Emirates as "laundromats" for Russian oil. Together, during the war's first year the volume of their imports of Russian crude climbed by 140% (77.3m

tonnes, worth \$50bn) from the previous year. Their exports of refined oil products to price-cap countries also rose in volume by 26% (10.3m tonnes, worth \$19.5bn), compared with just 2% to other destinations.

The laundromats are not necessarily selling products made from Russian crude to the West. They could easily use oil from other sources to generate refined exports, and make up for the shortfall with Russian supplies. But on net, bans and price caps have not stopped Russian oil from powering Western economies. They have just created opportunities for middlemen.

This does not mean that the cap is failing. As long as it cuts Russian profits, it is doing its job. And the new rules do impose costs on Russia. Shipping oil to China and then to Europe burns a lot of it in the process. Refiners have to adjust to new grades of crude. And dodging the price cap requires new, possibly unfavourable deals with non-Western tankers and insurers.

However, these costs are hard to measure. Although tracking firms report that Russia's Urals crude sells for \$25-35 a barrel below the global Brent benchmark, records of sales to countries such as India reveal much higher prices. Russia also ships oil to China via pipelines, avoiding the price cap.

Official Russian figures show oil production 8% below pre-war forecasts, and revenues in the first quarter of 2023 down 40% year-on-year. But some of the firms handling Russian oil may have Kremlin ties, keeping additional income close to Mr Putin. And if global oil prices rebound, the \$60 cap will prove ever harder to enforce.

Chart sources: Centre for Research on Energy and Clean Air; Kpler; Rystad Energy; bruegel.org



崛起中的大象

印度经济影响力日增促使美国示好

但仅凭年轻的劳动人口可能不足以维持经济快速增长【深度】

印度总理莫迪在6月底访问美国。很少有出访者能像他一样，在华盛顿受到如此高规格的欢迎。美国总统拜登将在白宫为他举办正式宴会。国会参众两院的领导人也不甘示弱，邀请他第二次在两院联席会议上发表演讲——此前只有丘吉尔等人获此殊荣。用白宫新闻发布会上的溢美之词来说，此次访问将是对“美印之间深厚而密切的伙伴关系的确认”。

事实上，印度和美国的伙伴关系从未这般深厚或密切。不过这样的关系却是美国的共和、民主两党的领导人所乐见的。他们视印度为与中国的竞争中不可或缺的帮手。毕竟，印度不久前刚成为世界上人口最多的国家。近来它的外交政策变得更强硬，对中国也更敌对，尽管它仍然反对由美国主导世界秩序。它的侨民人数为世界之最，且影响力非同一般。但印度的吸引力还在于，人们认为它可能终于要发挥自己的经济潜力了。如今它已是世界第五大经济体。莫迪承诺要实现足够的经济增长，让印度成为世界经济的支柱，与美国、中国或欧盟并驾齐驱。尽管他的政府在经济管理上有诸多失策，这并非一个不可实现的目标。

莫迪的副手们认为，得益于年轻的劳动人口、强有力的产业政策，以及西方公司对中国的警惕心骤生所带来的机遇，印度经济将会蓬勃发展。许多商界大腕也认同这一点。苹果不久前刚在印度开设了第一家门店，其老板蒂姆·库克5月对投资者宣称：“印度市场生气勃勃，这种活力令人难以置信……印度正处于一个转折点。”几天后，富士康耗资五亿美元的工厂在印度破土动工。印度第一季度GDP同比增长6.1%。投资占GDP的比重达到了十多年来最高的水平。

但也不乏怀疑的声音。有人指出任人唯亲和保护主义阻碍经济发展，还有人吐槽不可靠的统计数据夸大了增长。印度在新冠疫情期间遭受重创，给

穷人造成了持久的苦难。西方人将莫迪对民主规范的侵蚀和日益加剧的宗派主义视为经济增长的潜在威胁。而中国官员则认为印度还不够威权。今年3月，笔者就曾听到一位中国官员面对来自世界各地的老板们发言说，印度之所以没能打造出有吸引力的营商环境，是它的语言种类繁多、多级立法体制和工人受教育程度低造成的。

但是，印度要成为世界经济的支柱，并不需要所有这些问题都能奇迹般得到改善。它只需要大致保持目前的增长速度。高盛预计印度的GDP将在2051年超过欧元区，在2075年超过美国（见图表1）。该预计假设印度未来五年的增长率为5.8%，在2030年代为4.6%，再往后则更低。

高盛的信心有一部分来自人口结构。中国和欧盟的劳动力因人口老龄化而在萎缩。而成员主要为富裕国家的经合组织（OECD）预测，印度的劳动力增长将持续到2040年代末。在高盛对未来五年印度经济年增速的预测中，不断壮大的劳动力贡献了足足一个百分点。然而，印度仍然会相对贫穷。即使到2075年，印度的人均产出也将比中国低45%，比美国低75%左右。

1700年时，印度是世界上最大的经济体，甚至超过了中国。但在整个殖民时期，印度在全球产出中的份额不断下降，在一场金融危机后的1993年，其占比以市场汇率衡量跌到了有失颜面的低点——只有1%。不过自那以后，印度经济迅速增长，在2014年莫迪当选后仍然保持了这一势头。印度目前占全球GDP的3.6%，相当于2000年的中国。国际货币基金组织预测，到2028年，这一比例将达到4.2%，超过德国和日本。印度其他方面的影响力也在增加：它是仅次于美国、中国和日本的世界第四大股票市场。它的商品和服务年出口占GDP的比重接近历史最高水平。在过去十年里，它们增长了73%，印度占全球商品和服务出口的份额也因此从2012年的1.9%上升到2022年的2.4%。

在莫迪及其前几任领导人的治理下，印度的交通基础设施大为改善。与2010年代中期相比，这方面投资占GDP的比重增加了两倍多。自2014年以来，公路网络总里程增加了约25%，达到600万公里。机场数量翻了一

番，其中许多新机场堪比发达国家最豪华的机场。数字基础设施也蓬勃发展，截至去年印度宽带用户达到8.32亿，从电子银行到福利支付的一系列由政府资助的数字服务覆盖了数亿人。能源基础设施也在扩建中：据彭博新能源财经（Bloomberg New Energy Finance）报道，印度在2023年的新增太阳能发电产能将为世界第三高，仅次于美国和中国。

作为一个发展中经济体，印度对服务业的依赖程度异乎寻常地高：服务业出口额约占其出口总额的40%（见图表2）。这使得印度成为全球第七大服务业出口国——占全球服务业出口总额的4.5%，而十年前这一比例为3.2%。自新冠疫情爆发以来，印度的大型科技服务公司一直处于迅猛发展期，它们求贤若渴，打磨其行销全球的软件。印度还通过自己庞大的侨民与硅谷建立联系，这有助于它保持创新步伐，并支持新兴的创业文化。

问题在于，IT服务业虽然给印度带来了2000多亿美元的巨额出口收入，但它直接雇用的员工仅约500万人。实际上，在印度超九亿的劳动年龄人口中，只有约一半参与劳动力市场，而大约6000万人有正式工作。解决这个问题的一个方法是通过发展制造业来创造更多的蓝领岗位。而这也是印度三十年来的一个政策决策要点。

莫迪提出“印度制造”的口号来推动制造业的发展，目的是抓住西方公司将供应链迁出中国以实现多元化的需求。印度的基础设施已经改善，它提供了一个相当大的国内市场，还拥有大量潜在劳动力。国际货币基金组织4月的一项研究报告指出，如果供应链因为地缘政治分歧而撕裂，印度将是为数不多的受益地区之一。为此，莫迪在2020年推出了一项330亿美元的补贴计划，采用“生产挂钩激励”（PLI）措施，在从制药到太阳能电池板生产的14个行业里，奖励销售额达到一定目标的企业。

一些制造部门正在蓬勃发展：机械、电子产品、汽车及其零部件的出口在过去五年中增长了63%，如今占到印度所有商品出口的五分之一。据彭博报道，苹果7%的手机在印度组装。包括塔塔集团（Tata Group）在内的印度企业集团正在投资生产电子产品。然而，尽管PLI已经促成了大量投资公告，但迄今为止实际到位的资本可能不到100亿美元。一些报道称，一

个在古吉拉特邦（Gujarat）投资190亿美元建设半导体工厂的大型项目已经陷入停滞。

去年最后一个季度，印度制造业同比只增长了4.5%，占GDP的17%，仅略高于过去十年的平均水平。自2019年以来，印度的商品出口增长（按价值计）约三分之一源于对俄罗斯石油购买的持续增加，其中一些石油在印度精炼后再出口到其他地方。越南争取到的从中国转移出来的制造活动要多于印度——印度在全球商品出口中的份额仅小幅上升，从2012年的1.6%上升到2022年的1.8%。总之，尽管印度制造业可能会继续稳步增长，但并没有迎来大爆发。

这种不同寻常的增长模式可持续吗？该模式的一些基本元素，包括充足的劳动力、强大的精英教育、创业文化以及与有影响力的海外侨民的有益联系等，看起来肯定会持续下去。莫迪有望在明年赢得第三个任期。这将在中央层面为经济决策提供连续性，尤其是在重金投入基础设施方面。与美国更密切的关系也有利于印度经济，毕竟美国是印度许多出口服务的买家。而由于银行系统相对封闭，印度将继续依赖西方的网络进行跨境支付。

与此同时，过去金融不稳定的顽疾似乎不再有那么大的风险。银行系统已经得到整顿，企业债务水平低。与中国一样，印度拥有大量外汇储备。它还禁止外国投资进入其银行和政府债券市场，以降低资本外逃影响金融稳定的风险。今年1月，做空机构对一家背景深厚的企业集团阿达尼集团（Adani Group）的攻击暴露了印度资本市场的缺陷，比如不透明的公司治理等，但同时也显示出其资本市场具有一定的韧性：它们对这一事件不以为意。

但有三个威胁确实笼罩印度经济。首先，IT服务业的繁荣可能后劲不足。印度公司拥有大量熟练劳动力储备，因此采用了劳动密集型模式。但包括人工智能在内的新科技可能会破坏这一战略。为做好准备，该行业开始谋求多元化发展，进军数据科学等新领域，通常是通过“全球能力中心”为外国公司提供服务。此外，印度也在扩展会计和咨询服务：上个季度，印度

的非科技业服务约占其所有服务出口的五分之一。

第二个风险是，莫迪对国内领军企业的扶持和对法院等机构的侵蚀可能会开始吓退外国投资。许多中国科技公司被封杀。长期以来，跨国公司不得不小心应对印度变化多端的关税、法规和税收。现在它们越来越觉得有必要与印度本土大公司达成协议：欧洲水泥公司豪瑞（Holcim）将其印度分公司出售给了阿达尼；Meta投资了拥有大型数字部门的信实工业公司（Reliance Industries）。

流入印度的外国直接投资总额从过去几年每月平均约70亿美元，放缓到今年2月和3月的50亿美元以下，对不公平的竞争环境的担忧或许是原因之一。其他迹象也显示出外国大投资者的踌躇不决。本刊调查了在印度最活跃的四家全球性银行在那里的风险敞口，它们通常为跨国公司提供服务。它们对印度的敞口（以美元计）在2022年平均下降了11%。

但印度政府可能认为，从更长远看，印度庞大的市场足以吸引西方公司，无论游戏规则有多扭曲。西方公司在印度的子公司的销售额接近2500亿美元。根据本刊对央行数据的分析，过去五年，在印度的所有跨国公司的利润增长了80%，达到560亿美元。这足以抵消很多令人头痛的事情。

最后一个风险是，印度不露声色的“涓滴”经济学战略可能会引发民众反弹。它依靠的不是制造业工作，而是来自规模相对较小的正规行业的财富在整个经济中流动，以让更多往往受教育程度低下的人口受益。这种战略并不一定是空中楼阁：例如，给富人建造更多的住房带动了建筑业的快速发展，从而吸引了非技术型工人。强化涓滴经济学一直是莫迪的一项重要工作。政府已经强制要求众多小公司开始纳税，以推动它们合并、正规化和开展投资。印度的数字福利计划提高了向穷人提供援助的效率，并可用于更大规模的收入补贴。

尽管如此，行政管理和技术上的进步可能不会让那些受教育不足的人口成为更富生产力的工人。而如果印度庞大的未充分就业人口的抱负不能得到至少部分满足，印度的经济增长很可能就会受挫。即使大范围的社会动荡

得以避免，也可能是因为政客们试图满足民众或转移他们的挫败感，实际上却于事无补。莫迪的经济现代化结合了非自由主义和宗教沙文主义。为平息无业者的怨愤，他和他的继任者可能还会变得更高压和宗派主义。公众舆论也可能转向反对经济开放。而印度正在亲近的那些西方国家看到这样的事态走向可能会望而却步。印度的经济崛起是真真切切的，也可能会持续下去，但并非没有陷阱。 ■



The elephant in a boom

America is courting India in part for its growing economic clout

But a young population may not be enough to sustain rapid growth

FEW VISITORS can expect the sort of welcome Narendra Modi, India's prime minister, will receive in Washington later this month. Joe Biden, America's president, is throwing a formal banquet for him at the White House. The leaders of the two chambers of Congress, not to be outdone, have invited him to address a joint session for the second time—an honour previously accorded only to the likes of Winston Churchill. The visit will, in the words of a gushing White House press release, "affirm the deep and close partnership between the United States and India".

In fact, the partnership between India and America has never been that deep or close. But America's leaders, both Republican and Democratic, would like it to be. They see India as an indispensable accomplice in their rivalry with China. After all, India recently became the world's most populous country. Its foreign policy has become more assertive and more hostile to China of late, even if it remains opposed to the idea of an American-led order. Its diaspora is the world's biggest, and remarkably influential. But India's allure also rests on the sense that its economy may at last be starting to fulfil its potential. It is already the world's fifth-biggest. Mr Modi has promised growth of a sort that would turn it into a pillar of the world economy, on a par with America, China or the European Union. Despite the many failings of his government's economic management, it is not an implausible target.

India's economy will boom, Mr Modi's lieutenants argue, because of its young workforce, muscular industrial policy and the opportunities presented by Western firms' sudden wariness of China. Many high-flying businessmen are persuaded. Tim Cook, Apple's boss, who has just opened

its first store in India, declared to investors in May, “The dynamism in the market, the vibrancy, are unbelievable...India is at a tipping point.” Days later Foxconn, a Taiwanese electronics firm, broke ground on a \$500m factory. India’s GDP grew by 6.1% in the first quarter, year-on-year. Investment as a share of GDP is at its highest for over a decade.

There is no shortage of sceptics. Some point to cronyism and protectionism, which hold the economy back; others complain that dodgy statistics exaggerate its growth. India was hit badly during the pandemic, causing enduring suffering among the poor. Westerners see Mr Modi’s erosion of democratic norms and growing sectarianism as potential threats to growth. Chinese officials, meanwhile, think India is not authoritarian enough. In March your correspondent heard one tell an audience of global bosses that India’s linguistic diversity, its layers of legislation and its poorly educated workers made it an unattractive place to do business.

But for India to become a pillar of the world economy, no miraculous improvement on all these scores is required. It just needs to keep growing at roughly its present pace. Goldman Sachs projects India’s GDP will overtake the euro area’s in 2051 and America’s by 2075 (see chart 1). That assumes a growth rate of 5.8% for the next five years, 4.6% in the 2030s and lower beyond.

Goldman’s confidence rests partly on demography. The workforces of China and the EU are shrinking as their populations age. But according to projections from the OECD, a club mostly of rich countries, India’s will grow until the late 2040s. The swelling supply of labour accounts for a full percentage point in Goldman’s forecast of India’s annual economic growth over the next five years. India will, however, remain relatively poor. Even by 2075 its output per person will be 45% lower than China’s and about 75% below America’s.

In 1700 India's economy was the world's biggest, eclipsing even China. But its share of global output declined throughout the colonial era and in 1993, after a financial crisis, hit a humiliating low of 1% when measured using market exchange rates. Since then it has grown fast, a trend that has continued after Mr Modi's election in 2014. India now accounts for 3.6% of global GDP, the same as China in 2000. By 2028, the IMF forecasts, it will hit 4.2%, overtaking both Germany and Japan. India's heft is growing in other ways, as well: its stockmarket is the fourth-biggest after those of America, China and Japan. Its annual exports of goods and services relative to GDP are near record levels. They have grown by 73% over the past decade, and as a result India's share of global exports has gone from 1.9% in 2012 to 2.4% in 2022.

Transport infrastructure has improved dramatically under Mr Modi and his recent predecessors. Investment in it has more than tripled as a share of GDP compared with the mid-2010s. The length of the road network has increased by about 25%, to 6m kilometres, since 2014. The number of airports has doubled—and many of the new ones rival the sleekest in the rich world. Digital infrastructure has also blossomed, with 832m broadband connections as of last year and a range of state-sponsored digital services, from e-banking to welfare payments, that reach hundreds of millions of people. There is a build-out of energy infrastructure, too: India will add more solar generating capacity in 2023 than anywhere else bar America and China, according to Bloomberg New Energy Finance.

India is unusually reliant on services for a developing economy: they account for about 40% of all exports (see chart 2). That makes India the world's seventh-largest exporter of services, accounting for 4.5% of the global total, up from 3.2% a decade ago. Its big tech-services firms have been on a growth spurt since the pandemic began, hiring eagerly and honing their software, which is sold around the world. Links to Silicon Valley via India's vast diaspora help maintain the pace of innovation and support a

nascent startup culture.

The catch is that the IT-services industry, while earning a huge \$200bn-odd in export revenues, directly employs a mere 5m or so people. Indeed, out of a total of over 900m people of working age, only about half are in the labour force and perhaps 60m have formal jobs. One way to remedy this would be to create more blue-collar employment by fostering manufacturing. This has been a preoccupation of Indian policymaking for three decades.

Mr Modi's manufacturing push, under the slogan "Make in India", aims to seize on Western firms' desire to diversify their supply chains away from China. India's infrastructure has improved, it offers a sizeable domestic market and it is awash with potential workers. An IMF study in April concluded that it would be one of the few places to benefit if supply chains were split by a geopolitical divide. To that end, Mr Modi launched a \$33bn subsidy scheme in 2020, using "production-linked incentives" (PLIs), which reward firms in 14 industries, from pharmaceuticals to solar panels, if their sales hit certain targets.

Some manufacturing is booming: exports of machinery, electronics and vehicles or parts have risen by 63% in the past five years and are now a fifth of all goods exports. Apple assembles 7% of its handsets in India, according to Bloomberg. Indian conglomerates, including Tata Group, are investing in electronics. Nonetheless, although PLIs have prompted plenty of announcements, actual capital deployed so far is probably below \$10bn. One big project, a \$19bn semiconductor plant in Gujarat, has stalled, according to some reports.

Manufacturing grew by only 4.5% year-on-year in the last quarter of 2022, and as a share of GDP, at 17%, is only a little above the average for the past decade. About a third of the increase in exports of goods by value since 2019 reflects India's growing purchases of Russian oil, some of which

is refined and re-exported. Vietnam has captured more activity displaced from China than India, whose share of global goods exports has risen only marginally, to 1.8% in 2022 from 1.6% in 2012. In short, there is no big bang in manufacturing in India, although steady growth may continue.

Is this unusual pattern of growth sustainable? Elements of the formula seem sure to endure, including an abundant workforce, strong elite education, an entrepreneurial culture and valuable links to an influential diaspora. Mr Modi is expected to win a third term in office next year. That will provide continuity in economic policymaking at the central level, especially for the infrastructure splurge. Closer relations with America are also helpful for the economy. America, after all, is the buyer of many of India's exports of services. And with a relatively closed banking system, India will continue to rely on Western networks for cross-border payments.

Meanwhile financial instability, a plague in the past, seems less of a risk. The banking system has been cleaned up and corporate debt is low. Like China, India has large currency reserves. It also inhibits foreign investment in its banks and government-debt markets to diminish the risk of destabilising capital flight. An attack by short-sellers in January on Adani Group, a well-connected conglomerate, revealed flaws in India's capital markets, such as opaque governance, but also a degree of resilience: they shrugged off the episode.

But three threats do loom. First, the boom in IT services could run out of steam. India's firms have access to a huge pool of skilled labour, and so have adopted a labour-intensive model. But new technology, including artificial intelligence, could undermine this strategy. In preparation, the industry is diversifying into new fields, such as data-science, often provided through "global capability centres" for foreign firms. And it is expanding in accounting and consulting: non-tech services made up about a fifth of all services exports in the last quarter.

The second risk is that Mr Modi's promotion of domestic champions and erosion of institutions, including the courts, may begin to deter foreign investment. Many Chinese tech firms have been banned. Multinationals have long had to deal with India's fluid tariffs, rules and taxes. Now they increasingly feel the need to strike deals with big domestic firms: Holcim, a European cement firm, sold its Indian arm to Adani; Meta invests in Reliance Industries, which has a large digital arm.

Fear of an uneven playing field may explain why gross inflows of foreign direct investment have slowed from a rough average of \$7bn a month for the past few years to below \$5bn in February and March. There are other signs of tentativeness from big foreign investors. We examined the exposure to India of the four global banks most active there, which often cater to multinationals. On average their exposure to India fell by 11% in 2022 in dollar terms.

But India's government probably reckons that in the longer term it is big enough to draw Western firms, however warped the rules of the game. Their subsidiaries there have sales of almost a quarter of a trillion dollars. Over the past five years the profits of all multinationals in India rose by 80% to \$56bn, according to our analysis of central-bank data. That's enough to compensate for a lot of headaches.

The final risk is that India's implicit strategy of "trickle-down" economics may cause a popular backlash. Instead of manufacturing jobs, it relies on wealth from the relatively small amount of formal industry to flow through the economy to benefit a bigger share of the population, who are often poorly educated. This is not necessarily pie in the sky: as more housing is built for the well-off, for example, the construction industry is growing fast, drawing in unskilled workers. And part of Mr Modi's agenda has been to augment trickle-down economics. The government has forced hordes of tiny firms to start paying tax, giving them an incentive to merge, formalise

and invest. India's digital welfare schemes have made the provision of aid to the poor more efficient, and could be used to supplement incomes on a bigger scale.

Still, better administration and tech may not make ill-educated people more productive workers. And if the aspirations of India's vast army of the underemployed are not at least partially satisfied, India's growth is likely to suffer. Even if widespread social unrest is averted, it may be because politicians try to satisfy or deflect frustration in unhelpful ways. Mr Modi has combined economic modernisation with illiberalism and religious chauvinism. To placate the jobless, he and his successors may become even more repressive and sectarian. Public opinion could also turn against economic openness. And the Western countries which India is befriending could be put off by such developments. India's economic rise is real, and probably durable, but not without its pitfalls. ■



在一厢情愿中沉沦

中国经济迈向“二次探底”

疫情后经济本应强劲复苏，却再度衰退

中国以坚定不移的领导和稳定的经济增长为荣。这应该让它的命运容易预测。但最近几个月，世界第二大经济体的表现却屡屡出人意表，让老道的中国观察人士和精明的投资者都措手不及。

比如，由于突然解除新冠疫情防控措施，中国今年年初的经济增长快于预期。到了四五月份，情况又出现反转：经济复苏的速度慢于预期。零售、投资及房地产销售数字都低于预期。中国城镇青年失业率超过20%，为2018年有记录以来最高。现在一些人认为，第二季度的经济环比增速可能为零。投资银行野村证券的陆挺表示，按中国的标准，这会是“二次探底”。

第三个有关中国的预测也错了。中国没有成为世界经济的一股通胀力量，令人庆幸。中国今年的石油需求上升，但并没有影响全球基准布伦特原油价格从1月的峰值下降了超过10%。钢铁和铜的价格也有所下降。5月，中国的工业生产者出厂价格同比下降超过4%。人民币走弱。美国劳工统计局（Bureau of Labour Statistics）的数据显示，5月美国人购买中国商品的价格同比下降了2%。

中国这次经济放缓主要是受房地产市场的拖累。经过一轮灾难性的违约、滞销及断供风波，今年早前，房地产市场似乎有复苏之势。政府创造条件方便负债累累的房地产开发商筹集资金以完成延迟的建设项目。去年，中国动辄实施封控，人们购房受阻，有此需求的家庭在2023年头几个月重返市场，重拾之前推迟的购房计划。一些分析师甚至担心房地产市场会过度反弹，令以往的投机风气再次抬头。

然而这股被压抑的需求似乎已经释放完毕。高盛的一项指数显示，5月的新房价格较上月出现下跌。房地产开发商在积极完成在建项目，但不愿意

启动新项目。据咨询公司龙洲经讯（Gavekal Dragonomics）计算，房地产销售已回落至2019年（中国最后一个相对正常的年份）同期水平的70%，房屋新开工面积仅为当时水平的约40%（见图表2）。

政府该如何应对？有好几周，政策制定者似乎无意采取什么行动，令人担忧。今年的官方增长目标为5%左右，并不算宏伟。地方政府经常为追求增长而大肆投资，中央政府似乎很想控制住地方政府债务。中国人民银行面对价格下跌好像镇定自若。它可能还担心降息会过度挤压银行的利润，因为存款利率的降幅可能不像贷款利率那样大。

但在6月6日，人行要求国内最大型银行下调存款利率，为它在6月13日把政策利率下调0.1个百分点做好铺垫。随后，银行对“优质”客户的贷款利率也同步下降，这将进一步降低房贷利率。尽管降幅可谓微不足道，但表明政府并非对眼前风险坐视不理。6月16日，国务院的一次会议暗示将出台更多措施。

摩根士丹利的邢自强预计利率将进一步下调。他还认为一、二线城市可能会放松住房限购。中国的“政策性银行”可能为基建项目提供更多贷款。地方政府可能获准发行更多债券。从中国的财政预算看，政府预计2023年的卖地收入会保持稳定。然而到目前为止，卖地收入已减少约20%。邢自强指出，如果这种情况持续整年，地方政府将失去超过一万亿元的收入。中央可能不得不填补这一缺口。

这就足以实现政府的增长目标吗？邢自强认为是的。他表示，第二季度的放缓不过是个“小坡小坎”。据他计算，今年年初，中国服务业的就业人数如果没有发生疫情的情况少3000万人。未来12个月内，随着餐饮等“密集接触”服务业复苏，其中1600万个岗位将得以恢复。待就业回归，收入和支出也会重振。另外1000万个流失的职位是在电子商务和教培等在2021年受监管整治的行业。近几个月，政府对这类公司的态度有所软化，随着经济复苏，其中一些公司可能壮起胆子恢复招聘。

其他经济学家则不那么乐观。中银国际的徐高认为，进一步放宽货币政策

不会起作用。既然中国经济中最大的两个借款方——房地产开发商和地方政府——都已债务缠身，贷款需求对利率并不敏感。当局降息更多是出于无奈而非希望。

他的看法也许是对的。但在实施之前就认定货币宽松政策起不了作用，这有些奇怪。贷款需求并非这些政策重振经济的唯一渠道。据中国社科院的张斌及合著者估计，假如人行的政策利率下调两个百分点，将减少利息负担7.1万亿元，股市将增值13.6万亿元，房价也会上升，提振房主信心。

假如货币宽松政策不起作用，政府将不得不尝试财政刺激。去年，地方政府融资平台（由政府支持的准商业实体）加大投资支出以推动增长。许多平台因而现金吃紧。据研究公司荣鼎集团（Rhodium Group）最近对2892家这类机构的调查，只有567家手上有足够现金偿还短期债务。在甘肃省省会兰州和以山水如画的喀斯特地貌闻名的南方城市桂林，地方政府融资平台支付的利息已超过市政府“财政能力”（即财政收入加融资平台的净现金流）的100%。它们的债务大山可不是什么如画风景。

假如说中国经济需要更多的推动，中央政府将不得不制造这样的推力。原则上，刺激措施可以包括加大养老金开支和消费优惠。例如，政府延长了新能源汽车购置税减免，助推了汽车销售。

官员们还可以尝试仿效浙江各市在疫情早期首创的做法，以高科技手段派发消费券。它们通过电子钱包派发了数百万张优惠券，例如，持有人一周餐饮消费满210元便可减免70元。蚂蚁集团研究院院长李振华及合著者称这些消费券非常有效。每花出一元的财政资金诱发了三元以上的自费消费。

可惜，中国财政当局似乎仍然认为发放这类补贴太过小儿科或乱花钱。如果政府要支出或放贷，那费这番功夫得要能换来经久耐用的资产。因此，在实践中，任何财政刺激都很可能把更多投资导向绿色基础设施、城际交通和中国五年计划支持的其他公共资产上。面对中国的意外之年，那倒会是个全不叫人意外的反应。 ■



Wishful sinking

China's economy is on course for a “double dip”

The post-covid economy was meant to roar. But it is faltering again

CHINA PRIDES itself on firm, unswerving leadership and stable economic growth. That should make its fortunes easy to predict. But in recent months, the world’s second-biggest economy has been full of surprises, wrong-footing seasoned China-watchers and savvy investors alike.

Early this year, for example, China’s economy grew faster than expected, thanks to the country’s abrupt exit from covid-19 controls. Then, in April and May, the opposite happened: the economy recovered more slowly than hoped. Figures for retail sales, investment and property sales all fell short of expectations. The unemployment rate among China’s urban youth passed 20%, the highest since data were first recorded in 2018. Some now think the economy might not grow at all in the second quarter, compared with the first. By China’s standards this would be a “double dip”, says Ting Lu of Nomura, a bank.

China has also defied a third prediction. It has failed, thankfully, to become an inflationary force in the world economy. Its increased demand for oil this year has not prevented the cost of Brent crude, the global benchmark, from falling by more than 10% from its January peak. Steel and copper have also got cheaper. China’s producer prices—those charged at the factory gate—declined by more than 4% in May compared with a year earlier. And the yuan has weakened. The price Americans pay for imports from China fell by 2% in May compared with a year earlier, according to America’s Bureau of Labour Statistics.

Much of the slowdown can be traced to China’s property market. Earlier

in the year it seemed to be recovering from a disastrous spell of defaults, plummeting sales and mortgage boycotts. The government had made it easier for indebted property developers to raise money so that they could complete delayed construction projects. Households that refrained from buying last year, when China was subject to sudden lockdowns, returned to the market in the first months of 2023 to make the purchases they had postponed. Some analysts even allowed themselves the luxury of worrying about whether the property market might bounce back too strongly, reviving the speculative momentum of the past.

Yet this pent-up demand seems to have petered out. The price of new homes fell in May compared with the previous month, according to an index from Goldman Sachs, a bank. Although property developers are keen to complete building projects, they are reluctant to start them. Gavekal Dragonomics, a consultancy, calculates that property sales have fallen back to 70% of the level they were at in the same period of 2019, China's last relatively normal year. Housing starts are only about 40% of their level then (see chart 2).

How should the government respond? For a worrying few weeks, policymakers looked as though they might not do much at all. The official growth target for this year—around 5%—lacks ambition. Beijing seemed keen to keep a lid on the debts of local governments, which are often urged to splurge for the sake of growth. The People's Bank of China (PBOC), the central bank, seemed unperturbed by falling prices. It may have also worried that a cut in interest rates would put too much of a squeeze on banks' margins, because the interest rate they pay on deposits might not fall as far as the rate they charge on loans.

But on June 6th the PBOC asked the country's biggest lenders to lower their deposit rates, paving the way for the central bank to reduce its policy rate by 0.1 percentage points on June 13th. The interest rate banks charge their "prime" customers then fell in tandem, which will further lower mortgage

rates. Although the cut was negligible, it showed the government was not oblivious to the danger. A meeting of the State Council, China's cabinet, on June 16th, dropped hints of more to come.

Robin Xing of Morgan Stanley, a bank, expects further cuts in interest rates. He also thinks restrictions on home purchases in first- and second-tier cities may be relaxed. The country's "policy banks" may provide more loans for infrastructure. Local governments may be allowed to issue more bonds. China's budget suggests it expected land sales to stay steady in 2023. Instead, revenues have so far fallen by about 20%. If the shortfall persists for the entire year, it would deprive local governments of more than 1trn yuan (\$140bn) in revenue, Mr Xing points out. The central government may feel obliged to fill that gap.

Will this be enough to meet the government's growth target? Mr Xing thinks so. The slowdown in the second quarter will be no more than a "hiccup", he argues. Employment in China's service sector began this year 30m short of where it would have been without covid, Mr Xing calculates. The rebound in "contact-intensive" services, such as restaurants, should restore 16m of those jobs over the next 12 months. When jobs do return, income and spending will revive. Another 10m of the missing jobs are in industries like e-commerce and education that suffered from a regulatory storm in 2021. China has struck a softer tone towards these firms in recent months, which may embolden some of them to resume hiring as the economy recovers.

Others economists are less optimistic. Xu Gao of Bank of China International argues that further monetary easing will not work. The demand for loans is insensitive to interest rates, now that two of the economy's biggest borrowers—property developers and local governments—are hamstrung by debt. The authorities cut interest rates more out of resignation than hope.

He may be right. But it is odd to assume monetary easing will not work before it has really been tried. Loan demand is not the only channel by which it can revive the economy. Zhang Bin of the Chinese Academy of Social Sciences and his co-authors estimate that if the central bank's policy rate dropped by two percentage points, it would cut interest payments by 7.1trn yuan, increase the value of the stockmarket by 13.6trn yuan and lift house prices, bolstering the confidence of homeowners.

If monetary easing does not work, the government will have to explore fiscal stimulus. Last year local-government financing vehicles (LGFVs), quasi-commercial entities backed by the state, increased their investment spending to prop up growth. That has left many strapped for cash. According to a recent survey of 2,892 of these vehicles by the Rhodium Group, a research firm, only 567 had enough cash on hand to meet their short-term debt obligations. In two cities, Lanzhou, the capital of Gansu province, and Guilin, a southern city famous for its picturesque Karst mountains, interest payments by LGFVs rose to over 100% of the city's "fiscal capacity" (defined as their fiscal revenues plus net cash flows from their financing vehicles). Their debt mountains are not a pretty picture.

If the economy needs more of a push, the central government will have to engineer it. In principle, this stimulus could include extra spending on pensions and consumer giveaways. The government has, for example, extended tax breaks on electric vehicles that have helped boost car sales.

Officials could also experiment with high-tech consumer handouts of the kind pioneered by cities in Zhejiang province during the early days of covid. They distributed millions of coupons through e-wallets, which would, for example, knock 70 yuan off a restaurant meal if the coupon holder spent at least 210 yuan in a week. According to Zhenhua Li of Ant Group Research Institute and co-authors, these coupons packed a punch. They induced more than three yuan of out-of-pocket spending for every one yuan of

public money.

Unfortunately, China's fiscal authorities still seem to view such handouts as frivolous or profligate. If the government is going to spend or lend, it wants to create a durable asset for its trouble. In practice, any fiscal push is therefore likely to entail more investment in green infrastructure, intercity transport and other public assets favoured in China's five-year plan. That would be an utterly unsurprising response to China's year of surprises. ■



经济学人视频

加密货币的未来 - 预告片

有些人认为，它可能会是互联网全面转型的关键。



The Economist Film

The future of Crypto - Trailer

Some believe it could hold the key to a wholesale transformation of the internet.



狼来了

人工智能还没有消灭工作岗位

白领工人越来越多

在人工智能（AI）取得惊人突破之后，许多人担心自己会被扔进经济废品堆。最近几个月，谷歌上“我的工作安全吗？”的搜索量翻番，因为人们担心自己会被大语言模型（LLM）取代。有迹象显示大范围的颠覆即将到来。在最近的一篇论文中，OpenAI的泰纳·埃伦杜（Tyna Eloundou）及其同事认为，“美国大约80%的劳动力可能有至少10%的工作量会受到引入LLM的影响”。另一篇论文指出，法律服务、会计和旅行社将面临前所未有的剧变。

不过，经济学家往往更喜欢对自动化做预测，而不喜欢测试自动化。在2010年代初，许多经济学家大声预测机器人将夺走数百万人的工作，但当发达国家的就业率升至历史最高水平时，他们就哑口无言了。对于日本、新加坡和韩国等全球科技使用率最高的国家为何失业率一直处于最低水平，末世论者拿不出什么好的解释。

在此，我们启动对AI如何影响就业的追踪。在美国各种职业的就业数据中，我们把白领工人单挑出来。其中包括后台支持、财务运营以及文案撰写等各种岗位人员。生成式AI在逻辑推理和创造力方面的表现越来越好，通常认为白领职位特别容易受其影响。

不过，目前还没有什么证据表明AI对就业造成了冲击。2020年春季，白领岗位占全部工作岗位的比例上升，因为许多服务业从业者在疫情开始时失业了（见图表）。现在随着休闲和接待业的复苏，白领岗位的比例有所下降。但是在过去一年里，那些被认为受生成式AI威胁的职业占总就业的比例上升了0.5个百分点。

当然，现在说什么还为时尚早。企业普遍还没有大规模使用生成式AI工具，因此对就业的影响可能只是延后了。但另一种可能是，这些新技术最

终只会摧毁一小部分岗位。AI在某些任务上可能很高效，但可能不太擅长其他任务，比如管理以及理解、解决别人的需求。

AI甚至可能给就业带来积极影响。如果员工利用AI提高工作效率，公司的利润就可能会上升，老板们就能招更多人。IT招聘公司万宝瑞华（Experis）最近的一项调查显示存在这种可能。调查发现，超过一半的英国雇主预计，未来两年AI技术将对他们的雇员人数产生积极影响。

为了看清结果究竟如何，我们每隔几个月会更新一次这项分析。但就目前而言，就业末日似乎还很遥远。 ■



Boy cries wolf

AI is not yet killing jobs

White-collar workers are ever more numerous

AFTER ASTONISHING breakthroughs in artificial intelligence, many people worry that they will end up on the economic scrapheap. Global Google searches for “is my job safe?” have doubled in recent months, as people fear that they will be replaced with large language models (LLMs). Some evidence suggests that widespread disruption is coming. In a recent paper Tyna Eloundou of OpenAI and colleagues say that “around 80% of the US workforce could have at least 10% of their work tasks affected by the introduction of LLMs”. Another paper suggests that legal services, accountancy and travel agencies will face unprecedented upheaval.

Economists, however, tend to enjoy making predictions about automation more than they enjoy testing them. In the early 2010s many of them loudly predicted that robots would kill jobs by the millions, only to fall silent when employment rates across the rich world rose to all-time highs. Few of the doom-mongers have a good explanation for why countries with the highest rates of tech usage around the globe, such as Japan, Singapore and South Korea, consistently have among the lowest rates of unemployment.

Here we introduce our first attempt at tracking AI’s impact on jobs. Using American data on employment by occupation, we single out white-collar workers. These include people working in everything from back-office support and financial operations to copy-writers. White-collar roles are thought to be especially vulnerable to generative AI, which is becoming ever better at logical reasoning and creativity.

However, there is as yet little evidence of an AI hit to employment. In the

spring of 2020 white-collar jobs rose as a share of the total, as many people in service occupations lost their job at the start of the covid-19 pandemic (see chart). The white-collar share is lower today, as leisure and hospitality have recovered. Yet in the past year the share of employment in professions supposedly at risk from generative AI has risen by half a percentage point.

It is, of course, early days. Few firms yet use generative-AI tools at scale, so the impact on jobs could merely be delayed. Another possibility, however, is that these new technologies will end up destroying only a small number of roles. While AI may be efficient at some tasks, it may be less good at others, such as management and working out what others need.

AI could even have a positive effect on jobs. If workers using it become more efficient, profits at their company could rise which would then allow bosses to ramp up hiring. A recent survey by Experis, an IT-recruitment firm, points to this possibility. More than half of Britain's employers expect AI technologies to have a positive impact on their headcount over the next two years, it finds.

To see how it all shakes out, we will publish updates to this analysis every few months. But for now, a jobs apocalypse seems a way off. ■



老师们的心头好

ChatGPT可能协助教师并降低上大学的成本

大学申请文书可能正在消亡，但人工智能对教育有诸多好处

许多人都在思索ChatGPT可能会如何改变世界，特别是学校。很多人担心会发生最坏的情况。大学申请文书已被宣告死亡。《高等教育内幕》（Inside Higher Ed）称，ChatGPT正在引发一场教育“危机”。也许是的。但ChatGPT也可能成为老师们的益友。

还是威胁更清晰可见。用户可以要求ChatGPT比较米尔顿·弗里德曼（Milton Friedman）和保罗·萨缪尔森（Paul Samuelson），它就会生成一则包含五点的总结，对比两者的观点。如果让它创作一首关于弗里德曼的说唱，它会给出这样的歌词：“他这位经济学家有着独到的眼光/精准道出了自由市场的真相。”这样的精妙的表述和创造力引发了许多教师和中小学的担忧。美国最大的学区纽约市公立学校在1月禁用了ChatGPT，但在5月又撤销了这一决定。其他国家的一些大学已发出禁用令。

位于康涅狄格州的昆尼皮亚克大学（Quinnipiac University）的英语助理教授乔纳森·托雷斯（Jonathan Torres）表示：“一开始.....所有人都觉得天要塌下来了。”他在该校还从事培训中小学教师的工作，并认为人工智能（AI）可以激励老师们改进教学。例如，在ChatGPT出现之前，经济学教师可能会要求学生写一篇描述凯恩斯主义的文章。有了ChatGPT，老师可能会让学生评估和修改它针对该问题给出的回答——这是个更有难度的任务。AI对教师而言还有其他实际用途。它们可以帮助教师按照不同阅读水平甚至以不同语言编写课程计划和练习题。它们还可以减少花在非教学工作上的时间，比如写推荐信，这些工作占用了大量本可以用于教学的时间。

一些机构甚至走得更远。非营利教育机构可汗学院（Khan Academy）最近推出了试验版本的Khanmigo，这是一个运用GPT-4（ChatGPT的最新升

级版）为学生和教师提供支持的虚拟向导。如果学生答错了一道数学题，GPT-4就会协助他们靠自己解决问题。在科学课上，GPT-4评估开放式问题。在英语课上，它会就学生们的作文向他们提问。在历史课上，学生可以和GPT-4辩论，为课堂讨论做准备。

该程序会向教师汇报学生们的活动。Khanmigo可以帮助教师创建课程，并在之后测试学生对知识掌握得如何。它可以支持使用不同语言的学生。它甚至能让学生通过模拟来与历史人物或文学人物“交谈”。可汗学院的创始人萨尔·可汗（Sal Khan）说：“这让我们有机会为每个学生提供一对一的辅导，为每个老师提供助教，甚至还能给予更多。”

对于那些负责中小学和大学行政工作的人来说，好处甚至可能更明显。纽约州的一所文理学院联合学院（Union College）的校长戴维·哈里斯（David Harris）决定试试ChatGPT。他让它拟一封信，宣布学院在春季学期后不再要求接种新冠疫苗加强针。结果还不错，于是他向每一位高层人员展示了用它生成的各种例子：一封公关总监告知同学们要更换校园吉祥物的信；发布在Instagram上展现春假校园风光的照片；人事部向某个经常迟到的员工发出最后警告。

哈里斯对这一切可能降低大学成本的前景感到兴奋。包括联合学院、斯坦福大学等大学在内的许多大学明年将收取每年约8万美元的学费和食宿费。2021年，美国家庭收入中位数为7.1万美元。美国大学的行政部门已经变得臃肿。AI可能会消除对其中一些职位的需求，也许还能让大学把节省下来的钱用在学生身上。ChatGPT或许扼杀了大学申请文书，但考虑到它在课堂内外的潜力，那可能也没什么大不了的。■



Teacher's pet

How ChatGPT could help teachers and lower the cost of college

The college essay may be dying, but AI has plenty of upsides in education

MANY HAVE mused on how ChatGPT could change the world, not least schools. Plenty fear the worst. The college essay has been pronounced dead. ChatGPT is causing an educational “crisis”, claims Inside Higher Ed. Maybe so; but ChatGPT could also be a teacher’s friend.

It is easier to see the threat. Users can ask ChatGPT to compare Milton Friedman with Paul Samuelson, and it will create a five-point summary that contrasts their views. Ask it to create a rap about Friedman, and it delivers lines like: “He was an economist with a unique vision / Spittin’ truth about free markets with precision”. This sophistication and creativity worries lots of teachers and schools. New York City public schools, America’s largest school district, banned ChatGPT in January, only to reverse the decision in May. Some universities abroad have banned its use.

“Initially...everybody was thinking that the sky was falling,” says Jonathan Torres, an assistant professor of English at Quinnipiac University in Connecticut. He also trains teachers at Quinnipiac, and argues that AI can push them to become better. For example, before ChatGPT came along, an economics teacher might ask pupils to write an essay describing Keynesianism. With ChatGPT as an option, the teacher might ask the students to assess and revise the chatbot’s response to the same question—a more difficult task. AIs have other practical uses for teachers. They can help write lesson plans and worksheets at different reading levels and even in different languages. They can also cut down the time spent on duties, such as writing recommendation letters, that devour time that could be spent teaching.

Some organisations are going even further. Khan Academy, an education non-profit, recently launched a pilot of Khanmigo, its virtual guide that uses GPT-4, the latest upgrade of ChatGPT, to support pupils and teachers. If pupils get a wrong answer to a maths problem, the chatbot helps them solve it on their own. In science, the program evaluates open-ended questions. In English class, it asks pupils questions about their essays. And in history, a pupil can debate with the bot to prepare for an in-class discussion.

The program provides teachers with a report on their pupils' activities. Khanmigo can help teachers create lessons and test pupils' knowledge afterwards. It can support pupils in different languages. It even allows pupils to "talk" to historical figures or literary characters via simulations. "This gives us the opportunity to give every student a one-on-one tutor, every teacher a teaching assistant, and more," says Sal Khan, the founder of Khan Academy.

For those in charge of school and college administrations the benefits are, if anything, clearer. David Harris, president of Union College, a liberal-arts college in New York state, decided to play around with ChatGPT. He asked it to write a letter announcing that the college would no longer require the covid-19 booster jab after the spring term. The results were good enough for him to show examples to each of his senior staff—a letter to students about changing the campus mascot for his communications director, an Instagram post for campus photos on spring break, a final warning for an employee with chronic lateness for human resources.

Dr Harris is excited about what all this could mean for college costs. Many universities, including Union College, Stanford University and others, will charge about \$80,000 a year next year for tuition, room and board. In 2021 the median household income in America was \$71,000. College administration in America has become bloated. AI could eliminate the need

for some of these jobs, and maybe enable colleges to pass savings on to students. ChatGPT may have killed the college essay, but with all its potential in and out of the classroom, perhaps that is OK. ■



熊彼特

特斯拉和其他车企能从福特学到什么

这家120年历史的公司展示了自知之明的重要性

吉姆·法利（Jim Farley）酷爱挑战。这位福特老板是个热衷经典车的业余赛车手，今年1月，他开着一辆马力强劲的现代款野马GT-4首次亮相职业赛道。不过，若与驾驭福特勇闯汽车制造的新时代相比，在赛道上飞驰的风险就不算什么事了。6月16日，福特将庆祝公司诞生120周年。与其他老牌车企一样，福特正努力变身，以求能在电气化和软件定义汽车的时代一逐高下。它既面对老对手，也要迎战新进者——冲在最前面的就是马斯克的特斯拉。在这个拥挤的赛道上，法利正在跑出一条独特的轨迹线。

长期以来，老牌汽车制造商一直被投资者斥为“老破车”，其特点是低增长、低利润，以及格外擅长让股东价值跳水。从2014年到2020年10月法利接掌福特之前，福特的市值缩水了五分之三，跌至270亿美元。2022年初，该公司的电动化计划点燃了市场热情，市值一度飙升至1000亿美元，随后又回落至570亿。法利显现了赛车手本色，他毫不畏惧。他将公司重组为三个部门，分别聚焦电动汽车（福特计划在2022至2026年间投资500亿美元）、高利润的汽油车，以及福特领先全球的商用车业务。他认为，到2026年福特可以将营业利润率从2022年的6.6%提高到10%，并使电动汽车业务扭亏为盈（预计2023年这项业务的亏损会达到30亿美元）。

法利这一计划的成败取决于能否从颠覆者那里学到一两招，而他比其他大多数汽车老板更早认识到颠覆者对行业的贡献。他承认：“特斯拉对我们的思路影响很大。”最重要的是，他清楚地知道在哪些方面模仿对手有利于建立自己公司的竞争优势，还有更关键的是，在哪些方面不该跟风。

马斯克对汽车制造的最大贡献或许是证明了电动汽车这项让老企业常年亏钱的业务可以带来稳健的利润。到2022年，特斯拉的营业利润率为17%，显著高于大多数老牌车企的汽油车型。为了实现电动化目标，法利正在效

仿马斯克扭转多年来的行业惯例——过去大品牌一直都让最大的供应商去管理下游价值链。

福特并不是唯一一家将供应链更多转到内部的传统车企。通用汽车和大众等竞争对手也在贴近大型市场建造电池“超级工厂”。但法利就像马斯克一样，比大部分老板都更积极地与矿业公司直接谈判以确保电池材料供应。福特计划到2026年每年生产200万辆电动汽车，现在已经签署协议锁定了所需锂和镍的90%的供应。福特甚至打算将部分锂矿加工放在美国，这应该有助它降低对中国精炼厂的依赖，整个行业都在这方面依赖中国。此举也可确保福特的电动汽车符合《通胀削减法案》中“美国制造”的条件，从而有资格从这项去年通过的庞大绿色拨款法案中获得补贴。因此，法利希望不久之后能在密歇根州的福特工厂生产出全美最便宜的电池。

法利还在效仿马斯克力图减少汽车行业出了名的复杂度。这背后的思路是，正如一辆更轻便、更灵活的汽车更有机会在赛道上领先大体型、大马力的汽车一样，更简单的公司组织也应该更有能力穿越行业变革中的迂回曲折。众所周知，特斯拉只生产四款车型，几乎不提供定制选项。同样，据福特的电动汽车产业化负责人丽莎·德雷克（Lisa Drake）介绍，福特的下一代电动皮卡将配备相同的座舱、车架和标准电池，只提供七种基本搭配。相比之下，最畅销的汽油动力皮卡F-150提供数不胜数的组合。福特计划于2025年推出的电动汽车新架构将使用更多相同的机械和软件基础构件，而不再去整合供应商提供的几百种零部件并逐一搭配适用芯片。

法利和马斯克的想法也有不同，那就是车企除了制造汽车之外还应该做什么。马斯克认为特斯拉可以扮演更广泛的角色，从自行设计车载信息娱乐系统，到建设充电网络供车主给电池充电。而法利完全专注于造车，并乐于将其他事务外包出去。5月，福特与特斯拉签署协议，让福特电动汽车接入特斯拉设有12,000个充电站的北美超级充电网络，许多观察人士为之震惊。

比达成充电协议还更令人惊讶的是，福特决定继续依靠外部合作伙伴来开发大量的车载软件。这与业界的共识背道而驰——一般认为，从卫星导航

到音乐流媒体等信息娱乐系统将在决定私家车的体验、实现汽车品牌差异化以及利用新服务产生收入方面发挥越来越大的作用。苹果的CarPlay和谷歌的Android Auto都把驾驶者的智能手机连接到汽车仪表盘，但特斯拉并不支持这些平台。通用汽车最近宣布将放弃CarPlay和Android Auto，自行推出更好的系统。法利认为，在安全保障等关键领域有必要保持对计算机程序的控制。但他承认，福特在驾驶舱体验的竞争中已经输给了大型科技公司。

有迹象表明，一些老牌车企可能日益清楚地认识到自身局限。6月8日，通用汽车宣布与特斯拉达成了类似的充电协议。如果有更多公司能更加实事求是地看待自己的软件实力，它们可能就会从中受益。坚持做自己擅长的事情，其他的留给别人，这是众多竞争对手可以从福特借鉴的经验。■



Schumpeter

What Tesla and other carmakers can learn from Ford

The 120-year-old company shows the importance of knowing your limits

JIM FARLEY relishes a challenge. In January Ford's boss, an enthusiastic amateur racer of historic cars, made his professional debut on the track in a powerful modern Mustang GT-4. Yet the risks of tearing round a circuit are nothing compared with manoeuvring Ford, which on June 16th will celebrate 120 years in business, through a new age of carmaking. Ford, like other legacy firms, is trying to reinvent itself to compete in an era of electrification and software-defined vehicles. It faces established rivals as well as newcomers, foremost among them Elon Musk's Tesla. Amid this packed grid, Mr Farley is charting a singular racing line.

Established carmakers have long been written off by investors as clunkers, characterised by low growth, low margins and an unmatched ability to destroy shareholder value. Between 2014 and Mr Farley's taking the wheel in October 2020, Ford's market capitalisation shrivelled by three-fifths, to \$27bn. After a euphoric spike in early 2022, when it hit \$100bn on enthusiasm about the company's electric plans, it is back down to \$57bn. But as befits a racing driver, Mr Farley is undaunted. He has reorganised the company into three units, focusing on electric vehicles (EVs, in which Ford plans to invest \$50bn between 2022 and 2026), on high-margin petrol-driven cars and on Ford's world-beating commercial-vehicle business. He thinks that Ford can boost operating margins from 6.6% in 2022 to 10% by 2026 and turn EV-related losses, which are forecast to reach \$3bn in 2023, into profits.

Mr Farley's plan hinges on learning a thing or two from the disrupters, whose contribution to the industry he is quicker to acknowledge than most

other car bosses are. “Tesla has influenced a lot of our thinking,” he admits. Most important, he has a clear idea of where emulating rivals plays to his company’s competitive advantage and, critically, where it does not.

Mr Musk’s biggest contribution to carmaking may be proving that EVs, which have been losing the incumbents money for years, can turn a healthy profit. Tesla’s operating margin, of 17% in 2022, was comfortably higher than those that most established carmakers enjoy on their petrol-powered ranges. To achieve his electric goals, Mr Farley is following Mr Musk and reversing years of industry practice that left the big marques’ largest suppliers to manage those lower down the value chain.

Ford is not the only legacy carmaker to be bringing more of the supply chain in-house. Rivals such as General Motors (GM) and Volkswagen are also building battery “gigafactories” close to their big markets. But Mr Farley is, like Mr Musk, busier than most bosses in negotiating directly with mining firms to secure battery minerals. Ford has already signed deals to guarantee supplies of 90% of the lithium and nickel it needs for the 2m EVs it wants to be producing annually by 2026. Ford even intends to process some of the lithium in America. This should help it reduce the industrywide reliance on Chinese refiners. It also ensures that electric Fords qualify for subsidies under the “made in America” terms of the Inflation Reduction Act, a giant green-funding law passed last year. As a result, Mr Farley hopes soon to be making the cheapest batteries in America at Ford’s plant in Michigan.

Mr Farley is also emulating Mr Musk in trying to pare back the industry’s notorious complexity. Just as a lighter, nimbler machine has a better chance of staying ahead of a big and powerful one on the track, the thinking goes, a simpler company should be able to negotiate the twists and turns of industrial change. Famously, Tesla makes just four models with few options for customisation. Similarly, Ford’s next generation of electric pickups will come with one cabin, one frame and one standard battery in just seven

basic formats, says Lisa Drake, Ford's overseer for EV industrialisation. That compares with an options list for the bestselling petrol-powered F-150 pickup that allows for millions of combinations. Rather than integrating hundreds of parts from suppliers, each with chips that need to work in harmony, Ford's new EV architectures, set for launch in 2025, will share more common mechanical and software underpinnings.

Where Mr Farley's thinking and Mr Musk's diverge is over what besides manufacturing vehicles carmakers ought to be doing. Mr Musk has an expansive view of his company's role, which stretches from designing Teslas' infotainment system to building a charging network where owners can top up their batteries. Mr Farley, by contrast, is focusing squarely on manufacturing vehicles and is happy to outsource some of the other things. In May Ford stunned many observers when it signed a deal with Mr Musk's firm to grant Ford EVs access to Tesla's North American Supercharger network, with its 12,000 charging stations.

More surprising even than the charging deal is Ford's decision to continue relying on outside partners for a lot of in-car software. This flies in the face of received wisdom in the industry, according to which things like infotainment systems, from satellite navigation to music streaming, will increasingly determine the car-owning experience, differentiate car brands and generate revenues from new services. Tesla does not accommodate Apple's CarPlay and Google's Android Auto platforms, which connect motorists' smartphones to their cars' dashboards. GM recently declared that it would ditch CarPlay and Android Auto and come up with its own better system. Mr Farley sees the need to keep control of computer programs in critical areas such as safety and security. But he accepts that Ford has lost the battle for the cockpit to big tech.

There are signs that some incumbents may be becoming more clear-eyed about their limitations. On June 8th GM announced it had made a similar

charging arrangement with Tesla. More would probably benefit from greater realism about their software prowess. Stick to what you do well and leave the rest to others is a lesson that many of Ford's rivals could usefully learn.





首要之事乃是取代所有律师

生成式AI可能会彻底改变律师业

即便它不会替代整个律师队伍

律师是一群保守的人，适合这个奖励那些有备而来、聪敏睿智和尊重先例的人的职业。这就难怪人们会对发生在史蒂文·施瓦茨（Steven Schwartz）身上的故事发笑了。上个月，这位纽约律师事务所Levidow, Levidow & Oberman的人身伤害案律师借助ChatGPT准备了一份法庭文件。他有点太过依赖这个AI聊天机器人了。它帮他创建的动议中充满了虚构的案例、判决和引述，并向他保证“我提供的是真实案例，能在可信的法律数据库中查找到”（它们不是真的，也查不到）。施瓦茨不假思索地提交了这份动议。对技术持怀疑态度的律师可能得出结论说，此事的教训就是：还是老办法最好。

但这个结论是错的。把施瓦茨错误百出的动议归咎于AI，就像把印刷的动议文件中的错误归咎于印刷机一样没有道理。在这两种情况中，问题都出在提交动议前没有仔细查核的律师身上，而不是帮助律师生成动议的工具。因为这就是AI：既不是新时尚也不是大劫难，而是一种处于起步阶段的工具，一种有可能从根本上改变律师工作方式和律师事务所赚钱方式的工具。这种说法远不止在法律行业这一个领域成立，但很少有哪个行业如它这般面对清晰的应用前景和极高的风险并存。善用AI的公司将获得回报，行动迟缓的有可能要步排印工人的后尘。

高盛最近的一份报告认为，44%的法律工作可由AI完成，这一比例在受调查的职业中仅次于文书和行政支持类工作。律师需要花费大量时间仔细审阅枯燥乏味的文件，而AI已经显示了它能很好地完成这类事务。律师利用AI辅助完成各种任务，包括尽职调查、研究和数据分析。这些应用场景此前在很大程度上依靠“抽取式”AI——顾名思义，这种AI可以从文本中抽取信息，回答关于这些内容的问题。

ChatGPT等“生成式”AI的功能要强大得多。这些强大功能一定程度上可用来改进法律研究和文件审查工作。帕勃罗·阿雷东多（Pablo Arredondo）创建了名为CoCounsel的生成式AI“法律助理”。他解释说，用了CoCounsel“就不用再受关键词的严重制约……它可以明白‘我们撤回了詹金斯案’（Jenkins，一个虚构的法律案件）和‘我们遗憾地将詹金斯案扫进了历史的垃圾堆’是一个意思。”总部位于伦敦的大型律所Allen & Overy已经将名为Harvey的法律AI工具融入工作流程，用它来完成合同分析、尽职调查和诉讼准备。

并非所有律师都买AI的账。近来一项调查发现，82%的律师认为生成式AI可以用于法律工作，但只有51%的人认为应该这么做。许多人担心AI会出现“幻觉”（AI研究人员把聊天机器人一本正经地提供不实之词的倾向叫做幻觉，就像在施瓦茨的案例中呈现的），而且可能会无意中将受律师-委托人保密特权保护的信息输入到算法中。但如果这些挑战能被克服（有了更好的技术和认真仔细的人类工作人员参与，确实有可能克服），余下49%的人就可能消除疑虑。例如，施瓦茨大出洋相的消息传出后，得克萨斯州的一名联邦法官要求在他的法庭出庭的律师都要提交一份证明，声明他们完全没有使用生成式AI，或者在使用后已核对过最终的内容。当像Westlaw和LexisNexis这样比图书馆更大、更易搜索的数据库出现后，律师们只要点击鼠标就能利用它们，此时他们还要坚持在图书馆做法律研究就说不通了。同样地，当积极采用生成式AI的律所多到一定程度时，就将有更多的律所跟进。

AI有可能从三个主要方面改变法律行业。首先，它会削弱大律所的人力优势。在复杂的大型诉讼案中，大律所会要求几十名年轻受雇律师阅读浩如烟海的文件，为资深律师的问题和直觉寻找答案和证据。现在，一名律师或一家小律所可以把这些文件上传到一个诉讼准备AI中查询。正如哈佛法学院的劳伦斯·莱西格（Lawrence Lessig）所指出的那样：“一家更小、更精干的专业律所也能处理此类案件。”

其次，AI可能改变律所赚钱的方式。英国首席大法官的技术顾问理查德·萨斯金德（Richard Susskind）认为，律所赚钱是靠“聘用大批年轻律师，

给他们的工资低于向客户收取的费用”。如果AI可以在几秒钟内就完成这些年轻律师的工作，律所就将需要改变它们的计费方式。有些律所可能会转向根据提供的服务收取固定费用，而不是根据提供服务所花费的时间来计费。Silicon Valley Law Group的斯蒂芬·吴（音译，Stephen Wu）推测，律师可能会收取“技术服务费”，这样“客户就不会指望可以免费享用生成式AI的劳动成果”。

第三，AI可能会改变律师的数量和工作地点。莱西格说，很难想象AI最终“不会大幅减少这个世界所需的律师人数”。如果AI可以在20秒内完成一项需要十几名受雇律师每人花50个小时才能完成的任务，那么大律所为什么还要留着几十个这样的律师呢？纽约一家著名公司法律所的一名资深合伙人预计，受雇律师与合伙人的比例将从当今顶级律所大概七比一的平均水平下降到接近一比一。他说，如果受雇律师现在还不担心饭碗不保，“那他们该担心了”。

不过，这种变化可能还不会很快发生。此外，AI可能会让法律服务变得更便宜，从而也更普及，特别是对于目前经常负担不起这些费用的中小企业而言。雄心勃勃的法学院毕业生可能会发现AI为自立门户开辟了一条更便捷的道路。如果是这样，那么AI实际上可能会导致律师总数增加，并改变他们的工作类型。就像自动取款机一样，它们非但没有取代银行员工，反而导致他们人数增加。

最终，这对客户来说将是个好消息。“去找律师的人要的不是律师，而是解决问题或完全避免问题的办法。”萨斯金德解释说。如果AI可以提供这样的办法，那么人们就会去用AI。许多人已经在用软件来报税，而不再依赖专业人士，“他们中极少有人在抱怨这些税务顾问跟自己缺乏社交互动”。 ■



First thing we do, let's bot all the lawyers

Generative AI could radically alter the practice of law

Even if it doesn't replace lawyers en masse

LAWYERS ARE a conservative bunch, befitting a profession that rewards preparedness, sagacity and respect for precedent. No doubt many enjoyed a chuckle at the tale of Steven Schwartz, a personal-injury lawyer at the New York firm Levidow, Levidow & Oberman, who last month used ChatGPT to help him prepare a court filing. He relied a bit too heavily on the artificial-intelligence (AI) chatbot. It created a motion replete with made-up cases, rulings and quotes, which Mr Schwartz promptly filed after the bot assured him that the “cases I provided are real and can be found in reputable legal databases” (they were not, and cannot). Lesson learned, a tech-sceptic lawyer might conclude: the old ways are the best.

That is the wrong lesson. Blaming AI for Mr Schwartz’s error-filled brief makes no more sense than blaming the printing press for mistakes in a typed one. In both cases, fault lies with the lawyer who failed to check the motion before filing it, not the tool that helped produce it. For that is what AI is: neither a fad nor an apocalypse, but a tool in its infancy—and one that could radically change how lawyers work and law firms make money. The legal profession is hardly the only field about which one could say that. But few combine as clear a use case with so high a risk. Firms that get it right stand to reap rewards. Laggards risk going the way of typesetters.

According to a recent report from Goldman Sachs, a bank, 44% of legal tasks could be performed by AI, more than in any occupation surveyed except for clerical and administrative support. Lawyers spend an awful lot of time scrutinising tedious documents—the sort of thing that AI has already demonstrated it can do well. Lawyers use AI for a variety of tasks, including

due diligence, research and data analytics. These applications have largely relied on “extractive” AI, which, as the name suggests, extracts information from a text, answering specific questions about its contents.

“Generative” AIs such as ChatGPT are far more powerful. Part of that power can be used to improve legal research and document review. As Pablo Arredondo, creator of a generative-AI “legal assistant” called CoCounsel, explains, using it “removes the tyranny of the keyword...It can tell that ‘We reverse Jenkins’ [a fictional legal case] and ‘We regretfully consign Jenkins to the dustbin of history’ are the same thing.” Allen & Overy, a large firm based in London, has integrated a legal AI tool called Harvey into its practice, using it for contract analysis, due diligence and litigation prep.

Not all lawyers are convinced. One recent survey found that 82% of them believe generative AI can be used for legal work but just 51% thought it should. Many worry about “hallucinations” (as AI boffins refer to chatbots’ tendency to present falsehoods with aplomb, as in Mr Schwartz’s case) and about inadvertently feeding information subject to attorney-client privilege into algorithms. Yet if these challenges can be tackled—and they can, with better technology and careful humans in the loop—then the misgivings of the doubting 49% may pass. After news of Mr Schwartz’s debacle broke, for example, a federal judge in Texas told attorneys appearing before him to file a certificate attesting that they either did not use generative AI at all or that, if they did, they checked the final result. Much as it made little sense for lawyers to insist on doing legal research in libraries once the vastly larger and more easily searched databases of Westlaw and LexisNexis were a click away, when a critical mass of firms embraces generative AI, more will follow.

AI has the potential to transform the legal profession in three big ways. First, it could reduce big firms’ manpower advantage. In large, complex lawsuits, these firms tell dozens of associates to read millions of pages of documents

looking for answers to senior lawyers' questions and hunches. Now a single lawyer or small firm will be able to upload these documents into a litigation-prep AI and begin querying them. As Lawrence Lessig of Harvard Law School notes, "You can be a smaller, leaner specialised firm and have the capacity to process these sorts of cases."

Second, AI could change how firms make money. Richard Susskind, technology adviser to the Lord Chief Justice of England, argues that firms profit by "having armies of young lawyers to whom they pay less than they charge clients". If AI can do the work of those armies in seconds, firms will need to change their billing practices. Some may move to charging flat fees based on the service provided, rather than for the amount of time spent providing it. Stephen Wu of Silicon Valley Law Group speculates that firms may charge "a technology fee", so that "clients don't expect to get generative AI for nothing".

Third, AI could change how many lawyers exist and where they work. Eventually, Mr Lessig argues, it is hard to see how AI "doesn't dramatically reduce the number of lawyers the world needs". If AI can do in 20 seconds a task that would have taken a dozen associates 50 hours each, then why would big firms continue hiring dozens of associates? A veteran partner at a prestigious corporate-law firm in New York expects the ratio of associates to partners to decline from today's average of perhaps seven to one at the top firms to closer to parity. If associates aren't worried about their jobs, he says, "they should be".

That may not happen for a while, however. Moreover, AI could make legal services cheaper and thus more widely available, particularly for small and medium-sized businesses that currently often struggle to afford them. Ambitious law-school graduates may find that AI provides an easier path to starting a solo practice. If so, then AI could actually lead to an increase in the overall number of lawyers, as well as changing the sort of tasks they

perform—just as the ATM led to an increase in the number of human bank employees rather than their replacement.

Ultimately this will be good news for clients. “People who go to lawyers don’t want lawyers: they want resolutions to their problems or the avoidance of problems altogether,” explains Mr Susskind. If AI can provide those outcomes then people will use AI. Many people already use software to do their taxes rather than rely on professionals; “Very few of them are complaining about the lack of social interaction with their tax advisers.” ■



东非大碳谷

肯尼亚何以能引领除碳

地热能源和廉价人才带来相对优势

从红海延伸数千公里至莫桑比克的东非大裂谷是了解人类进化史的一个独特窗口。构造板块的漂移造就了那里幽深的湖泊和隐蔽的峡谷，为孕育现代人类的祖先以及保存他们的遗骨创造了条件。这些地质力量或许也能帮助人们以低成本从空气中捕获并储存导致全球变暖的二氧化碳，从而推开一扇通往未来的大门。

至少，肯尼亚环境学及发展专家詹姆斯·伊兰古·姆万吉（James Irungu Mwangi）心怀这样的希望。他称这个裂谷为“大碳谷”，大谈其中可以发掘的机会。他认为，这里具备发展可再生能源的潜能和适合碳储存的地质条件，这些关键特性有利于建立“直接空气捕获”（以下简称DAC）工厂，吸收空气中的二氧化碳。

DAC工厂需要大量能源，一部分是电力，用于运行风扇，把空气吹向吸收二氧化碳的化学品，然后还需要多得多的热能让这些化学品释放之前吸收的二氧化碳，再将二氧化碳压缩以供使用或储存。

东非大裂谷沿线的地壳较一般地方薄，因此地热潜能巨大。据美国政府估计，仅肯尼亚的地热发电潜力就达到10,000兆瓦，是其目前地热发电量的十倍多。这类发电站的一种副产品是大量废蒸汽，恰好可以用来加热DAC设备。而且由于肯尼亞近90%的电力来自可再生能源，这些设备消耗的电力不加剧全球变暖。

捕获二氧化碳只是整个过程中的一步。接下来还要把这些二氧化碳牢牢封存。东非大裂谷的地质条件在这方面也是得天独厚。它有绵延数千平方公里的多孔玄武岩（一种火山岩）地带。这使得该地区成为碳捕获和储存的“理想”之选，内罗毕大学的乔治·奥蒂诺·奥克克（George Otieno Okoko）和莉迪亚·奥拉卡（Lydia Olaka）在2021年发表的一篇论文指出。从空气中

捕获的二氧化碳会被溶于水中（与制造气泡水的方法相同）。再把这种带气泡的弱酸性液体注入岩石中。在那里，液体会与玄武岩发生反应，形成富含碳元素的矿物（实际上就是岩石），意味着这其中的二氧化碳不会再泄露回大气中。

已有类似的兼具地热能源和火山岩地质的其他地区吸引了企业投资。瑞士公司Climeworks于2021年在冰岛开设了全球最大的DAC工厂，每年可从大气中去除约4000吨二氧化碳，成本为每吨600至800美元。

肯尼亚创业公司Octavia Carbon的创始人马丁·弗赖米勒（Martin Freimüller）正在东非大裂谷建设全球第二大DAC工厂。他希望能以远比Climeworks低廉的价格封存二氧化碳，一方面是因为当地廉价的可再生能源电力和地热蒸汽，也因为在肯尼亚雇用专业工程师和化学家的成本低于富裕国家。

Octavia的试点DAC工厂计划于明年完工，预计每吨捕获成本远低于500美元。弗赖米勒的目标是在五年内把成本降至100美元以下，比波士顿咨询公司（BCG）预测的300至400美元的行业水平低得多。随着这个新市场的成熟，新生公司和技术将不得不迅速进化，否则只会被淘汰。■



The Great Carbon Valley

Why Kenya could take the lead in carbon removal

Geothermal energy and cheap talent offer comparative advantage

EAST AFRICA'S Rift Valley, which runs for thousands of kilometres from the Red Sea to Mozambique, provides a unique window into the evolutionary history of humanity. The shifting of tectonic plates that formed its deep lakes and sheltered canyons created conditions that first nurtured the ancestors of modern humans and then preserved their bones. Those geological forces may also push open a door to the future by making it possible to capture and store global-warming carbon dioxide cheaply from the air.

That, at least, is the hope of James Irungu Mwangi, a Kenyan environmentalist and development expert, who talks of the opportunity that could be afforded by what he calls “the Great Carbon Valley”. The rift, he argues, has the key attributes that make it attractive for “direct air capture” (DAC) stations to suck carbon dioxide from the air: renewable-energy potential and the right geology for storing carbon.

DAC plants need huge amounts of energy. Some of this is in the form of electricity, which is used to run fans blowing air through or over chemicals that absorb carbon dioxide. Much more energy is then needed in the form of heat to make these chemicals belch the gas, which is then compressed for use or storage.

Because the earth's crust is thinner than usual along the rift, it has vast geothermal potential. The American government reckons Kenya alone could generate 10,000MW of geothermal power, more than ten times the amount it currently produces. A by-product of such power stations is plenty

of waste steam, which can then be used to heat DAC machines. Moreover, since close to 90% of Kenya's power is renewable, the electricity these machines consume does not contribute to more global warming.

Capturing carbon dioxide is just part of the process. Next it has to be safely locked away. The rift's geology is particularly good for this, too. It has bands of porous basalt (a volcanic rock) that stretch across thousands of square kilometres. This makes the region "ideal" for carbon capture and storage, according to a paper published in 2021 by George Otieno Okoko and Lydia Olaka, both of the University of Nairobi. After carbon dioxide has been sucked from the air it is dissolved in water (in the same way one would make sparkling water). This slightly acidic and bubbly liquid is then injected into the rock. There it reacts with the basalt to form carbon-rich minerals—in essence, rocks—which means the gas will not leak back into the atmosphere.

A similar combination of geothermal energy and volcanic rock has already attracted companies elsewhere. Climeworks, a Swiss firm, opened the world's biggest DAC plant in Iceland in 2021. It can remove some 4,000 tonnes of carbon dioxide a year from the atmosphere at a cost of \$600-800 a tonne.

Martin Freimüller, the founder of Octavia Carbon, a Kenyan startup, is working to build the world's second-biggest DAC plant in the Rift Valley. He hopes it will be able to sequester carbon dioxide far more cheaply than Climeworks can, in part thanks to cheap renewable electricity and geothermal steam, and in part because hiring skilled engineers and chemists costs less in Kenya than in the rich world.

Octavia's pilot plant, scheduled for completion next year, is forecast to have costs of well below \$500 a tonne. Mr Freimüller aims to cut this to below \$100 within five years. That is far cheaper than industry-wide forecasts of

\$300-400 by BCG, a consulting firm. As this new market matures, nascent firms and technologies will have to evolve quickly, or die out. ■



回收旧轮胎

废旧轮胎可以变成对气候友好的燃料

从车轮上获取燃料【新知】

处理旧轮胎一直都是个难题。每年都有超过10亿条轮胎报废。直到最近，大部分废旧轮胎都被扔进了垃圾填埋场，或是摆在堆场里，时不时会着火。在更严格的环境法规之下，许多国家现在强制要求废旧轮胎回收。某种程度上它们的确是被回收了。所用的方法有些要好过直接丢弃，但也不是很环保。

能量回收是常用的方法之一。具体操作是在焚化炉中焚烧轮胎来发电，或是作为补充燃料为水泥窑和其他工业流程提供热能。但这会产生让地球变暖的污染。轮胎也可以整条或切碎后用于基建项目，如修建堤坝或修补道路。不过，有人担心轮胎中的化学物质会渗出污染地面。

因此，有些公司已经开始探索另一种令人愉悦的逆向闭环理念。既然轮胎主要由碳氢化合物制成，理论上应该可以将旧轮胎转化为低碳燃料，用于驱动产生旧轮胎的车辆。

在最为雄心勃勃地践行这一理念的公司中，有一家是总部位于挪威奥斯陆的Wastefront。今年晚些时候，它会开始在英格兰东北部的桑德兰动工建设一座巨大的轮胎回收工厂。待到几年后工厂完全投入运营时，将能够把800万条旧轮胎转化为新产品，其中包括大约2.5万吨被称为轮胎衍生油（tyre derived oil，TDO）的黑色粘稠液体。

这种工艺将轮胎拆解成三个主要部分。一是用来支撑轮胎结构的钢材，可以直接回收再用。二是炭黑，这是一种粉末状、类似煤烟灰的碳，用来提升轮胎的耐久性。三是橡胶，其中一些是从橡胶树的汁液中提取的天然橡胶，有些则是工厂用原油制成的合成橡胶。

拆解时首先要将轮胎切碎，除去支撑钢条。剩下的部分再经过一个叫做热

解的过程，即在没有空气的情况下将材料暴露在高温下。这会使橡胶分解成烃类气体的混合物，抽出这些气体之后，剩下的就是纯炭黑。

抽出的气体冷却后，其中一部分就会液化成TDO。剩余的气体含有甲烷，可以再输送回去为反应器提供燃料。Wastefront的老板维雅尼·瓦雷兹（Vianney Valès）说，这就创造出一个无排放的闭环系统。按重量计，整个加工过程的总产出有40%是TDO，30%是炭黑，20%是钢，剩下10%是燃气。

炭黑可以重新用于制造新轮胎。轮胎制造商对此有兴趣，因为有助实现碳中和。生产全新的炭黑需要不完全燃烧重油残渣或煤，会排放大量的温室气体。

回收的TDO类似于从地下开采出来的原油，非常适合制造柴油。为此，Wastefront正与瑞士公司维多（Vitol）合作，维多是世界上最大的独立石油贸易商，在世界各地经营着几家炼油厂。

虽然不是完全碳中和，但与传统燃料相比，由TDO制成的柴油确实能把二氧化碳这种主要温室气体的排放量减少80%到90%。尽管电动汽车正在稳步取代内燃机汽车，但未来清洁燃料的市场可能仍然很可观。在未来几十年里，化石燃料汽车仍会在路上行驶，尤其是像卡车这样的大型商用车辆，它们更难电动化，而且要烧大量柴油。火车和轮船也需要柴油。因此，在向交通电气化过渡的漫长过程中，任何有助于减少排放总量的措施都是有益的——尤其是它还能减少堆积如山的废物。■



Recycling old tyres

Old tyres can become a climate-friendly fuel

Getting fuel from your wheels

GETTING RID of old tyres has long been a problem. Every year more than a billion reach the end of the road. Until recently, most were thrown into landfills or piled up in storage yards, which occasionally caught fire. Tougher environmental laws mean many countries now insist tyres are recycled. And they are, sort of. Some of the methods might be better than dumping them, but they are not especially green.

Energy recovery is one common method. This involves burning tyres in an incinerator to generate electricity, or as a supplementary fuel to provide heat for cement kilns and other industrial processes. But that produces planet-warming pollution. Tyres can be used whole or shredded in construction projects, such as building embankments or repairing roads. There are, however, concerns about chemicals from the tyres leaching out and contaminating the ground.

Some firms, therefore, have begun exploring an alternative, pleasingly symmetrical idea. Since tyres are mostly made from hydrocarbons, it should be possible in principle to turn old tyres into low-carbon fuel which can be used to run the vehicles they came from.

One of the most ambitious firms pursuing the idea is Wastefront, which is based in Oslo, in Norway. Later this year the company will start building a giant tyre-recycling plant in Sunderland in north-east England. In a couple of years, when the plant is fully operational, it will be able to turn 8m old tyres into new products, including some 25,000 tonnes of a gooey black liquid called tyre derived oil (TDO).

The process works by deconstructing a tyre into its three main components. One is steel, which is used to brace the structure of a tyre and which can be readily recycled. The second is carbon black, a powdery, soot-like form of carbon used to improve the durability of the tyre. The third is rubber. Some of that will be natural rubber obtained from the sap of rubber trees. Some will be the synthetic sort, which is made in factories from crude oil.

In order to do the deconstructing, the tyres are first shredded and the steel bracing removed. The remaining material then goes through a process called pyrolysis. This involves exposing a material to high temperatures in the absence of air. That causes the rubber to decompose into a mix of hydrocarbon gases, which are drawn off. What is left behind is pure carbon black.

Once the drawn-off gas has cooled down, a proportion of it liquefies into TDO. The remaining gases, which include methane, are funnelled back around to be burned, fuelling the reactor. This, says Vianney Valès, Wastefront's boss, creates a closed-loop system that prevents emissions. The overall output of the process by weight is 40% TDO, 30% carbon black, 20% steel and 10% gas.

The carbon black can be re-used to make new tyres. That is of interest to tyre-makers because it helps efforts to become carbon neutral. Producing new carbon black requires the partial burning of heavy oil residues or coal, which produces plenty of greenhouse-gas emissions.

The recovered TDO is similar to crude oil fresh from the ground, and is well-suited for making diesel. To do that, Wastefront is working with Vitol, a Swiss company that is the world's largest independent oil trader, and which operates a number of refineries around the world.

While not completely carbon-neutral, diesel made from TDO does produce

an 80-90% reduction in emissions of carbon dioxide, the main greenhouse gas, compared with the conventional fuel. The future market for cleaner fuels is likely to remain substantial, even though electric vehicles are steadily replacing those with combustion engines. Fossil-fuelled vehicles will remain on the road for decades to come, particularly large commercial vehicles like lorries, which are harder to electrify and which are big burners of diesel. The fuel will also be needed by trains and ships. So, anything that helps to clean up overall emissions during what will be a long transition to the electrification of transport is useful—especially if it also shrinks a mountainous waste problem. ■



绿色能源

从空气中吸取碳中性燃料

为未来的汽车和飞机提供动力

今年3月欧盟通过了一项法律，要求从2035年起所有新车要实现零碳排放，而德国设法为使用“电子燃料”的车辆争取到了豁免。有人认为这是生产商继续向燃油车迷推销内燃机车的特许状。虽然这的确意味着有些烧汽油的跑车未来可能会继续生产，但支持者的希望是它们在烧油时不会让地球过热。

之所以叫“电子燃料”，因为它们是使用电力合成而来。其工艺是将氢与碳结合，生成各种碳氢化合物燃料，如柴油、汽油或航空煤油。

把水电解可以得到氢。碳则来自二氧化碳，可能是从工业烟囱里捕获，甚至通过所谓的直接空气捕获系统直接从大气中吸取。如果这两个过程都由零碳的电力驱动，那么生成的电子燃料就是碳中性的。毕竟，当燃料燃烧时，释放回空气中的碳与最初用来制造燃料的碳是一样的。

尽管少数大型工厂已经开始生产航空用的电子燃料，但大多数还是从过期食用油、动物脂肪和生物质中获取碳。有些工厂想要采用直接空气捕获，尽管这项技术很大程度上仍处于原型阶段。智利南部就有这样一家工厂。它由包括保时捷（属于德国大众汽车集团）在内的多家公司运营。智利是一个多风的地方，所以工厂由风力涡轮机供电。在它的直接空气捕获系统就绪之前，工厂从啤酒厂获取二氧化碳，那里的酵母在发酵过程中会产生二氧化碳。

对保时捷来说，以电子燃料为动力的车型将只会是副线，而不是主线产品。该公司的目标是到2030年超过80%的保时捷汽车使用电池。其电子燃料主管卡尔·达姆斯（Karl Dums）坦然承认，电动汽车在本质上总是比使用电子燃料的汽车效率更高。（因为将电力转化为合成燃料需要额外的步骤，而电池直接充电即可。）但他表示，2030年之后，路上仍将会有大量

内燃机汽车。这些汽车可以通过使用电子燃料而变得更加环保。

达姆斯认为，也许到这个十年结束时，规模经济会让电子燃料能与化石燃料抗衡。而且，他说，电子燃料可以让储存多余的可再生能源变得更为便捷，或者还能方便出口这些能源。智利有潜力生产大量的可再生电力。但是风和太阳不可预测，在一些日子里可能会生成多余的电力。智利缺乏远程电网将多余电力输送到其他地方。不过，如果将其转化为液体，就可以利用现有的化石燃料基础设施运往国外。

“最终，”达姆斯说，保时捷的业务是“为我们的客户实现梦想”。尽管电动汽车既平稳又轻快，但有些客户可能还是会怀念汽油发动机的轰鸣声。如果将来你真的想要一辆汽油动力的911，托电子燃料的福，保时捷也许真可以卖一辆给你。 ■



Green energy

Sucking a carbon-neutral fuel out of thin air

To power future cars and planes

WHEN IN MARCH the European Union approved a law requiring all new cars to have zero carbon emissions from 2035, Germany managed to wangle an exemption for vehicles running on “e-fuels”. Some saw it as a charter for producers to continue flogging internal-combustion engined cars to petrol-heads. While it does, indeed, mean some petrol-powered sports cars are likely to remain in production in the future, the hope is they can be powered without overheating the planet.

E-fuels get their name because they are made synthetically, using electricity. The process involves combining hydrogen with carbon to produce various hydrocarbon fuels, such as diesel, petrol or jet fuel.

The hydrogen can be made by using electrolysis to split water into its constituent elements. The carbon comes from carbon dioxide, perhaps captured from an industrial chimney-stack, or even sucked directly out of the atmosphere via so-called direct-air capture systems. Provided both processes are powered by zero-carbon electricity, e-fuels are carbon neutral. After all, the carbon released back into the air when the fuels are burned is the same that was used to make them in the first place.

Although a handful of big plants already make e-fuels for aviation, most obtain their carbon from old cooking oil, animal fat and biomass. Some aim to use direct-air capture, although the technology is still largely at the prototype stage. One such plant is in southern Chile. It is run by a group of companies that includes Porsche, part of the German Volkswagen group. Chile is a windy place, so the factory is powered by a wind turbine. Until its

direct-air capture system is ready, the plant is getting carbon dioxide from a brewery, where yeast produces it during fermentation.

For Porsche, cars powered by e-fuels will be a sideline rather than its main business. The firm aims to have more than 80% of its vehicles running on batteries by 2030. Karl Dums, the firm's head of e-fuels, readily agrees that an electric car will always be inherently more efficient than one that runs with e-fuels. (This is because of the extra steps involved in turning electricity into synthetic fuel, rather than just charging a battery directly.) But, he says, there will still be plenty of internal-combustion vehicles on the road after 2030. These could be made greener by filling them with e-fuels.

Dr Dums reckons economies of scale could make e-fuels competitive with fossil ones, perhaps by the end of the decade. And, he says, they offer a convenient way to store surplus renewable energy, or to make it suitable for export. Chile has the potential to produce huge amounts of renewable power. But the wind and the sun are unpredictable, and on some days could produce more electricity than necessary. Chile lacks the long-range grids to transmit that surplus elsewhere. If it were turned into a liquid, though, it could be shipped abroad using existing infrastructure designed for fossil fuels.

“In the end,” says Dr Dums, Porsche’s business is “fulfilling dreams for our customers.” Although electric cars are both smooth and nippy, some of those customers might miss the growl and thunder of a petrol-powered engine. If you do fancy a petrol-powered 911 in the future, e-fuels might allow Porsche to sell you one. ■



巴托比

为什么员工忠诚度可能被高估

朝三暮四大有好处

求职面试让人有机会实时观察忠诚的转向。在面试刚开始时，面试者通常会用“你们”来称呼可能的未来雇主（“你们希望这个职位上的人具备什么素质？”）。但时不时地，这个人称代词会发生变化（“我们应该多多思考我们线下营销的方法。抱歉，我的意思是“你们”）。

这个“我们”是带人穿越时空的微小一瞥，让人目睹某人想象自己是一家新公司的员工，一个崭新的身份正在成形，忠诚正在转移。

在大多数情况下，忠诚都被视为一种美德：在朋友、家人和足球迷之间。然而，员工的忠诚要更复杂。它更具交易性质。朋友之间不会做绩效评估，或因为成本原因炒对方鱿鱼。它也更不对等。员工可能对公司生出依恋之情，而公司却可能完全不为所动。（这就是为什么比起对于所在的组织，人们通常对团队成员和老板个人更忠诚。）而且，过多的员工忠诚可能造成高昂的代价。

涨工资和事业发展是建立在人们换工作的基础上的。亚特兰大联邦储备银行追踪了美国的工资增长，根据其数据，4月换工作的人的工资比去年同期高出7.6%，而守着老工作的人的薪水只高出5.6%。其他人稍微朝秦暮楚一点，那些不挪窝的人可能也会沾光。澳大利亚财政部官员内森·德意切尔（Nathan Deutscher）的一篇论文发现，在澳大利亚，不管是换了工作的还是没换工作的劳动者，当地劳动力市场上的跳槽率升高与他们的工资增长加快都存在关联。忠诚蛮好，议价能力也是。

过分忠诚还可能以其他方式伤害员工。今年早些时候，杜克大学的马修·斯坦利（Matthew Stanley）和合著者发表了一项研究，测试了老板们对忠诚的员工的看法。研究人员考察了管理者们在多大程度上愿意让一个名叫约翰的虚构员工无偿加班。如果约翰被描述为忠诚，那么老板们就更乐意

把更多的工作丢给他。反过来也适用：干更多活却没有奖励的员工更有可能被管理者描述为忠诚。要记得，狗是以忠诚而不是以聪明著称的。

雇主们往往对什么能激发忠诚心知肚明。发放留任奖金等于承认要留住最优秀的员工可能需要一点点“说服”。真正的忠诚往往会换来毫无价值的奖励：服务25年的员工可以多休一周假？奈飞（Netflix）鼓励自己的员工与猎头及其他招聘人员接触，了解自己在公开市场上的身价，这样它就可以开出挽留的价码（如果你本就打算支付最高价，这么做合情合理，但如果你在非营利部门，这就不大行得通了）。

尽管如此，企业还是可能会固守忠诚这种理念。上世纪50年代离开肖克利半导体实验室（Shockley Semiconductor Lab）创建飞兆半导体（Fairchild Semiconductor）的那群员工得了个出名的称号：“叛徒八人组”。这种轻蔑如今仍然很常见。但是，除非你是黑手党成员或神职人员，否则加入竞争对手既非背叛，也非异端。事实上，那些离开一个雇主后又“吃回头草”的员工能带来新技能，公司又对他们知根知底，这是个很有价值的组合。

员工过于忠诚可能对社会造成不良影响。2019年，芝加哥大学的詹姆斯·邓根（James Dungan）和他的合著者发表了一篇关于“吹哨”的论文。论文发现，如果员工更关心本组织以外的人们是否得到公平对待，就更有可能检举不义行为。如果他们更多受忠诚的驱使，就更不可能这样做。其他研究表明，竞争性的环境可能会促使忠于某群体的成员为了胜过另一个群体而舞弊。

员工忠心耿耿可能会非常棒。公司想要的是对自己尽忠的员工——那些愿意为它付出更多努力且不会一转头就加入竞争对手的人手。员工希望能相信公司并能在那找到归属感，能有信心公司值得他们投入有限生命中的大块时间。如果员工留在公司是因为觉得自己对公司倾注了很多，而不是因为找不到更好的下家，那对工作满足感和工作表现而言都会是更有益的。但在职场中，忠诚是一种自利的决定，而非一种道德决定。忠诚应该取决于个人是否被善待，而不应成为一个越发难以打破的习惯。如果你选择待在原地不动，最好是因为你喜欢那里，而不是因为离开是不道德的。





Bartleby

Why employee loyalty can be overrated

Many a fickle makes a muckle

JOB INTERVIEWS are an opportunity to see allegiances shift in real time. A candidate will usually refer to a prospective employer as “you” at the start of an interview (“What do you want to see from someone in this position?”). But occasionally the pronoun changes (“We should be thinking more about our approach to below-the-line marketing. Sorry, I mean ‘you’ should be”). That “we” is a tiny, time-travelling glimpse of someone imagining themselves as the employee of a new company, of a fresh identity being forged and of loyalties being transferred.

Loyalty is seen as a virtue in most situations: among friends, family and football fans. Employee loyalty, however, is more complex. It is more transactional. Friends don’t give each other performance reviews or fire each other for cost reasons. It is less reciprocal. A worker can feel attachment to a company and a company can feel precisely nothing. (Which is why people often feel more loyal to team members and individual bosses than to their organisations.) And too much of it can impose high costs.

Wage bumps and careers are built on people changing jobs. According to the Federal Reserve Bank of Atlanta, which tracks wage growth in America, in April job switchers were being paid 7.6% more than a year earlier; job stickers were being paid only 5.6% more. A little promiscuity on the part of other people can help those who choose to stay where they are. A paper by Nathan Deutscher, a Treasury official in Australia, found that higher rates of job-hopping in local Australian labour markets were associated with faster wage growth both for workers who switched jobs and for those who did not. Loyalty is nice; so is bargaining power.

Too much loyalty can harm workers in other ways. A piece of research published earlier this year by Matthew Stanley of Duke University and his co-authors tested how bosses felt about loyal workers. The researchers asked managers how willing they were to ask a fictional employee named John to work overtime for no pay. If John was described as loyal, then bosses were happier to dump more work on him. The reverse also applied: workers who did more work for no reward were more likely to be described by managers as loyal. Dogs are known for their loyalty, remember, but not for their brains.

Employers tend to be clear-eyed about what generates loyalty. Retention bonuses are an admission that the best employees might need a little nudge to stay. Actual loyalty tends to get nugatory rewards: a week's extra holiday for 25 years of service? Netflix encourages its employees to speak to recruiters so that they know their worth in the open market and so that it can respond with counter-offers (an approach that makes more sense when you are prepared to pay top dollar and less so if you are in the non-profit sector).

Companies can nonetheless be wedded to the idea of loyalty. The group of employees who left Shockley Semiconductor Lab in the 1950s to found Fairchild Semiconductor was famously dubbed the “traitorous eight”. Some of that attitude still prevails. But unless you are a member of the mafia or a cleric, joining a competitor is neither treachery nor heresy. Indeed, boomerang hires—people who leave an employer and then come back—can offer a valuable blend of known quantity and new skills.

Society can suffer if there is a surfeit of employee loyalty. A paper on whistle-blowing, published in 2019 by James Dungan of the University of Chicago and his co-authors, found that employees were more likely to report wrongdoing if their concern was fair treatment of people outside the organisation and less likely to do so if they were more motivated by

loyalty. Other research suggests that competitive situations can encourage loyal members of one group to cheat in order to best another.

Employee loyalty can be great. Companies want workers who feel committed to them, who are prepared to go the extra mile and not join a rival at a moment's notice. Workers want to believe in and belong at a firm, confident that it warrants chunks of their finite time on Earth. It is better all around, for job satisfaction and for performance, if employees stay put because they feel invested in their organisation than because they haven't got a better offer. But loyalty in the workplace is a self-interested decision, not a moral one. It should be contingent on being treated well, not a habit that becomes harder to break. Stay where you are because you like it, not because to leave would be immoral. ■



腐败克星

一个新的超级监管机构瞄准中国金融界泛滥的腐败

对中国的金融骄子们来说，严峻时刻到来

中国金融界几乎每天都有人“落马”接受反腐调查。官方媒体在6月5日警告称，银行业充斥着“蛀虫”——从内部一点点啃食银行资源的中层管理人员。而“内鬼”，也就是利用内部关系从银行窃取巨款的高管，往往带来更大的危险。查办的案件中有“窝案”，即同时在多家银行发现团伙欺诈；还有“串案”，即一个银行高管被捕接二连三地牵扯出其他人。在最近一连串的丑闻之后，一家官方报纸将中小银行称为“反腐重灾区”。

这样的用语透露出在拥有400万亿元资产的中国庞大的金融系统中贪腐泛滥。据官方声明和媒体报道，今年1月至5月，至少有60家金融机构有人员受到重点调查。本刊的研究显示，在过去五年里，中国八家最大银行的78名高管接受了调查或被指控腐败。自2018年以来，相关部门还调查了38.5万名涉嫌将银行当作个人小金库的村镇银行股东。

随着共产党大大加强了对执法的掌控，这场反腐运动没有减弱的迹象。今年早些时候，中央政府宣布将成立一个超级监管机构，负责监督除证券业之外的所有金融领域，这是20年来最大的监管改革。这一机构运用其超大权力的方式势必会重塑金融系统，而这个部门的健康和稳定对中国乃至全球经济都至关重要。

新机制仿照美国力图避免重叠授权的模式而建。这个名为国家金融监督管理总局（以下简称金融监管总局）的新机构被赋予了更靠近中央的地位。这让它拥有更强的执法权，类似美国的证券交易委员会（Securities and Exchange Commission）。它承担了保护投资者的职责，就像美国的金融稳定监督委员会（Financial Stability Oversight Council），并从中国人民银行手中接过了金融监管的职责（人行如今和美联储一样专注于宏观审慎政策）。

金融监管总局正着手推进可能已是史上最大规模的金融整顿运动。从2017年开始，其前身中国银保监会奋力减缓可能引发危险的高风险金融活动的增长。它加强了对影子银行的控制，将影子贷款的存量规模从2017年相当于银行总资产的25.3%缩减至去年的仅13.5%。它扼制了无序扩张的金融公司和试图操纵金融体系的权贵，其中包括安邦保险集团和中型银行包商银行。它摧毁了规模一万亿元的“P2P”个人对个人网贷平台。此外，中央政府还推倒了中国最著名的企业家马云的金融科技帝国，此前他的公司蚂蚁集团建立了规模庞大的贷款业务而没有受到多少监管。

新监管队伍将必须面对不断上升的整顿成本。许多理财产品爆雷，引发了投资者的抗议。整顿城商行和救助几家大型银行的花费已经达到10万亿元。仅救助安邦一家就耗资100亿美元。成千上万P2P借贷产品的投资者血本无归。近630家小银行进行了重组。

马云的倒台损害了中国作为创业实验安全之地的声誉。包凡不久前被拘留也产生了同样的负面影响，他是中国最著名的投资银行家之一。面对此类批评，监管高层大为恼火，他们认为，至少在马云的案例中，官方行动对于一个高风险的商业模式来说还过于畏手畏脚了。新系统赋予了金融监管总局对蚂蚁集团等金融控股公司的监管控制权，将会修正这一点。

对金融业的监管构想已逐步清晰。高官们相信自己一方面选取了美国体系的长处，一方面又摈弃了华尔街的价值观。在他们看来，这种价值观过去20年里已经渗入中国。这给银行家们传递了一个严峻的信息。企业家将被允许继续获取巨额财富。但政府不希望银行家富得离谱。似乎没有哪位知名金融家能够免受反腐调查，无论他知名度多高。

金融监管总局面临几个紧迫的任务。首先，它必须用自己的人手替换地方金融监管机构，并拆除银行与地方政府之间的连结。上世纪90年代以来新成立了数千家银行，加上政客们下令不断大兴土木，助长了不良资产的泛滥。全国各地涌现的小型贷款机构往往与当地政府和最大的公司（也就是开发商）关系密切。很多时候，在银行持有股份或有绝对控制权的房地产大亨利用银行为自己的生意提供资金。一个结果便是长达十年的高速经济

增长。另一个结果是贪腐猖獗和资金配置不当。

许多人认为腐败是中国金融稳定最大的威胁。咨询公司Enhance的山姆·拉德万（Sam Radwan）表示，到目前为止，这轮对腐败的猛攻卓有成效。被捕人数可能会下降。但这场反腐运动中曝光了大量不良资产，要将它们从金融系统中清理掉将是一项艰巨的工作，而且很紧迫。银行、房地产开发商和市政府之间的紧密联系给银行业留下了大量高风险贷款。澳新银行（ANZ）的邢兆鹏表示，在中国，开发商和地方政府下属企业欠银行130万亿元，约占银行总资产的42%。

这些债务大部分被认为是健康的。不久前被任命为金融监管总局局长的李云泽在6月8日表示，风险总体可控。在对银行系统最新的调查中，人行表示，整个系统中只有1.6%的资产被认为是高风险资产。

如果开发商和地方政府的处境恶化，情况可能就不这么乐观了。而这两方都感到越来越难以偿还贷款。一批被称为地方政府融资平台的公司常常以城市或省份的名义向银行借款，而最近几周，由于很多这类平台显现出即将违约的迹象，市场惊慌不已。此类风险往往突如其来，并有可能伤及银行。据称，中国最大开发商之一的大连万达已开始与银行就一项贷款延期计划进行谈判。它的未偿贷款超过900亿。中国西南部的一家地方政府融资平台据传正在用当地的社保基金偿还贷款。

如果不能处理好这一大堆债务，就有可能让整个系统陷入不良信贷的泥潭。许多这类贷款可能不会在一夜之间变成有毒资产。但其中一些会长期拖累银行利润。中国南部的另一家地方政府融资平台不久前与银行达成协议，通过降低利率和将贷款期限延迟20年，重组了156亿元的贷款。在这种情况下，银行除了展期之外几乎别无选择。

多年来，监管机构一直在尝试合并坏账银行。迄今为止已经合并了23家城商行。但业内人士表示，这个过程非常繁琐，可能会拖延数年，且最终可能只得到更大的坏账银行。还有一种选择是让银行倒闭。这种做法只试过几次，而且有可能带来存款挤兑的风险——这与中国领导人想要实现的稳

定背道而驰。

大银行正在吸收一些中小银行的坏账。但它们这方面的能力有限，而且也不太可能接受陷入困境的银行的股权。据中国的媒体报道，一些地方国有企业已经开始向村镇银行注入流动性并持有其股份。这种类型的资本重组正在改善银行的资产负债表，并留给它们更多余地来处理坏账。

治疗金融部门的唯一办法是识别并处理不良贷款。但此前所做的努力杂乱无章。2019年，监管机构表示将要求银行公布不良贷款的真实规模，而不是用花里胡哨的做账方法来隐藏它们。但随后的新冠疫情迫使监管机构放松了这些规定的执行；它们还指示银行将贷款展期。此举避免了大规模的企业违约，但也让不良资产进一步暗中积累。不良债务投资公司新岸资本（ShoreVest Partners）的方杰明（Ben Fanger）表示，随着疫情的结束，拖延已久的认识更多坏账的工作现在启动了。这意味着大量不良资产即将涌入市场。

国有资产管理公司将以折扣价买下其中部分坏账。20年前，堆积如山的不良资产未能吸引那些搜罗便宜货的人，而如今不同的是，更多本地私人投资者愿意从银行抢购不良贷款。一些企业投资者还将在房地产行业的残局中搜寻不良债务，以期用低价接手一些项目。随着经济放缓和金融腐坏的程度暴露，中国新的监管机构只能寄希望于这样的投资者能有足够多。■



Graftbusters

A new super-regulator takes aim at rampant corruption in Chinese finance

Grim times for the country's star moneymen

HARDLY A DAY passes without someone in Chinese finance “falling off his horse”, or coming under a corruption investigation. State media warned on June 5th that the banking industry is infested with “moths”—mid-level managers who slowly ingest lenders’ resources from the inside out. “Internal ghosts”, executives who use insider connections to pilfer billions from banks, often pose a greater danger. There are “nest cases”, where clusters of fraud spanning several banks are discovered at once, and “skewer cases”, in which the arrest of one banker leads to another, then another. After a recent spate of scandals an official newspaper dubbed smaller banks an “anti-corruption disaster zone”.

Such parlance hints at pervasive graft throughout China’s vast financial system, which has assets of 400trn yuan (\$56trn). Between January and May at least 60 financial institutions were hit with major investigations into personnel, according to official statements and press reports. Research by The Economist shows that, over the past five years, 78 executives at China’s eight largest banks have been investigated or charged with corruption. Since 2018 authorities have also probed 385,000 shareholders of rural banks suspected of using the lenders as personal piggy banks.

The crackdown has shown no sign of ebbing as the Communist Party gains a much firmer grip over enforcement. In the biggest regulatory change in two decades, the central government announced earlier this year that it would create a super watchdog that oversees all areas of finance except the securities industry. How it applies its mega-powers is bound to remould a

sector the health and stability of which matters hugely not just to China, but also to the global economy.

The new system is modelled on America's, which seeks to avoid overlapping mandates. The National Administration for Financial Regulation (NAFR), as the new watchdog is dubbed, has been granted status that moves it closer to the central government. That gives it stronger enforcement powers, similar to America's Securities and Exchange Commission. It has gained investor-protection responsibilities, akin to America's Financial Stability Oversight Council, and taken over financial oversight from the central bank (which, like the Federal Reserve, now focuses on macroprudential policy).

NAFR is preparing to take forward what has perhaps been the most extensive financial clean-up campaign in history. Starting in 2017, its predecessor scrambled to slow down a dangerous rise in risky financial activities. It tightened rules on shadow banking, shrinking the stock of shadow loans from the equivalent of 25.3% of total banking assets in 2017 to just 13.5% last year. It subdued sprawling financial firms and powerful people that had sought to manipulate the system. Among them were Anbang, an insurance group, and Baoshang Bank, a mid-tier lender. It crushed a 1trn yuan peer-to-peer lending industry, where people lent to one another via online platforms. The central government also upended the fintech empire of Jack Ma, China's most famous entrepreneur, after his company, Ant Group, built a mammoth lending business that received little regulatory scrutiny.

The new team will have to reckon with the costs of the clean-up, which are mounting. Many wealth-management products have gone bust, causing investors to protest. The bill for cleaning up urban banks and bailing out several large lenders has come to 10trn yuan. Rescuing Anbang alone cost \$10bn. Tens of thousands of investors in peer-to-peer lending products have lost their savings. Nearly 630 small banks have been restructured.

The cutting down of Mr Ma has hurt China's reputation as a place safe for entrepreneurial experimentation. So has the recent detention of Bao Fan, one of China's most famous investment bankers. Senior regulators bristle at such criticisms and feel that, at least in Mr Ma's case, official actions were too timid for a risky business model. The new system will rectify that by giving NAFR regulatory control over financial holding companies such as Ant.

The vision for regulating the financial sector is becoming clear. Senior officials believe they have chosen the best features of the American system while rejecting the values of Wall Street, which, in their view, have seeped into China over two decades. The message to bankers is grim. Entrepreneurs will be allowed to continue to reap enormous fortunes. But the government does not want bankers to become exorbitantly wealthy. No celebrity financier, no matter how high-profile, appears immune from corruption probes.

NAFR has several pressing tasks ahead of it. First it must replace local financial regulators with its own teams and dismantle the connections between banks and local governments. The establishment of thousands of new banks since the 1990s and commands from politicians to build endlessly have helped feed a cesspool of bad assets. The small lenders that sprung up across the country often had close connections with local governments and the largest local companies, namely developers. In many cases tycoons who held shares in the banks, or controlled them outright, used them to fund their businesses. One result was a decade of high-speed economic growth. Another was rampant graft and poor allocation of funds.

So far the onslaught on corruption, the biggest threat to China's financial stability according to many, is proving highly effective, says Sam Radwan of Enhance, a consultancy. The number of arrests will probably fall. But to purge the financial system of the bad assets revealed by the campaign will

be a big job—and it is an urgent one. Tight links between banks, property developers and city governments have left the industry with masses of risky loans. Developers and local-government companies owe China's banks 130trn yuan, or about 42% of total banking assets, according to Xing Zhaopeng of ANZ, a bank.

Most of those debts are deemed healthy. Li Yunze, who was recently appointed to lead NAFR, said on June 8th that the risks are controllable. In its most recent review of the banking system, the central bank said just 1.6% of total system assets are considered high-risk.

That could change if things get worse for developers and local governments. Both are finding it increasingly hard to pay back loans. A group of companies called local-government financing vehicles (LGFVs), which often borrow from banks on behalf of cities and provinces, have spooked markets in recent weeks as many show signs of impending failure. Such risks often emerge suddenly and have the potential to contaminate banks. Dalian Wanda, one of China's top developers, has reportedly entered into talks with banks on a loan-relief plan. It has more than 90bn in outstanding loans. An LGFV in south-west China is rumoured to be paying back loans using local social-security funds.

Failure to handle this pile of debt threatens to mire the system in bad credit. Many such loans may not turn into toxic assets overnight. Instead, some will become long-term drags on bank profits. Another LGFV in southern China recently agreed with banks to restructure 15.6bn yuan in loans by lowering interest rates and pushing the maturity of the loans out by 20 years. In such situations banks have few other options than to extend.

Regulators have been experimenting with merging bad banks for years. So far 23 urban banks have been combined. But insiders say the process is cumbersome, can drag on for years and ultimately leads to the creation of

larger bad banks. Another option is letting banks fail. This has been tested only a few times and risks causing runs on deposits—the opposite of the stability China's leaders are trying to achieve.

Large banks are absorbing some bad debts from smaller ones. But their ability to do this is limited, and they are unlikely to take on equity in troubled banks. Some local state-owned firms have started injecting liquidity into rural lenders and taking shares in them, according to Chinese media. This type of recapitalisation is bolstering banks' balance-sheets and giving them more room to dispose of bad debts.

The only way to heal the sector is to recognise and treat soured loans. Efforts to do so have been haphazard. In 2019 regulators said they would require banks to declare the true scale of bad loans instead of using fancy accounting to hide them. But the pandemic then forced watchdogs to enforce the rules less stringently; they also told banks to roll over loans. This avoided mass corporate defaults, but also added to the hidden accumulation of bad assets. Now, with the pandemic at an end, the long-delayed recognition of more bad debts is starting, says Ben Fanger of ShoreVest Partners, an investor in distressed debt. This means a vast flow of toxic assets is coming on to the market.

State-owned asset managers will buy up some of that debt at discounted rates. Unlike 20 years ago, when the previous mountain of bad assets failed to lure bargain-hunters, there are now more local private investors willing to snap up non-performing loans from banks. Some corporate investors will also pick through the rubble of the property sector to search for distressed debts that allow them to take over projects on the cheap. As the economy slows and the extent of the financial rot is revealed, China's new regulators can only hope there are enough of them. ■



司法失控

两本书就美国最高法院的权力发出警示

但《绝对多数》和《影子裁决》提出的批评各有侧重【《绝对多数》、《影子裁决》书评】

《绝对多数》，迈克尔·沃尔德曼著。西蒙与舒斯特出版社，400页；29.99美元。

《影子裁决》，斯蒂芬·弗拉德克著。Basic Books出版社，352页；30美元。

美国最高法院并非从一开始就像今天这样手握大权且有时甚至专横跋扈。在1777年的《邦联条例》（Articles of Confederation）中，根本就没有设置联邦法院。作为1789年在宪法中新增的第三个机构，起初有点像是画蛇添足。1800年美国政府搬迁到哥伦比亚特区时，大法官们只能在国会大厦的地下室开会。国会对最高法院一点也不客气，让法官在夏天出去“巡回审判”，甚至取消了他们从1802年4月到1803年2月的任期。

然而那年晚些时候，第四任首席大法官约翰·马歇尔（John Marshall）大胆地抓住了司法审查的权力——可以推翻违宪的法律。120多年后，第十任首席大法官威廉·霍华德·塔夫脱（William Howard Taft）坚持要把大法官们从国会的老巢中解放出来，将他们安置在马路对面威严雄伟、专属于他们的大楼里。

塔夫脱的这座“大理石宫殿”的青铜前门高17英尺（5米），每扇重达6.5吨，意气风发的法学家们在里头一锤定音，而他们正是两本新书的主角。纽约大学布伦南司法中心（Brennan Centre for Justice）主任迈克尔·沃尔德曼的《绝对多数》（The Supermajority）分析了去年几项裁决的深远影响。得克萨斯大学法学教授斯蒂芬·弗拉德克（Stephen Vladeck）所著的《影子裁决》（The Shadow Docket）则第一次揭示了最高法院如何用不太显眼（但影响渐增）的方式暗中扭曲宪法。两位作者都想要发出警示。

沃尔德曼关注的焦点是最高法院里保守派以6比3占多数的局面。自1970年以来，由共和党任命的法官一直都在该院占据主导，但《绝对多数》回顾了2022年6月的三项裁决，表明最高法院现在已经全面右倾。多布斯诉杰克逊妇女健康组织案（Dobbs v Jackson Women's Health Organisation）推翻了半个世纪以来为堕胎权提供宪法保护的裁决。沃尔德曼表示，大法官塞缪尔·阿利托（Samuel Alito）在多数意见书中的思路将“19世纪的社会规范原封不动地保留下来”。

他还痛斥了这些绝对多数派对持有和携带武器权利的极端诠释。在纽约州步枪和手枪协会诉布鲁恩案（New York State Rifle & Pistol Association v Bruen）中，大法官克拉伦斯·托马斯（Clarence Thomas）无视“历史上压倒性的证据”，即“禁止携带隐蔽武器并无不妥”。在西弗吉尼亚州诉环保署（West Virginia v Environmental Protection Agency）案中，法院否决了一项限制温室气体排放的计划，“严重阻碍”了政府应对气候变化的能力。

沃尔德曼指出，在有争议的问题上抛弃先例、彻改法律可说是厚颜无耻，但这种情况以前也发生过。在另外三个时期，最高法院“分裂了美国”：1857年臭名昭著的德雷德·斯科特（Dred Scott）判决为美国内战铺平了道路；20世纪初的一些裁决阻碍了工人改革，包括（在一段时间内）阻碍了罗斯福新政；20世纪50和60年代自由派的沃伦法院（Warren Court）触发了保守派的强烈抵制。

书中关于这些历史的章节有点单薄，尤其是对沃伦法院的分析本应更加犀利。沃尔德曼写道，随着各种权利在美国扩大普及，这一时期是最高法院“最伟大的时代”——但他也批评大法官们“为了迎合自己的政治偏好而捏造权利”。有些令人难以置信的是，他在字里行间暗示，如果过去在避孕、堕胎和刑事司法方面的裁决没有采用那么“时髦有趣”和“迷幻”的措辞，或许保守派就不会如此怒不可遏。

弗拉德克对历史的叙述更加细致入微，也与他书中的论点相得益彰：最高法院滥用“影子裁决”（紧急诉讼程序）而损害了其合法性。“最高法院大部分行为都发生在幕后，”他解释说，而且“遮遮掩掩”。

“影子裁决”一词在2015年才出现，但这个概念和最高法院一样古老——是指任何不经口头辩论的裁决，通常不多加解释，也少有法官透露投票情况。在2017年之前，影子裁决“几乎毫无争议”。这在特朗普任期内发生了变化，那届政府扩大了“紧急”的概念，频繁向大法官发起申请。在之前四个总统任期内，总检察长总共只提交了八份紧急申请。特朗普的官员提交了41份。最高法院大部分时间都相当配合，满足他至少部分愿望共28次，包括调用资金来修筑他的边境墙，禁止穆斯林国家的公民入境，以及处决联邦囚犯。

弗拉德克为影子裁决的兴起写下了引人入胜的编年史。他追溯到1890年，当时最高法院在其常规案件中获得了更多的自由裁量权，并就拒绝审理案件的决定“开创了不予解释的做法”。接下来是最后一刻死刑上诉激增（不得不任命一名“死刑书记员”来处理这些申请）。弗拉德克批判的一个典型出现在1984年，当时大法官威廉·布伦南（William Brennan）在以5比4的投票恢复执行一项死刑时投了反对票。他称之为“站不住脚的、未加解释的草率判决”，“麻木不仁，甚至残忍可怖”。

作者发挥自己身为一名法学教授的才能，清晰透彻地解释了最高法院如何在涉及堕胎、宗教自由和选举法的影子裁决中随意践踏自己的法理。他强调，大法官艾米·康尼·巴雷特（Amy Coney Barrett）在上任头几周所扮演的角色不声不响但“影响惊人”。她投下的第五票支持以宗教理由反对防疫公共卫生措施，四个月前这些反对理由被左翼大法官和首席大法官约翰·罗伯茨（John Roberts）联手否决。

沃尔德曼的观点来自与大法官的实质性分歧，而弗拉德克的论点更加公允。他称赞了一个他不赞同的判决，因为在程序上“按章办事”，而批评了另一个他赞同的判决，因为没有给出理由充分的解释。他还注意到，最近有迹象表明一些大法官在外界的批评声音之下（尤其是弗拉德克本人的批评，但他并不居功），在使用影子裁决时变得更明智了些。

要约束最高法院不容易。沃尔德曼坚持认为美国左翼民众“不能再热爱最高法院”，这种看法有点奇怪，因为四分之三的民主党人本来就已经厌

憎它了。面对多布斯案判决引发强烈反弹的迹象，他欢欣鼓舞，但并没有说明这种集体情绪如何能够促成他提出的一项改革——限制大法官任期（他也承认，无论如何，大法官自己就可以推翻这些限制）。弗拉德克将最高法院运作系统的一个晦暗角落暴露在阳光之下，诉求看起来更加温和不起眼。但是《影子裁决》的启示可以为大法官的工作带来更多原则、问责和“程序规范性”——有助于避免这个充满争议的机构完全脱离轨道。■



Runaway justice

Two alarming books on the power of America's Supreme Court

But the criticisms in "The Supermajority" and "The Shadow Docket" are different

The Supermajority. By Michael Waldman. Simon & Schuster; 400 pages; \$29.99

The Shadow Docket. By Stephen Vladeck. Basic Books; 352 pages; \$30

THE SUPREME COURT of the United States did not start out as the powerful, at times imperious, institution of today. Under the Articles of Confederation of 1777, there were no federal courts at all. The third branch added by the constitution in 1789 was, at first, something of a third wheel. The justices met in the basement of the Capitol when the government moved to the District of Columbia in 1800. Congress paid the Supreme Court little courtesy, sending justices to "ride circuit" over the summer and even cancelling their term from April 1802 to February 1803.

Later that year, however, John Marshall, the fourth chief justice, boldly seized the power of judicial review—the ability to strike down laws that violate the constitution. A century and a quarter later, the tenth chief, William Howard Taft, insisted on liberating the justices from Congress's lair and installing them in a spectacular home of their own across the road.

The emboldened jurists now calling the shots in Taft's "marble palace"—the bronze front doors of which stand 17 feet (five metres) high and weigh six and a half tons apiece—are the cast of two new books. "The Supermajority" by Michael Waldman, head of the Brennan Centre for Justice at New York University, analyses the seismic effects of rulings made last year. "The Shadow Docket" by Stephen Vladeck, a law professor at the University of Texas, is the first book to pull back the curtain on the less visible (but

increasingly influential) way the court is twisting the constitution in the shadows. Both authors aim to alarm.

Mr Waldman's focus is on the court's 6-3 conservative majority. Republican appointees have dominated the court since 1970, but in recapping three decisions of June 2022, "The Supermajority" shows that the rightward lean has gone full tilt. *Dobbs v Jackson Women's Health Organisation* abandoned rulings that for half a century provided a constitutional right to abortion. Justice Samuel Alito's approach in his majority opinion preserves "in amber 19th-century social norms", says Mr Waldman.

He also lambasts the supermajority for its extreme interpretation of the right to keep and bear arms. In *New York State Rifle & Pistol Association v Bruen*, Justice Clarence Thomas ignored "overwhelming evidence throughout history" that "prohibitions on carrying concealed weapons were just fine". And by striking down a plan to restrict greenhouse-gas emissions in *West Virginia v Environmental Protection Agency*, the court "hobbled" the government's ability to deal with climate change.

Casting aside precedents and revolutionising the law on contentious questions may be brazen, Mr Waldman notes, but it has happened before. In three other periods, the court "divided America": the infamous Dred Scott decision of 1857 paved the way for civil war; rulings in the early 20th century blocked worker reforms, including (for some time) the New Deal; and the liberal Warren Court of the 1950s and 1960s triggered a conservative backlash.

These historical sections in the book are thin; its analysis of the Warren Court, in particular, could be sharper. Mr Waldman writes that this period, with its expansion of rights in America, was the court's "greatest era"—yet he also criticises its justices for "making up rights to fit their political predilections". Somewhat implausibly, he implies that conservatives might

have been less upset if decisions on contraception, abortion and criminal justice had been couched in less “groovy” and “psychedelic” terms.

The history that Mr Vladeck recounts is more nuanced, as well as being attuned to the argument of his book: that the court has damaged its legitimacy in abusing its “shadow”, or emergency, docket. “Most of what the court does is behind the scenes,” he explains, and “shrouded in obscurity”.

The term “shadow docket” dates only to 2015 but the concept—any decision made without oral argument and, typically, with scant explanation and few justices disclosing how they voted—is as old as the Supreme Court. Until 2017 shadow-docket affairs were “almost entirely uncontroversial”. That changed when Donald Trump’s administration stretched the concept of “emergency” by regularly running to the justices. Across the four previous presidential terms, solicitors-general filed just eight emergency applications. Mr Trump’s officials filed 41. The court was mostly obliging, granting at least part of his wishes—such as to divert funds to his security wall, ban travellers from Muslim countries and execute federal prisoners—28 times.

Mr Vladeck offers a fascinating chronicle of the shadow docket’s rise. He traces it to 1890, when the court gained more discretion over its regular docket and “inaugurated the practice of offering no explanation” when it declined to hear a case. The next step was a surge in last-minute execution appeals (a “death clerk” had to be nominated to handle the applications). A prototype of Mr Vladeck’s critique came in 1984 when Justice William Brennan dissented from a 5-4 decision to reinstate an execution. He called it “an indefensible—and unexplained—rush to judgment” that was “insensitive, if not ghoulish”.

The author’s skill as a law professor shines in thorough, clear explanations of how the court has run roughshod over its own jurisprudence in shadow-

docket cases involving abortion, religious liberty and election law. He highlights the silent but “stunningly impactful” role Justice Amy Coney Barrett played in her first weeks on the job. She added a fifth vote in favour of religious objections to pandemic public-health measures which, four months earlier, had been rejected by the left-leaning justices and Chief Justice John Roberts.

Whereas Mr Waldman’s case rests on substantive disagreements with the justices, Mr Vladeck’s is more even-handed. He praises an order he disagreed with for being “by the book” in terms of procedure, and faults another he liked for failing to include a reasoned explanation. He also notes recent signs of wiser use of the shadow docket as some justices respond to outside criticism (not least, though he takes no credit, from Mr Vladeck himself).

Reining in the court will be tricky. Mr Waldman’s insistence that left-leaning Americans “must fall out of love with the Supreme Court” is odd, as three-quarters of Democrats already hate it. He is cheered by signs of a backlash to Dobbs, but does not show how this sentiment might lead to judicial term limits, one of his proposed reforms (the justices themselves could anyway strike those down, as he acknowledges). In shining a light on a tenebrous corner of the court’s work, Mr Vladeck’s agenda looks more modest. But the illumination in “The Shadow Docket” could help bring more principle, accountability and “procedural regularity” to the justices’ work—and help stop a controversial institution going completely off the rails. ■



相爱相杀

在超级AI的世界里，人类会怎么做？

一个基于经济学原理的思想实验【深度】

在2008年上映的电影《机器人总动员》（WALL-E）中，人类可谓生活在一个全自动化的、极为享受的共产主义世界。形式迥异的人工智能机器人承担了所有的生产劳动。人们变得大腹便便，窝在扶手椅里看电视。苏格兰小说家伊恩·M·班克斯（Iain M.Banks）的《文明》（Culture）系列小说则更进一步，设想了这样一个世界：AI变得足够强大，具有了超级智慧——能力远远超出目前所有的预想。这套小说深受亚马逊老板贝索斯和特斯拉老板马斯克的喜爱。在班克斯营造的世界里，物质短缺已成为历史，大部分生产都由AI“头脑”指挥。人类转而搞弄艺术，探索浩瀚宇宙的文化，并且沉浸在单纯的享乐主义的快乐中。

这样的构想似乎有点不着边际。但生成式AI（OpenAI当红的聊天机器人ChatGPT的底层技术）的快速发展让许多人开始更认真地看待这些构想。5月22日，OpenAI的创始人发表了一篇博文称：“可以想象，在未来十年内，AI系统在大多数领域将具备超过人类的专业技术水平，并像当今最大的一家公司那样完成大量生产活动。”去年夏天，深受许多技术人员喜爱的在线预测平台Metaculus上的预测者认为，要到2040年代初才会产生这样的AI：它能通过两个小时的聊天，让人类把它误当作人；具备足够的自动操作性能来组装模型汽车；并通过其他各种高难度认知测验。鉴于过去一年AI取得的惊人突破，Metaculus上的预测者现在认为，这样的AI在2030年代初就会出现。眼下也不缺研究资金。今年已经新出现了五家生成式AI独角兽（即估值达到或超过10亿美元的创业公司）。

通往“通用AI”（方方面面都超越人类最高水平的AI）的道路可能会比预期的更长。然而，随着超强AI出现的可能性越来越大，一个问题浮现了：当它到来时，人类会如何？他们会成为《机器人总动员》里那样的“沙发土豆”吗？在此，我们以经济学原理为指导展开一次思想实验，试图给出一

些答案。

这样的思想实验不可避免会涉及一些相当大胆的假设。首先，我们假设AI将是仁善的、可控的，且仍可与人类相区分。我们还假设，人类文化不会因技术进步而发生根本性的改变，就是说人们不会变得开始热爱甚至崇拜AI。在这里，我们把AI视作工具：一个虚拟的、极其聪明又非常廉价的机器人。我们还假设，制约广泛应用AI的因素，比如能量限制，将不再是问题。这些假设无一能确保成立，但有助于让这样的实验进行下去。

2019年，菲利普·阿吉翁（Philippe Aghion）、本·琼斯（Ben Jones）和查德·琼斯（Chad Jones）这三位经济学家建模探索AI的影响。他们发现，如果AI可以被用来让所有的生产（包括研究过程本身）自动化，从而实现自我改进，就有可能实现爆炸性的经济增长。几乎无限量的AI可以就任何指定的难题展开合作，这为科学带来了无限可能。不过，他们的模拟成果带有一条重要的附加说明。如果AI只让大部分、而不是全部的生产自动化，或者只让大部分、而不是全部的研究过程自动化，就不会带来迅猛增长。三位经济学家指出：“制约经济增长的或许不是我们做得好的地方，而是那些至关重要却难以改善的部分。”

已故经济学家威廉·鲍莫尔（William Baumol）提出的一个看法为此提供了解释。在1965年发表的一篇论文中，他和同事威廉·鲍恩（William Bowen）研究了演艺行业的报酬。他们指出“小提琴手在普通音乐厅演奏舒伯特四重奏的每工时产出是相对固定的”。尽管同一时期的技术进步提高了其他行业的生产率，演艺行业却未受影响。因为即使价格上涨，人们仍然愿意在艺术上花钱——需求“对价格变化缺乏弹性”——艺术占GDP的比重增大，从而拖累了整体经济增长。

鲍莫尔举的例子指向一个更广泛的原则。如果AI能够完全自动化的领域不能完全替代AI不能完全自动化的领域，并且对不可自动化的行业的需求又难以撼动，那么低生产率部门在GDP中的占比会上升，从而拉低整体经济增长。阿吉翁等三位经济学家指出，事实上，上世纪很多时候就是这种情况。科技让农业和制造业的大量领域实现了自动化，压低了它们产出的相

对价格。其结果就是人们把更多的收入花在了教育、医疗和娱乐等生产率没有得到同样提升的行业上。

在一个AI比最能干的人还要能干的世界里，鲍莫尔的说法还成立吗？如果AI一直不能拥有可行为的有形实体——原因也许是人形机器人技术的进步赶不上计算技术——那么答案无疑是肯定的。大部分经济领域显然都需要身体的参与，包括建筑业和制造业。有不计其数的工种同时需要聪明才智和行走有形世界的能力，比如医疗行业中的许多岗位。在AI开始主导认知型工作的场景下，这些工作的重要性只会增加。人类或许会在AI“老板”或“教授”的指导下，在有形世界里工作。

但如果超强AI也发展出了超级类人机器人，又会怎样呢？物质需求几乎肯定会由机器人来满足。那么你可能会预期人类将停止辛勤劳作，就像《机器人总动员》里的场景。事实上，另一位经济学家凯恩斯在他于1930年撰写的文章《我们后代的经济前景》（Economic Possibilities for our Grandchildren）中推测，一个世纪后，人们每周的工作时间将少于15小时。他预言，科技带来的增长将解决“经济问题”，并让人们将注意力转向那些本身就令人愉悦的活动。诚然，凯恩斯的每周工作15小时的愿景还没有实现——但如他所料，财富水平的提高（可能会增加休闲的吸引力）确实已经缩短了工作时长。富裕国家的每周平均工作时长已从上世纪后期的约60小时下降到今天的不到40小时。

然而，即使是在一个有超强类人AI的世界里，有些需求也许还是只有人类才能满足。同样值得注意的是，本身就让人愉悦的活动可能也包含工作。我们不妨看一下人类可能仍然发挥作用的三个领域：和娱乐难以区分的工作、娱乐本身，以及人类能保持某种优势的工作。

先说工作和娱乐之间的模糊边界。虽然过去一个世纪里工作时长减少了，但大部分发生在1980年代之前。如今，富人比穷人工作更久的情况日益多见。对于这种反常的走向，可以从凯恩斯的文章中找到线索。他将人类的欲望分为两种：“一种是绝对意义上的需求，即无论其他人的处境如何，都会感受到这种需求；另一种是相对的需求，即只有当这些需求带来的满

足感让我们感受到高人一等的优越感时，我们才会感受到它们。”

凯恩斯或许低估了这第二种需求的规模。愤世嫉俗的人可能会说，整个学术界都陷入了这第二类需求：其存在对世界没有明显的价值——然而学者们还是投身于以才智论地位的激烈竞争中。经济学家会说，对许多人来说，工作已经成了一种“消费品”，它提供的效用远远超过带来的收入。

为什么人们可能不会完全停止工作？各种比赛为这个问题的答案提供了另一个线索。有数以百万计的人从事娱乐和体育方面的工作，在一些人认为无关紧要的活动中争夺影响力。当AI在比赛中超越人类时，人们观看此类比赛的兴趣也许会下降。但是，从人类已经屈居AI之下的一些体育运动来看，情况并非如此。自1997年IBM的“深蓝”（DeepBlue）在国际象棋比赛中击败国际象棋大师加里·卡斯帕罗夫（Garry Kasparov）以来，人们对这种比赛的兴趣有增无减。其他被AI“干掉”的游戏，包括围棋这种古老的中国棋盘游戏和电竞游戏，也呈现了类似的模式。过去十年，全球电子游戏玩家人数几乎翻了一番，去年达到32亿人。如今，越来越多的玩家靠参赛或直播为生。

AI可能会增强这种兴趣。正如班克斯推测的那样，人类可能会专门从事“人生中真正（重要的）事情，比如运动、游戏、恋爱、研究已经无人使用的语言、蛮族社会和一些无解的难题，以及徒手登山”。其他人想必也愿意看人做这些事情。

人们似乎不太可能把政治控制权交给机器人。相反，一旦AI超越人类，人们可能会更加密切地关注政治。人们可能会把一些政治任务交给机器人：例如，人类可以各种人的偏好输入一个AI模型，让它给出平衡这些偏好的建议。然而，正如包括17世纪的约翰·洛克（John Locke）和上世纪的约翰·罗尔斯（John Rawls）在内的一些政治哲学家所认为的那样，公民参与到政治程序中，便会让大家认为结果具有合法性。一些更愤世嫉俗的看法也会得出同样的预测。人就喜欢对他人施加影响。即使在一个所有人的基本需求都由机器来满足的世界里也一样。事实上，在从投票到花在政治上的时间等一系列指标上，最富有的1%的美国人参与政治的比例是普通公众

的两到三倍。

最后来看人类在提供商品或服务方面具有优势的领域，姑且称之为“人类溢价”。即使在有超先进AI的时代，这种溢价也会维持对人类劳动力的需求。人类可能具有溢价的地方是公布私密信息。只要人们比起机器更愿意与其他人分享自己的秘密，那些受到信任人就会有用武之地——有选择性地向世人透露这些信息，使之可为机器摄取。笔者斗胆揣测调查记者仍然会保住饭碗。

这所谓的人类溢价也可能出现在其他地方。人们珍视历史、神话和意义。可在区块链上验证出处的非同质化代币的价值通常比具有相同像素、但来历不同的图像高出许多倍。在看护和治疗等领域，人们从花费自己宝贵的时间来陪护他们的人那里获得价值，这为互动增添了情感。人造钻石的分子结构与天然钻石相同，但交易价格却大打折扣——据估计只有天然钻石的30%左右。在未来，带有“人类制造”标签的物品可能会特别受追捧。

如果这种溢价特别高，甚至有可能拖累经济增长。将经济部门划分为高人类溢价的部门和没有人类溢价的部门来看，如果人类不用机器产出的商品和服务取代人类自己产出的商品和服务，那么鲍莫尔效应只会变得更严重。测得的经济增长甚至可能为零。事实上，如果极其强大的AI没能强力推动增长，那就意味着经济重心已经从物质消费转向了娱乐、政治，以及那些人们最看重的东西是人际互动的领域。

也许有一天，AI会生产出全新的商品和服务，能够战胜人类取悦他人和与他人互动的欲望。这样一场竞赛会如何展开将揭示一些深刻的东西：人类到底在多大程度上是一种“社会动物”？ ■



Love and conflict

What would humans do in a world of super-AI?

A thought experiment based on economic principles

IN “WALL-E”, a film released in 2008, humans live in what could be described as a world of fully automated luxury communism. Artificially intelligent robots, which take wonderfully diverse forms, are responsible for all productive labour. People get fat, hover in armchairs and watch television. The “Culture” series by Iain M. Banks, a Scottish novelist, goes further, considering a world in which AI has grown sufficiently powerful as to be superintelligent—operating far beyond anything now foreseeable. The books are favourites of Jeff Bezos and Elon Musk, the bosses of Amazon and Tesla, respectively. In the world spun by Banks, scarcity is a thing of the past and AI “minds” direct most production. Humans turn to art, explore the cultures of the vast universe and indulge in straightforwardly hedonistic pleasures.

Such stories may seem far-fetched. But rapid progress in generative AI—the sort that underpins OpenAI’s popular chatbot, ChatGPT—has caused many to take them more seriously. On May 22nd OpenAI’s founders published a blog post saying that “it’s conceivable that within the next ten years, AI systems will exceed expert skill level in most domains, and carry out as much productive activity as one of today’s largest corporations.” Last summer forecasters on Metaculus, an online prediction platform that is a favourite of many techies, thought it would take until the early 2040s to produce an AI capable of tricking humans into thinking that it was human after a two-hour chat, had good enough robotic capabilities to assemble a model car and could pass various other challenging cognitive tests. After a year of astonishing AI breakthroughs, Metaculus forecasters now think that this will happen by the early 2030s. There is no shortage of money for

research, either. Five new generative-AI unicorns (startups valued at \$1bn or more) have already been minted this year.

The road to a general AI—one better than the very best of humanity at everything—could take longer than expected. Nevertheless, the rising possibility of ultra-powerful AI raises the question of what would be left for humans when it arrives. Would they become couch potatoes as in “Wall-E”? Here is a thought experiment, guided by the principles of economics, to provide something of an answer.

Inevitably, such a thought experiment involves some fairly heroic assumptions. For a start, we suppose that AI will be benevolent, controllable and distinguishable from humans. We also suppose that human culture will not be radically altered by technological progress to the point that people begin to love or even worship AIs. Instead, we imagine AI as a tool: a virtual, super-smart, dirt-cheap bot. We assume that constraints on the widespread use of AI, such as energy limits, will be resolved. None of this is guaranteed, but it helps make an exercise like this possible.

In 2019 Philippe Aghion, Ben Jones and Chad Jones, three economists, modelled the impact of AI. They found that explosive economic growth was plausible if AI could be used to automate all production, including the process of research itself—and thus self-improve. A nearly unlimited number of AIs could work together on any given problem, opening up vast scientific possibilities. Yet their modelling carried an important caveat. If AI automated most but not all production, or most but not all of the research process, growth would not take off. As the economists put it: “Economic growth may be constrained not by what we do well but rather by what is essential and yet hard to improve.”

An idea put forward by William Baumol, a late economist, offers an explanation for this. In a paper published in 1965, he and William Bowen,

a colleague, examined wages in the performing arts. They noted that the “output per man-hour of the violinist playing a Schubert quartet in a standard concert hall is relatively fixed”. Even as technological progress made other industries more productive, the performing arts remained unaffected. Because humans were still willing to spend on the arts even as prices rose—demand was “inelastic”—the arts took up more of GDP and therefore weighed on overall growth.

Baumol’s example points to a broader principle. If the domains that AI is able to fully automate are only imperfect substitutes for those which it cannot, and the demand for non-automatable industries is hard to budge, then the unproductive sectors will grow as a share of GDP, reducing overall growth. Messrs Aghion, Jones and Jones note that this is in fact what has happened across much of the past century. Technology has automated swathes of agriculture and manufacturing, driving down the relative price of their outputs. As a result, people have spent a greater share of their incomes on industries such as education, health care and recreation, which have not seen the same productivity gains.

Will Baumol’s story matter in a world in which AI is more capable than the most talented humans? If the AI is not embodied—maybe because progress in robotics lags that in computing—then the answer is surely yes. Much of the economy, including construction and manufacturing, is decidedly physical. There are countless forms of employment, including many in health care, that require a combination of braininess and an ability to traverse the physical world. These jobs would only increase in importance in a scenario where AI began to dominate cognitive labour. Humans would work in the physical world, perhaps under the guidance of AI “chief executives” or “professors”.

But what if ultra-powerful AI develops super-humanoid robots, too? Material needs would almost certainly be met by machine hands. One might

then expect humanity to give up on toil, much like in “Wall-E”. Indeed, in 1930 John Maynard Keynes, another economist, penned an essay entitled “Economic Possibilities for our Grandchildren”, in which he speculated that a century in the future people would work for less than 15 hours a week. The growth generated by technology would solve the “economic problem”, he predicted, and allow people to turn their attention to activities that are intrinsically pleasurable. Admittedly, Keynes’s 15-hour work week has not arrived—but higher levels of wealth, which may increase the appeal of leisure, have cut working hours much as he expected. The average number of hours worked a week in the rich world has fallen from around 60 in the late 20th century to under 40 today.

There are, nevertheless, some wants that perhaps only humans can satisfy even in a world of supercharged, embodied AI. It is also worth noting that what is intrinsically pleasurable may include work. Consider three areas where humans may still have a role: work that is blurred with play, play itself and work where humans retain some kind of an advantage.

Start with the blurring boundary between work and play. Although working hours have fallen over the past century, most of the drop was before the 1980s. Increasingly, rich people labour for longer than poorer people. Keynes’s essay hints at an explanation for this odd development. He divided human desires in two: “Those needs which are absolute in the sense that we feel them whatever the situation of our fellow human beings may be, and those which are relative in the sense that we feel them only if their satisfaction lifts us above, makes us feel superior to, our fellows.”

Keynes perhaps underestimated the size of this second class of wants. A cynic might suggest that entire academic disciplines fall into it: existing with no apparent value to the world, with academics nevertheless competing furiously for status based on their braininess. Economists would say that, for many, work has become a “consumption good”, offering far

more utility than the income it generates.

Games offer another hint as to why people may not stop working altogether. Millions of people are employed in entertainment and sports, competing for clout in activities that some consider immaterial. Perhaps when AIs overtake humans, interest in watching such games will wane. But evidence from sports where humans are already second-rate suggests otherwise. Since IBM's DeepBlue defeated Garry Kasparov, the world grandmaster, in chess in 1997, interest in the game has only increased. Other games that have been "solved" by AI, including Go, an ancient Chinese board game, and competitive video games, have witnessed a similar pattern. Across the world the number of video-game players has nearly doubled in the past decade, reaching 3.2bn last year. Nowadays a growing class of gamers compete or stream for a living.

AI might supercharge this interest. As Banks speculated, humans might specialise in "the things that really [matter] in life, such as sport, games, romance, studying dead languages, barbarian societies and impossible problems, and climbing high mountains without the aid of a safety harness." Other humans would presumably want to watch them, too.

It seems unlikely that people will give up control of politics to robots. Once AIs surpass humans, people will presumably pay even closer attention to them. Some political tasks might be delegated: humans could, for instance, put their preferences into an AI model that produces proposals for how to balance them. Yet as a number of political philosophers, including John Locke in the 17th century and John Rawls in the 20th, have argued, participation in political procedures gives outcomes legitimacy in the eyes of fellow citizens. There would also be more cynical considerations at play. Humans like to have influence over one another. This would be true even in a world in which everyone's basic needs and wants are met by machines. Indeed, the wealthiest 1% of Americans participate politically at two to three

times the rate of the general public on a range of measures from voting to time spent on politics.

Last, consider areas where humans have an advantage in providing a good or service—call it a “human premium”. This premium would preserve demand for labour even in an age of superadvanced AI. One place where this might be true is in making private information public. So long as people are more willing to share their secrets with other people than machines, there will be a role for those who are trusted to reveal that information to the world selectively, ready for it then to be ingested by machines. Your correspondent would like to think that investigative journalists will still have jobs.

The human premium might appear elsewhere, too. People value history, myths and meaning. Non-fungible tokens, for which provenance can be verified on a blockchain, are typically valued at many multiples more than images with identical pixels but a different history. In areas such as caregiving and therapy, humans derive value from others spending their scarce time with them, which adds feeling to an interaction. Artificial diamonds, which have the same molecular structure as those from the ground, trade at an enormous discount—around 70% by one estimate. In the future, items with a “made by a human” tag might be especially desirable.

If this premium is big enough, it could even weigh on growth. Divide the sectors of the economy into those with a large human premium and those without. If humans do not substitute machine-produced goods and services for those made by fellow humans, the Baumol effect would only deepen. Measured economic growth could even hit zero. Indeed, if extremely powerful AI failed to supercharge growth, it would suggest that the economy had already moved beyond materiality towards play, politics and areas where what people value most of all is interacting with others.

Perhaps one day AIs will produce entirely new goods and services that will outcompete the desire to please and interact with other humans. The manner in which such a contest played out would reveal something profound: just how much of a “social animal” is a human? ■



以苍穹为画布

艺术家们想把自拍变成彗星

两个太空艺术项目想要点亮夜空

太空飞行诞生以来的大部分时间里，都是以军事、科学或商业为目的。但也还是可以拿它做些更轻松愉快的事情。对太空心驰神往的富人已经可以花钱踏上进入轨道之旅（下一个此类任务是由一家名为Axiom space的公司运作，在5月21日将四名宇航员送往国际空间站）。现在，两个团体正计划将天空用于艺术创作，一个想造一颗人造彗星，另一个想设置人造流星雨。

先说彗星。在《宇航学报》（Acta Astronautica）上发表的一篇论文中，康奈尔大学的学者格雷格·帕斯（Greg Pass）和他的同事描述了他们的一项艺术项目计划，该项目将能让多达10亿人将微小的自拍照发射到太空中，并被太阳吹出，形成人造彗星的尾巴。

天然彗星是沿高椭圆轨道在太空中飞行的圆球，由岩石和冰组成。远离太阳时，它们处于休眠状态，肉眼无法看见。当它们靠近太阳，辐射和太阳风的混合物促使它们甩出水和尘埃。这些微小的颗粒反射阳光，形成了彗星壮观的彗尾。帕斯和同事们提议用数以百万计的微型自拍来代替这些尘埃和冰粒。该项目被称为“阿尔塔米拉彗星”，得名于西班牙的一个洞穴，其洞壁上有新石器时代的手印——该团队称之为“史前自拍”。

天然彗星很大，至少以地球上的标准来看是这样。哈雷彗星每75年左右飞过太阳一次，从地球上很容易就能看到，其直径约为15千米。相比之下，阿尔塔米拉彗星被设计成一颗立方体卫星（CubeSat）——一颗边长均为10厘米的微型卫星。立方体卫星可以在更大型的航天器发射时搭个顺风车。

立方体卫星的规格将阿尔塔米拉的有效载荷限制在差不多一颗板球大小。要利用这么小的空间再现接近天然彗星的效果并非易事。每幅自拍都必须

很小——大约一米的一千两百万分之一。研究人员计划将它们蚀刻在硅上，然后镀上一层黄金，让它们在释放时能够闪闪发亮。按照该团队规划的轨道，彗星将在距地球1.5万公里的范围内经过，这个距离在太空中只相当于一根头发丝那么宽。即便如此，也需要大型望远镜才能看到由此造就的盛景。

不过，该计划在技术上似乎可行。这篇论文表明，这种镀金自拍照是可以规模化生产的。在电子束光刻技术的帮助下，帕斯和同事们制造了500万个这样的自拍，并让它们悬浮在一小瓶水中。他们正在与一家名为纽富来（NuFlare Technology）的日本芯片制造公司合作，扩大生产规模。

人工流星雨则是总部位于东京的ALE公司的创想。自然流星雨是由地球大气中微小的尘埃和岩石颗粒燃烧而产生的。ALE在小型卫星中填充直径约1厘米的微小球体，希望能够应需求随时重现这种现象。

把卫星放在合适的轨道上，并在合适的时间释放这些小球，应该就能在世界任何地方创造壮观的流星雨。该公司估算其人造流星雨应该能在大约200公里之外看到。而且由于它的流星将比天然流星的移动速度慢，所以每条光的可见时间应该会更长。

不消说，和任何自负的艺术项目一样，这两个项目的基调也很崇高。阿尔塔米拉的10亿张自拍号称将是一种“个体对集体参与感的表达”。ALE希望“为人类的可持续发展做出贡献”。但首先需要做大量乏味的工程工作。阿尔塔米拉彗星将需要扩大其自拍照生产流程，并找到合适的火箭搭便车。ALE最初计划用2019年发射的一颗卫星来测试其想法，但由于技术问题而受阻。该公司现在计划在2025年举行首次演示。■



Painting the heavens

Artists hope to turn selfies into comets

A pair of space art projects hope to light up the sky

FOR MOST of its history, spaceflight has been done with military, scientific or commercial motives in mind. But lighter-hearted uses are possible too. Wealthy space cadets can already buy trips into orbit (the next such mission, run by a firm called Axiom Space, is due to take four astronauts to the International Space Station on May 21st). Now two groups are planning to use the heavens for art. One wants to build an artificial comet; the other to set up man-made meteor showers.

Start with the comet. In a paper published in *Acta Astronautica*, Greg Pass, an academic at Cornell University, and his colleagues describe their plans for an art project that would allow up to a billion people to have tiny self-portraits launched into space and blown out by the sun, forming the tail of a man-made comet.

Natural comets are space-going balls of rock and ice in highly elliptical orbits. When they are far from the sun, they are dormant and invisible. As they get closer, a mixture of radiation and the solar wind causes them to start spewing water and dust. Those tiny particles reflect sunlight, giving comets their spectacular tails. Dr Pass and his colleagues propose to substitute those grains of dust and ice with millions of tiny self-portraits. The project is called the Altimira comet, after a cave in Spain featuring neolithic handprints—"prehistoric selfies", as the team describe them—on the walls.

Natural comets are big, at least by earthly standards. Halley's comet, which flies past the sun every 75 years or so and is easily visible from Earth, is

about 15km across. The Altimira comet, by contrast, is designed to fly as a CubeSat—a miniature satellite 10cm on each edge. CubeSats are designed to tag along as passengers on the launches of bigger spacecraft.

The CubeSat specification limits the satellite's payload to a volume about the size of a cricket ball. Reproducing something approximating the effect of a natural comet from such a small space will be tricky. Each of the portraits must be tiny—about 12 millionths of a metre across. The plan is to etch them into silicon and then coat them with gold to help them sparkle upon release. The team has proposed an orbit that would see the comet pass within 15,000km of Earth—a hair's breadth in space. Even so, big telescopes would be needed to see the resulting display.

Still, the plan seems technically feasible. The paper demonstrates that making the gold-coated selfies can be done at scale. With the help of electron-beam lithography, Dr Pass and his colleagues produced 5m of them and suspended them in a vial of water. They are working with a Japanese chip-making firm called NuFlare Technology to scale up production.

The artificial meteor showers, meanwhile, are the brainchild of ALE, a firm based in Tokyo. Natural meteor showers are caused by small particles of dust and rock burning up in Earth's atmosphere. ALE hopes to recreate the phenomenon on demand by filling small satellites with tiny spheres about 1cm across.

Putting the satellite in the proper orbit, and releasing the spheres at the right moment, would allow it to create spectacular meteor showers anywhere in the world. The company reckons its ersatz meteor showers should be visible from about 200km away. And because its meteors will be travelling more slowly than the natural kind, each streak of light should remain visible for longer.

As is de rigueur for any self-regarding art project, both endeavours strike a high-minded tone. Altimar's billion selfies, apparently, will be an "individually expressed act of collective participation". ALE hopes to "contribute to the sustainable development of humankind". But plenty of unglamorous engineering will need to be done first. The Altimira comet will need to scale up its selfie-production process and find a suitable rocket on which to hitch a ride. ALE was originally due to test its idea with a satellite launched in 2019, but was stymied by technological problems. It now plans the first demonstration for 2025. ■



增长问题

日本的股市反弹可能令投资者失望

治理得到改善，增长仍未实现

上一次日经225指数达到今天这样的高位时，苏联开始解体，互联网仍在起步中，日本明仁天皇刚刚登上菊花宝座。日本股市现在只比历史最高点低五分之一，那是在1989年12月日本经济泡沫高涨时期创下的绝对顶点（见图表）。

一轮追捧日本股票（今年迄今已上升24%）的热潮也许会进一步推高市场。得益于日元汇率走低，从国外赚钱的日本公司的盈利被推高。对公司治理改革的乐观加上美国投资人巴菲特的关注，为日本股市提供了推动力。世界其他地区股市缺乏吸引力也是个因素。今年到目前为止，外国投资者净买入的日本股票达3.8万亿日元（270亿美元），为2013年以来之最。

获益的包括日本被低估的价值型股票，比如巴菲特已入股的五家综合商社。今年，这些公司的股价轻松跑赢大市，上涨了28%至45%。从年度股东大会上的提案来看，低估值公司的股东维权行动今年创下新高，这在古板保守的日本董事会中曾被视为大忌。

但资深投资者都知道，这个“日出之国”已经太多次迎来虚幻的黎明。日经225指数在1999年底到2000年3月的峰值之间上升超过40%，之后遇上互联网泡沫破裂。从2004年底到2007年中，在全球金融危机爆发前，该指数上涨了超过50%。2012年安倍晋三当选首相并承诺提振经济增长，之后那几年它上涨了一倍多。

安倍任内的股市反弹不仅在规模上比现在的要大，外国参与也更多。2013年，海外买家抢购了16万亿日元的日本股票，是今年迄今购买量的四倍。尽管在过去十年里日本企业的治理显著改善，外国投资者实际上已经卖光了他们在乐观情绪爆发期间积攒的所有日本股票。这是因为安倍承诺的增

长大多未能实现。以美元计算，MSCI日本指数的每股收益仍低于全球金融危机前的水平，也略逊色于英国和欧元区那些低迷的股票市场。

一些分析人士预期日本经济状况将有所改善。咨询公司Gavekal Research的乌迪斯·希坎德（Udith Sikand）认为，日本重现通胀（在截至4月的一年里，除新鲜食品和燃料以外，其他商品价格上涨了4.1%）预示一个良性循环开启，工资和消费者支出将随之上升。但是，如果说这样的周期即将到来，到目前为止还看不到多少迹象。过去一年，名义工资只上涨了1%，意味着劳动者实际上是在承受减薪。

对股东友好的企业治理提升了盈利能力和回报，帮助推高了日本股市。公司估值提高会推动股市进一步上涨。然而，要维持长期反弹，实际上还是要以坚实的经济增长为前提，这就意味着另一代日本的投资者可能很快会吃到苦头。 ■



Growth problems

Japan's stockmarket rally may disappoint investors

Governance has improved; growth is still missing

THE LAST TIME Japan's Nikkei 225 stock index was as high as it is today, the Soviet Union was collapsing, the internet was in its infancy and Emperor Akihito had just ascended to the Chrysanthemum throne. Japanese stocks are now only a fifth short of their all-time high, which was set in December 1989—at the absolute zenith of Japan's bubble-era exuberance (see chart).

A wave of interest in the country's stocks, which have risen by 24% so far this year, may yet propel the market further. The cheap yen has padded the bottom line of firms that make money abroad. Optimism about corporate-governance reforms, and interest from Warren Buffett, an American investor, have provided a boost. A dearth of compelling options in other parts of the world also helps. So far this year, foreign investors have bought ¥3.8trn (\$27bn) more in Japanese stocks than they have sold, the most since 2013.

Beneficiaries include Japan's cheaply priced value stocks, such as the five sogo shosha (general trading companies) that Mr Buffett has bought stakes in. The share prices of these firms have comfortably beaten the market this year, rising by between 28% and 45%. Shareholder activism at cheaply valued firms, once anathema in stuffy Japanese boardrooms, hit a new record this year, as measured by shareholder proposals at annual general meetings.

But experienced investors know that the land of the rising sun has had more than its fair share of false dawns. The Nikkei 225 rose by over 40% between the end of 1999 and a peak in March 2000, after which the dotcom bubble

burst. It rose by over 50% between the end of 2004 and mid-2007, before the global financial crisis. It more than doubled in the couple of years after Shinzo Abe was elected prime minister in 2012, promising to lift growth.

The Abe rally was not just larger in size than the present one; it also saw more foreign participation. In 2013 overseas buyers snapped up ¥16trn of Japanese stocks, four times the amount they have purchased this year. Even though the quality of Japanese governance has improved markedly in the past decade, foreign investors have sold practically all the shares they accumulated during that burst of optimism. This is because the growth Abe promised has mostly failed to materialise. Revenues per share on the MSCI Japan index are, in dollar terms, still below the levels they reached before the global financial crisis, and are marginally worse than on the humdrum stockmarkets of Britain and the euro zone.

Some analysts foresee better economic conditions. Udit Sikand of Gavekal Research, a consultancy, argues that the return of inflation to Japan—prices excluding fresh food and fuel rose by 4.1% in the year to April—heralds the beginning of a virtuous cycle, which will lift wages and consumer spending. However if such a cycle is coming, the evidence so far is thin. Wages have risen by just 1% in nominal terms over the past year, meaning workers are enduring real-terms pay cuts.

The improved profitability and returns that result from shareholder-friendly governance have helped lift the Japanese stockmarket. Improved valuations would lift it higher still. Yet solid economic growth is practically a precondition for sustaining a prolonged rally—meaning another generation of investors in Japan may soon have their fingers burned. ■



海平面上升的威胁

中国的新长城

中国正在建造堤坝来保护千百万民众免受海平面上升的冲击

中国共产党总认为自己擅长长远规划。看一下中国的沿海地带，可能会觉得确实如此。40多年前，已故最高领导人邓小平开始在沿海城市试行自由市场政策，并吸引外国投资。如今，广州、深圳和上海熠熠生辉的摩天大楼和熙熙攘攘的港口已经成为全球供应链的核心。这些城市的财富增长了上百倍。内陆欠发达地区的人口纷纷涌向沿海城市。

然而，尽管邓小平知道大海能给沿海城市带来财富，但他和他的继任者们似乎没有为另一件事做过打算：在一个世纪内，不断上升的海平面可能带来严重麻烦。这对中国的威胁要高于对大多数国家。据美国非政府组织气候中心（Climate Central）的科学家预测，到2100年，将可能有4300万至5700万中国人生活在高潮位线以下地带，另外还有6000万人每年会受到海岸洪水的威胁。英国气候变化委员会（Committee on Climate Change）和中国国家气候变化专家委员会的科学家的一份报告称，在温室气体排放量居高不下的“可能的最坏情况”下，到2050年，中国受海岸洪水威胁的GDP产出可能达32万亿元左右，约占届时预测GDP总量的10%。

世界上不同海域的升温和扩张速度各不相同，所以一些地方的海平面上升速度比其他地方更快。在这一点上，中国处境不利。根据中国自然资源部4月发布的一份令人警醒的报告，自1993年以来，中国沿海海平面平均每年上升4毫米，而全球平均每年上升3.4毫米。2022年，中国沿海海平面上升了10毫米。

由于地处太平洋西岸，中国的东南沿海地区每年还要遭受十几次台风袭击。随着海洋温度的升高，这种袭击会更趋严重。当台风登陆时，上升的海平面只会加剧风暴潮。

自改革开放以来的土地开发让情况变得更糟糕。中国有一半的沿海湿地和

红树林被毁消失，而它们本是抵御洪水的天然屏障。城市过度抽取地下水，建造了很多楼体沉重的摩天大楼。由此产生的沉降导致一些沿海城市地面下沉的速度甚至超过了海平面上升的速度。深圳部分地区的地面正以每年74毫米的速度下沉。北方城市天津也面临类似的挑战。

不断上升的海平面已经带来了种种问题。中国部分地区的海岸线朝内陆后退了几十米，损毁了建筑物和基础设施。海水正在渗入农田，海水中的盐分毁坏庄稼，威胁饮用水安全。

最大的威胁还是洪水。中国应对洪灾的记录好坏参半。得益于紧急预警和疏散能力的提升，死于洪水的人数有所下降。但洪水造成的经济损失在增加，而很少有人未雨绸缪。

根据慕尼黑再保险公司（Munich Re）的数据，去年广东、广西和福建等沿海省份的洪水造成了高达50亿美元的损失，其中只有6%投了保险。当救援工作搞砸时，官员们就想办法掩盖真相。2021年，中部城市郑州遭暴雨肆虐，报道洪水的外国媒体受到阻挠，受灾规模也被刻意隐瞒。

中国政府拒绝接受气候中心等一些国际组织对海平面上升的估计。更遗憾的是，它还以安全顾虑为由，警告非政府环保组织不可调查研究其海岸。2021年，一个试图监测海洋污染的组织被指控为外国间谍收集数据。

但另一方面，中央的一些部委也开始要求采取行动。自然资源部4月的报告指出，沿海城市应将对海平面上升情况的预测纳入城市规划，并为可能造成的影响做准备。该报告指出，一些重要的经济区应做好最坏的打算，制定人口迁移方案。

尚不清楚沿海地区的官员对这类风险有多上心。一些最不计后果的开发项目已经放缓。由于加大了保护力度，一些区域的湿地和红树林得以恢复。1985年至2010年间，填海造地让沿海增加了超过7500平方公里的低洼土地，而现在填海项目不再那么容易获批了。地下水得到了更妥善的管理。

但是，中国最值钱的土地就是沿海的土地。官员们还是更愿意继续在这里

大兴土木。在沿海各地，各种大型项目的建设如火如荼。在以超强台风而闻名的南部港口城市汕头，一座可容纳2.2万人的体育场不久前在海边落成。它周围的工地今后将建成工业园区和住宅区。

官员们寄希望于用海堤来保护这些资产。中国有上万公里的海堤。小城市的海堤应该能抵御那些百年一遇的洪水，也就是从历史上看在某一年发生几率为1%的洪水。大城市应该有抵御200年一遇洪水的能力。上海少见地按千年一遇的标准建设了保护中心城区的防洪工程。相比之下，荷兰的规划人员对沿海城市防洪标准的要求是万年一遇。

但一份政府报告显示，中国约一半的海堤质量不佳。即使是那些符合官方标准的海堤，使用寿命可能也不会很长。联合国政府间气候变化专门委员会（Intergovernmental Panel on Climate Change）2019年的一份报告预测，由于海平面上升，到2050年，从前百年一遇的洪水可能每年都会发生。

这一切意味着中国应该会在未来几十年进行大规模的海堤建设，宾夕法尼亚大学（University of Pennsylvania）的斯科特·摩尔（Scott Moore）表示。目前已经开建的海堤大约有430公里。但是新的海上长城有其弊端。升级改造海堤会变得越来越昂贵，因为成本会随着高度增加而急剧上升。而随着海平面上升加速，失败的风险也在增加。加高的海堤会让人产生虚幻的安全感，从而导致更多的陆地建设。“这可能是自找失败……也会让人们在日后面临真正的危险。”摩尔表示。

马里兰大学（University of Maryland）的孙来祥表示，还有一种选择，那就是建设更具挑战性的工程项目。他曾建议上海在黄浦江上修建一道防潮汐洪水的屏障，类似于伦敦的泰晤士河水闸。官员们讨论这个想法已有几十年。但泰晤士河水闸是在遭遇了灾难性的洪水之后才开建的。孙来祥担心中国可能不到灾难来临不会行动。“如果我们不采取行动，如果我们继续等下去，我们可能会后悔莫及。”他表示。

汕头人对大海的危险再清楚不过了。在1969年的一场暴风雨中，堤坝坍

塌，500多名试图保护围垦农田的士兵和大学生被淹死。如今人们仍然在纪念碑前供奉烟酒，祭奠死者。

2013年，防洪堤再次溃决，造成10人死亡。今年早些时候，汕头市政府在一份报告中承认其防洪工程存在不足。不过，当地人似乎并不担心。许多人认为海平面上升的危险离自己还很遥远。他们说，只要把房屋建得高一些，就能不被风暴中的洪水淹没。一位店主回忆道，上次大洪水过后，当地经济很快就恢复了过来。她说她相信政府自有安排。

不难看出这样的信心从何而来。过去20年里，汕头的人均GDP增长了430%。当地一家博物馆里陈列的照片展示了汕头在改革开放前后的对比。大片的湿地和泥泞的田野变成了高楼和工厂。展览用“沧海桑田”这个中国成语贴切地描述了这些巨大的变化。沧海可能变桑田，但危险在于，似乎很少有人相信这个过程也可能倒转。 ■



The threat of rising sea levels

China's new Great Wall

The country is building barriers to protect millions of people from rising seas

CHINA'S COMMUNIST PARTY likes to think it is good at long-term planning. A glance along the country's coastline might suggest that it is. More than 40 years ago Deng Xiaoping, the late paramount leader, started letting coastal cities dabble in free-market policies and attract foreign investment. Now the gleaming skyscrapers and bustling ports of Guangzhou, Shenzhen and Shanghai are at the heart of global supply chains. Locals' wealth has increased a hundredfold. Immigrants from poorer inland areas have flocked to cities by the sea.

Yet, although Deng knew that the sea could bring wealth to coastal cities, he and his successors appear not to have planned for the fact that, within a century, rising sea levels could bring serious problems. This represents a greater threat to China than to most countries. By 2100 43m-57m Chinese people could find themselves living below the high-tide line, with an additional 60m threatened by annual coastal floods, according to projections by scientists at Climate Central, an American NGO. By 2050 some 32trn yuan (\$4.5trn) of GDP (about 10% of China's predicted total) could be vulnerable to coastal flooding in a "plausible worst-case" scenario where greenhouse-gas emissions stay high, according to a report by scientists from Britain's Committee on Climate Change and China's Expert Panel on Climate Change.

Different areas of sea around the world warm up and expand at different rates, so sea levels rise faster in some places than others. China is unfortunate in this regard. According to a sobering report released in April by China's Ministry of Natural Resources, the country's coastal sea levels

have been rising by an average of 4mm per year since 1993, compared with a global average rise of 3.4mm. In 2022 sea levels on China's coasts rose 10mm.

China's position in the western Pacific also exposes its southern and eastern coasts to about a dozen typhoons a year. These are set to get more severe as the oceans warm. Higher sea levels will only amplify the storm surges experienced when the typhoons come ashore.

Development since Deng's reforms has made things worse. Half of China's coastal wetlands and mangrove forests—natural shields against floods—have been destroyed. Cities have pumped unsustainable amounts of groundwater out of the earth and built heavy skyscrapers. The resultant subsidence has caused the land in some cities to sink towards the sea even faster than the sea rises. Parts of Shenzhen are falling by 74mm a year. Tianjin, in the north, faces a similar challenge.

Rising seas are already causing problems. Parts of China's coast have retreated by dozens of metres, damaging buildings and infrastructure. Seawater is seeping into farmland, its salt spoiling crops and threatening drinking water.

The biggest danger is flooding. Here, China's record is mixed. The number of people dying from floods has fallen, thanks to better emergency warnings and faster evacuation. But the economic damage from floods is increasing, and few people are well prepared.

Last year floods in the coastal provinces of Guangdong, Guangxi and Fujian caused \$5bn of damage, of which just 6% was insured, according to Munich Re, an insurance company. When rescue efforts are botched, officials resort to cover-ups. In 2021, after rainfall devastated the central city of Zhengzhou, foreign media covering the floods were harassed and the scale of the

damage hidden.

China's government has rejected some international estimates of sea-level rise, like that of Climate Central. It has also, unhelpfully, warned environmental NGOs away from studying its coasts, citing security concerns. In 2021 one group trying to monitor marine pollution was accused of collecting data for foreign spies.

But some parts of the central government are demanding action. The report from April said coastal cities should include sea-level-rise projections in urban planning and prepare for the possible impact. Important economic regions, it said, should set out migration blueprints based on worst-case scenarios.

It is not clear how worried officials on the coasts are about such risks. Some of the most reckless sorts of development have slowed. Now better protected, wetlands and mangrove forests are growing again in some areas. Land reclamations, which added over 7,500 sq km of low-lying coastal land between 1985 and 2010, are approved less often. Groundwater is better managed.

Coastal land, though, is China's most valuable. Officials would prefer to continue building on it. Giant construction projects are ongoing all along the coastline. In Shantou, a port city on the south coast known for its fierce typhoons, a 22,000-seat stadium was recently completed beside the sea. It is surrounded by construction sites which will become industrial parks and residential buildings.

Officials are betting on sea walls to protect such assets. China has thousands of kilometres of them. Smaller cities are supposed to have walls resilient to one-in-100-year floods—those which historically had a 1% chance of occurring in a given year. Big cities are supposed to have one-in-200-year

flood protection. Shanghai is unusual in building one-in-1,000-year protection for its central districts. In the Netherlands, for comparison, planners demand one-in-10,000-year standards for coastal cities.

But around half of the sea walls in China are shoddy, according to a government report. Even those that do meet official standards may not last long. A report in 2019 by the UN's Intergovernmental Panel on Climate Change predicted that one-in-100-year floods could occur every year by 2050, owing to sea-level rise.

This all means that massive sea-wall construction can be expected in the coming decades, says Scott Moore of the University of Pennsylvania. Some 430km is under construction already. But a new Great Wall on the sea will have downsides. Upgrading sea walls will become more expensive, as costs rise sharply with height. And the risk of failure increases as sea-level rise accelerates. Higher sea walls create illusions of safety that lead to more construction. “You may be setting yourself up for failure and...setting people up for real danger later on,” says Mr Moore.

More ambitious engineering works are another option, says Sun Laixiang of the University of Maryland. He has suggested that Shanghai build a tidal barrier across the Huangpu river, similar to the Thames barrier in London. Officials have been discussing the idea for decades. But the Thames barrier was undertaken only after disastrous floods. Mr Sun worries that China might not act until catastrophe strikes. “If we do not take action, if we wait, we may feel great regret,” he says.

In Shantou people know all about the dangers of the sea. In 1969 over 500 soldiers and university students drowned when a dyke collapsed during a storm. They were trying to protect farmland which had been reclaimed from the water. Cigarettes and alcohol are still left as gifts for the dead at a shrine to their memory.

Flood defences failed again in 2013, killing ten people. Earlier this year the city government admitted in a report that its defences were incomplete. Locals do not seem worried, though. Many view sea-level rise as a distant danger. Houses, they say, can just be built higher to leave space for storm waters. One shop-owner recalled how quickly the local economy recovered after the last big floods. She said she was confident that the government had a plan.

It is not hard to see where this confidence comes from. Shantou's GDP per person has grown by 430% in the past two decades. Photos in a local museum show before-and-after images of the city since the launch of Deng Xiaoping's reforms. Swathes of wetland and muddy fields morph into high-rise blocks and factories. The exhibition uses an apt Chinese idiom to describe these great changes: "The blue sea turned into mulberry fields." The danger is that few seem to believe that this process could be reversed. ■



唾手可得

便宜的疫苗可能防止数百万人死于宫颈癌

消灭这种疾病的努力建立了转折点

和乙肝病毒引发的疾病一样，宫颈癌也堪称世界上最致命的疫苗可预防疾病。大多数已存在有效儿童疫苗、且疫苗普遍可获得的疾病已不再威胁公众健康。但在2020年，也就是几乎可以完全预防发病的疫苗问世14年后，宫颈癌仍导致34.2万名女性死亡。如果疫苗的接种率上升，这种癌症可以被消除殆尽。而对于达成接种率目标，我们有了新的理由燃起希望。

足有95%的宫颈癌病例是由人类乳头瘤病毒（HPV）引起的，这是一组性传播病毒。HPV非常普遍，几乎每个性活跃的人都会感染某种毒株。大多数人感染过却不自知，因为身体会在两年内将它排出体外。然而，在某些情况下，病毒会留存下来，并在女性宫颈上形成可能致癌变的病灶。

这种致命的病变是15岁至44岁女性中第二常见的癌症。在富裕国家，五年生存率约为70%。宫颈癌死亡人数有90%在最贫穷的地区，那里能活下来的女性患者据信不到五分之一。

如果在性活跃之前接种HPV疫苗，可以完全预防HPV。但接种进展缓慢。在发达国家，15岁以下人群的疫苗接种率从日本的零（直到2022年才重新推荐接种）到英国的81%不等。许多较贫穷的国家从未开始推广接种HPV疫苗。在全球范围内，2021年只有12%适合接种的女孩完成了接种，低于2019年的14%。

HPV的特性会阻碍推广疫苗的努力。许多国家缺少为9至15岁儿童接种疫苗的制度，一些父母对给年轻女孩接种抗性传播病毒的疫苗感到别扭。而且，打疫苗的好处要到宫颈癌可以被诊断出来的年龄才能感受到——通常是在15年至35年后。

不过，另外两大障碍正在被清除。去年12月，世界卫生组织（WHO）表

示，注射一剂HPV疫苗就能提供全面保护。这将大大加快疫苗接种。此外，中国和印度的公司正在生产它们的第一批国产HPV疫苗。印度血清研究所（Serum Institute of India）计划在两年内生产2亿剂疫苗，价格远低于目前的市场价。它的产出应该能支持印度第一次全国性疫苗接种行动。

世卫组织已经设定了到2030年HPV疫苗接种覆盖率达90%的目标，这意味着要保持每年增长9个百分点。根据伦敦卫生与热带医学学院（London School of Hygiene and Tropical Medicine）的学者建立的统计模型，我们估计如果实现这一目标，到2030年适合接种的女孩中最终死于宫颈癌的人数相比维持现状将减少265万。若在2030年以后继续维持90%的接种覆盖率，接种疫苗的女孩中每年又可避免65万人死亡（不考虑人口增长）。随着便宜的单剂疫苗即将问世，这样的数字可能不再是幻想。

图表资料来源：伦敦卫生与热带医学院；世界卫生组织；联合国儿童基金会；HPV Information Centre；《经济学人》 ■



Low-hanging fruit

Cheap vaccines could prevent millions of deaths from cervical cancer

A turning-point looms in the campaign to eliminate the disease

ALONGSIDE AILMENTS resulting from hepatitis B, cervical cancer has a strong claim to be the world's deadliest vaccine-preventable disease. Most illnesses for which effective vaccines for children are widely available no longer threaten public health. But in 2020, 14 years after the advent of a jab that prevents almost all cases, cervical cancer still killed 342,000 women. If take-up of the vaccine rose—a goal about which there are new grounds for hope—this cancer could be nearly eliminated.

Fully 95% of cervical-cancer cases are caused by human papillomavirus (HPV), a group of sexually transmitted viruses. So common is HPV that nearly every sexually active person contracts a strain. Most never know, because the body flushes it out within two years. In some cases, however, the virus lingers, forming lesions on women's cervixes that can become cancerous.

This deadly condition is the second most common cancer among women aged 15-44. In rich countries, five-year survival rates are around 70%. In the poorest ones, which account for 90% of deaths from cervical cancer, less than one in five women with the disease are thought to survive.

The HPV jab, if given before people become sexually active, fully protects against HPV. But take-up has been slow. In the rich world, the share of people vaccinated by age 15 ranges from zero in Japan, which only resumed recommending the jab in 2022, to 81% in Britain. Many poorer countries have never begun vaccination drives. Worldwide, just 12% of eligible girls got the jab in 2021, down from 14% in 2019.

The nature of HPV can hinder vaccination efforts. Many countries lack systems to distribute vaccines at ages nine to 15, and some parents are squeamish about vaccinating young girls against a sexually transmitted virus. Moreover, the jab's benefits are not felt until the age when cervical cancer is diagnosed, typically 15-35 years later.

However, two other roadblocks are now being cleared. In December the World Health Organisation (WHO) said that a single dose of the HPV jab provided full protection. This will vastly expedite vaccination efforts. In addition, firms in both China and India are now producing their countries' first domestic HPV jabs. The Serum Institute of India plans to make 200m doses in two years at prices well below the current market rate. Its output should supply India's first national vaccination effort.

The WHO has set a goal for the HPV vaccination rate to reach 90% by 2030, entailing a sustained increase of nine percentage points per year. Based on a statistical model built by scholars at the London School of Hygiene and Tropical Medicine, we estimate that among girls eligible for vaccination by 2030, this path would reduce the number who wind up dying of cervical cancer by 2.65m, when compared with the status quo. Maintaining the 90% rate beyond 2030 would prevent another 650,000 deaths among girls vaccinated in each subsequent year, before accounting for population growth. With cheap, single-dose vaccines on the horizon, such numbers may no longer be the stuff of fantasy. ■

Chart sources: London School of Hygiene & Tropical Medicine; WHO; UNICEF; HPV Information Centre; The Economist ■



出埃及记

新一波大移民潮已经掀起

对富裕经济体有何影响？

去年有120万人移居英国，人数之多几乎可以肯定是史上之最。澳大利亚的净移民（即移入者减去移出者）是疫情前的两倍。西班牙这个数字近期也创下历史新高。预计美国今年将净移入近140万人，比疫情前多三分之一。2022年，加拿大的净移民人数达到先前纪录的两倍多，德国的数字甚至比2015年“移民危机”期间还要高。

富裕世界正处于一股外来移民热潮之中，其外国出生人口的增速比史上任何时期都要快（见图表1）。这对全球经济有什么影响？

不久前，许多富裕国家似乎已经坚决转向反对大规模外来移民。2016年，英国人公投脱欧，之后美国人投票选出了特朗普任总统，这些政治抉择有着强烈的反移民倾向。在随后掀起的全球民粹主义浪潮中，从澳大利亚到匈牙利的各国政客都承诺严限外来移民。接下来疫情爆发，导致各国关闭边境，移民潮中止，而由于许多移居者决定返回母国，甚至出现了逆转。2019年至2021年间，科威特和新加坡这两个一向大量接收移民的国家的人口下降了4%。2021年，澳大利亚移民国外的人数自1940年代以来首次超过了移入人数。

如今移民激增，令一些地区有回归正常的感觉。新加坡的外国劳动力人口近期已恢复到疫情前规模。在另一些地方则令人感到变化十分剧烈，比如加拿大人口第二少的纽芬兰与拉布拉多省（Newfoundland and Labrador）。这里长期以来是爱尔兰天主教徒后裔的家园——听口音就知道。该省的净移民人数现在是疫情前的20倍不止。省会城市圣约翰（St John）感觉越来越像多伦多。哈茨迪莱特（Heart's Delight）这个乡间村落如今还开了一家乌克兰面包店Borsch。省政府正着手在印度的班加罗尔设立办事处来协助引入护士。

纽芬兰的新移民是富裕世界其他地区新移民的缩影。成百上千名乌克兰人已抵达该岛，而这只是自俄罗斯入侵以来逃离乌克兰的数百万人中的一小部分。印度人和尼日利亚人似乎也在大量迁离本国。他们许多人会说英语。而且很多人在更富裕的国家（特别是英国和加拿大）有亲属关系。

移民激增的部分原因是人们在弥补失去的时间。许多移民在2020年或2021年就拿到了签证，结果在疫情限制措施放松后才成行。但是，富裕世界的外国出生人口现在已远超一亿人，高于危机前的趋势，表明还有其他因素在起作用。

后疫情经济的特点可能是一个非常重要的因素。富裕国家的失业率仅为4.8%，为几十年来的低点。空缺岗位之多接近历史最高，老板们亟需人手。国外人口因而大有理由迁入。货币流动可能是另一个因素。现在一英镑可兑换超过100印度卢比，而在2019年只能换到90卢比。自2021年初以来，新兴市场货币对美元平均贬值约4%。相比以前，移民能够汇更多钱回家。

许多国家的政府也在努力吸引更多移民。加拿大的目标是在2023至2025年迎来150万新居民。德国和印度最近签署了一项协议，允许更多印度人在德国工作和学习。澳大利亚正在调整政策，把部分国际学生毕业后留澳工作的期限从两年延长至四年。英国愿意接收不满政府管治的香港人，已有超过十万人抵达。许多国家为乌克兰人入境提供便利。为抵消人口老龄化的影响，即使是日韩这类之前抵制移民的国家现在也对外来者持更积极包容的态度。

欢迎大量移民的经济体往往能获得长远的好处。美国就是个例子。外国移民带来了新想法。麻省理工学院的皮埃尔·阿祖莱（Pierre Azoulay）与同事最近发表的一篇论文发现，在美国，移民创立公司的可能性比本地出生者高约80%。研究表明，移民有助于在其母国和接收国之间建立贸易和投资纽带。补充进来的年轻劳动人口也有助贡献更多税收。

一些经济学家希望这轮移民潮带来更直接的好处。“大量移民有助美联储

给劳动力市场降温并缓解通胀。”资产管理公司阿波罗全球管理（Apollo Global Management）的托斯滕·斯洛克（Torsten Slok）说出了一种共识。但这种论调也许有点过分乐观了。人口增加确实会增加劳动力供应，在其他条件不变的情况下，这将抑制工资增长，但效果相当小。鲜有迹象表明接收移民最多的国家具有最宽松的劳动力市场。以加拿大为例，工资水平仍逐年上升，同比升幅约为5%（见图表2）。

移民也会提高对商品和服务的需求，可能推高通胀。在英国，伦敦的住房供应本就有限，新移民似乎进一步推高了租金水平。类似的效果也在澳大利亚显现。高盛的估算显示，澳大利亚目前50万人的年化净移民速度令租金上涨约5%。租金上升导致整体消费价格指数上升。来自移民的需求或许也能解释为什么在许多富裕国家房贷利率上升，房价却没下降多少。

在未来一年左右，移民数量可能会略为下降。疫情后的“追赶式”移民将会结束，富裕世界的劳动力市场正逐渐松动。从非常长远的视角看，全球生育率下跌意味着未来可能出现移民短缺。但我们有理由相信，在一段时间内移民潮仍将保持高涨。政府推出更友善的政策是一个因素。还有就是今天的移民会带来明天的移民，因为新来的人会把孩子和伴侣带过来。用不了多久，富裕世界在2010年代末的反移民转向看起来会像是一种反常现象。 ■



Exodus

A new wave of mass migration has begun

What does it mean for rich-world economies?

LAST YEAR 1.2m people moved to Britain—almost certainly the most ever. Net migration (ie, immigrants minus emigrants) to Australia is twice the rate before covid-19. Spain's equivalent figure recently hit an all-time high. Nearly 1.4m people on net are expected to move to America this year, one-third more than before the pandemic. In 2022 net migration to Canada was more than double the previous record and in Germany it was even higher than during the “migration crisis” of 2015.

The rich world is in the middle of an immigration boom, with its foreign-born population rising faster than at any point in history (see chart 1). What does this mean for the global economy?

Not long ago it seemed as if many wealthy countries had turned decisively against mass migration. In 2016 Britons voted for Brexit and then Americans for Donald Trump, political projects with strong anti-migrant streaks. In the global wave of populism that followed, politicians from Australia to Hungary promised to crack down on migration. Then covid closed borders. Migration came to a standstill, or even went into reverse, as people decided to return home. Between 2019 and 2021 the populations of Kuwait and Singapore, countries that typically receive lots of migrants, fell by 4%. In 2021 the number of emigrants from Australia exceeded the number of immigrants to the country for the first time since the 1940s.

The surge in migration has brought back a sense of normality to some places. Singapore's foreign workforce recently returned to its pre-pandemic level. In other places it feels like a drastic change. Consider Newfoundland

and Labrador, Canada's second-smallest province by population. Long home to people of Irish-Catholic descent—with accents to match—net migration to the province is running at more than 20 times the pre-pandemic norm. St John's, the capital, feels more like Toronto every time you visit. Heart's Delight, a small rural settlement, now has a Ukrainian bakery, Borsch. The provincial government is setting up an office in Bangalore to help recruit nurses.

The new arrivals in Newfoundland are a microcosm of those elsewhere in the rich world. Many hundreds of Ukrainians have arrived on the island—a tiny share of the millions who have left the country since Russia invaded. Indians and Nigerians also appear to be on the move in large numbers. Many speak English. And many already have family connections in richer countries, in particular Britain and Canada.

Some of the surge in migration is because people are making up for lost time. Many migrants acquired visas in 2020 or 2021, but only made the trip once covid restrictions loosened. Yet the rich world's foreign-born population—at well over 100m—is now above its pre-crisis trend, suggesting something else is going on.

The nature of the post-pandemic economy is a big part of the explanation. Unemployment in the rich world, at 4.8%, has not been so low in decades. Bosses are desperate for staff, with vacancies near an all-time high. People from abroad thus have good reason to travel. Currency movements may be another factor. A British pound buys more than 100 Indian rupees, compared with 90 in 2019. Since the beginning of 2021 the average emerging-market currency has depreciated by about 4% against the dollar. This enables migrants to send more money home than before.

Many governments are also trying to attract more people. Canada has a target to welcome 1.5m new residents in 2023-25. Germany and India

recently signed an agreement to allow more Indians to work and study in Germany. Australia is increasing the time period some students can work for after graduating from two to four years. Britain has welcomed Hong Kongers fleeing Chinese oppression—well over 100,000 have arrived. Many countries have made it easy for Ukrainians to enter. Even those countries hitherto hostile to migration, including Japan and South Korea, are now looking more favourably on outsiders as they seek to counteract the impact of ageing populations.

Economies that welcome lots of migrants tend to benefit in the long run. Just look at America. Foreign folk bring new ideas with them. In America immigrants are about 80% likelier than native-born folk to found a firm, according to a recent paper by Pierre Azoulay of the Massachusetts Institute of Technology and colleagues. Research suggests that migrants help to build trading and investment links between their home country and the receiving one. A slug of young workers also helps generate more tax revenue.

Some economists hope that the wave of migration will have more immediate benefits. “High immigration is helpful for the Fed as it tries to cool down the labour market and slow down inflation,” says Torsten Slok of Apollo Global Management, an asset manager, expressing a common view. Such arguments may be a little too optimistic. Having more people does increase the supply of labour, which, all else being equal, reduces wage growth. But the effect is pretty small. There is little sign that the countries receiving the most migrants have the loosest labour markets. In Canada, for instance, pay is still rising by about 5% year on year (see chart 2).

Migrants also lift demand for goods and services, which can raise inflation. In Britain new arrivals appear to be pushing up rents in London, which already had a constrained supply of housing. A similar effect is apparent in Australia. Estimates by Goldman Sachs, a bank, imply that Australia’s current annualised net migration rate of 500,000 people is raising rents by

around 5%. Higher rents feed into a higher overall consumer-price index. Demand from migrants may also explain why, despite higher mortgage rates, house prices in many rich countries have not fallen by much.

Over the next year or so migration may come down a bit. The post-pandemic “catch-up” will end; rich-world labour markets are slowly loosening. In the very long term, a global slump in fertility rates means there may be a shortage of migrants. Yet there is reason to believe that high levels of new arrivals will remain raised for some time. More welcoming government policy is one factor. And migration today begets migration tomorrow, as new arrivals bring over children and partners. Before long the rich world’s anti-immigrant turn of the late 2010s will seem like an aberration. ■



巨大的吸碳声

除碳会成为万亿美元级产业吗？

很有可能——而且早该如此【深度】

“今天我们见证了一个新物种的诞生。”凝视着面前荒凉的土地，胡里奥·弗里德曼（Julio Friedmann）宣布。4月下旬，这位能源技术专家与几百位达官贵人来到得克萨斯州石油产区偏远一隅的诺特里斯（Notrees）。邀请他的是美国西方石油公司（Occidental Petroleum，以下简称 Occidental）旗下的1PointFive，以及比尔·盖茨支持的加拿大创业公司 Carbon Engineering。他所说的物种有点像树木——但并不是在植物的意义上（在这片不毛之地上找不到树）。更确切地说，它是在工作原理上类似树木：世界首个商用级别的直接空气捕获（DAC）工厂。

DAC能像树木一样从空气中吸收二氧化碳，将其浓缩，然后满足某种用途。对树木来说，其用途是通过光合作用创造有机分子。至于DAC，其产物可以用到人类现在就需要二氧化碳的地方，例如在饮料中添加气泡，刺激温室植物生长，或者像Occidental这样，将其注入油田，以便从油藏中开采出更多原油。

不过，等到诺特里斯工厂在2025年全面运营，它每年将捕获的50万吨二氧化碳中有一部分会被灌入这片平原的地下，以实现一个更宏大的目标：应对气候变化。这是因为，不同于植物中存储的碳会在它们被砍伐或焚烧时重新释放出来，人工封存的二氧化碳很可能无限期地封存下去。一些公司想要减少自己的净排放，但觉得基于生物的碳抵消不可靠，就可以按封存的吨数向该项目的管理人支付费用。这样一来，诺特里斯工厂还让某种别的东西萌发出了新芽：一个真正的产业。

Carbon Engineering及其竞争对手，如瑞士的Climeworks、加州的Global Thermostat，以及全球各地无数的创业公司都在吸引资本。Occidental计划到2035年建成100个大型DAC设施。还有一些公司试图在发电厂和工业

生产过程产生的二氧化碳进入大气之前就将其尽数吸收，这种方法称为碳捕获和储存（CCS）。今年4月，埃克森美孚（ExxonMobil）公布了其成立不久的低碳部门的计划，该部门的长期目标是为钢铁和水泥等减排困难的行业客户提供这种脱碳服务。这家石油巨头认为，到2050年，脱碳行业的全球年收入可达6万亿美元。

无论是从空气中还是在各个工业排放源头除碳，蓬勃兴起的除碳产业发展速度仍然不够快。联合国下属机构政府间气候变化专门委员会认为，如果要想让地球气温有望较工业化前的水平上升不到2摄氏度，仅靠可再生能源、电动汽车和其他减排措施是不够的。CCS以及DAC等“负排放”源必须发挥作用。据美国能源部计算，要实现美国的气候目标，到2050年每年需要捕获和储存4至18亿吨二氧化碳，而目前仅有2000万吨。能源咨询公司伍德麦肯兹（Wood Mackenzie）估计，要在2050年前实现温室气体净零排放，需要各种形式的除碳措施完成全球减排量的五分之一。如果伍德麦肯兹计算正确，这将相当于每年要吸收逾80亿吨二氧化碳。这意味着需要大量的工业级除碳项目（见图表1）。

多年来，这些项目被认为或许在技术上可行，但经济账不划算。美国物理学会（American Physical Society）2011年一项颇有影响的估计认为，DAC捕获一吨二氧化碳的成本为600美元。相比之下，在欧盟排放交易体系中，碳排放许可证的交易价格约为每吨100美元。CCS的进展一直令人失望。伍德麦肯兹的西蒙·弗劳尔斯（Simon Flowers）表示，多年来电力行业已经在该领域投入了约100亿美元寻找可行方案，但收效甚微。

新一批除碳项目的支持者认为这次情况有所不同。他们乐观的原因之一是技术变得更好了，最重要的是更便宜了（见图表2）。诺特里斯项目并未披露它封存一吨二氧化碳的成本，但2018年发表在《焦耳》（Joule）期刊上的一篇论文认为，Carbon Engineering的DAC系统在大规模运营时的价格在每吨94美元至232美元之间。这远远低于600美元，与欧盟的碳价也相差不多。

CCS应该比DAC更便宜，也展现出了更好一些的前景。加拿大创业公司

Svante使用廉价材料从高污染工业烟气中捕获二氧化碳，价格约为每吨50美元（但不包括运输和储存）。其他公司将捕获的碳转化为产品，希望能出售盈利。CarbonFree与美国钢铁公司（US Steel）和英国石油天然气公司BP合作，从工业过程中提取二氧化碳并转化为特种化学品。LanzaTech与欧洲钢铁巨头安赛乐米塔尔（ArcelorMittal）及几家中国工业企业建立了商业级的合作关系，建造生物反应器来将工业排放的碳转化为有用的材料。一些材料被用于便携式碳储库，如露露乐蒙（Lululemon）的瑜伽裤。

据伍德麦肯兹预测，在这个十年里，碳捕获、利用和储存（在这个充斥着缩略语的领域里叫CCUS）可能会在全球吸引共计1500亿美元的投资。该咨询公司评估了当前和拟建的项目，估计全球CCUS产能——按其定义包括CCS，利用所捕获的碳的各式手段，以及DAC——到2030年将增至目前的7倍以上。

近期除碳活动兴起的第二个、也可能是更重要的原因是政府的行动。要促进该行业发展，一个显然易见的方法就是让碳污染者为其碳排放付费，只要费用足够高，它们就会愿意向除碳公司付费，从源头或从大气中除碳。合理的碳价（类似欧盟目前的那样）也许差不多能让CCS在商业上切实可行。但要让DAC企业实现盈利，碳税可能需要再提高一些，而这可能扼杀那些仍然依赖碳氢燃料的经济体。再加上全球统一征收碳税的前景渺茫，意味着需要国家支持来弥合当前碳价与除碳成本之间的差距。

技术专家、投资者和买方的最新观点是，除碳行业的发展可能会像几十年前的垃圾管理一样——最初成本高昂，需要政府支持才能起步，但最终可以实现盈利。政策制定者也开始转向这种观点。在美国最近批准的数千亿美元气候补贴中，有一部分就用于扶持该行业的起步。其中《通胀削减法案》（Inflation Reduction Act）包含了更大力度的税收抵免政策，每永久储存一吨二氧化碳最多可获得85美元，每使用一吨二氧化碳提高石油采收率可获得60美元，后者同时也封存了二氧化碳（尽管目的是为了开采更多油气）。据投资公司古根海姆证券（Guggenheim Securities）的克里奥·克雷斯皮（Clio Crespy）计算，这一税收抵免将让美国除碳后“可获利”的

排放量增加十倍以上。眼见美国热火朝天地推动气候举措，欧盟的反应很可能也会推动除碳发展。今年早些时候，欧盟和挪威宣布成立“绿色联盟”，促进区域碳捕获计划。

碳信用的买家开始接踵而至。热衷于彰显自身进步主义形象的科技公司正在引领潮流。5月15日，微软表示将购买270万吨碳（具体金额不详），在十年内由丹麦清洁能源公司Orsted运营的生物质发电厂捕获，并由挪威国家石油公司（Equinor）、壳牌和道达尔能源（TotalEnergies）这三家欧洲石油巨头组成的联合企业注入到北海海底。5月18日，手握十亿美元除碳资金（主要由Alphabet、Meta、Stripe和Shopify提供）的公益购碳公司Frontier宣布与Charm Industrial达成5300万美元的交易。该公司将在2024至2030年间除碳112,000吨，方法是将农业废料转化为可储存于地下的油脂，从而避免废料在分解时排出二氧化碳。

不只是科技巨头在行动。日本企业集团三菱公司和瑞士除碳项目开发商South Pole的合资企业NextGen计划在2025年前购买超过100万吨经认证的除碳信用，并将其出售给其他公司。该公司刚刚宣布从1PointFive和另外两家企业购买近20万吨的已认证碳信用。最终买家包括瑞士两大金融巨头瑞士再保险（SwissRe）和瑞银（UBS）、日本航运公司商船三井和波士顿咨询公司。5月23日，美国最大的银行摩根大通（JPMorgan Chase）表示，将在未来几年斥资2亿多美元向除碳公司购买碳信用。

除碳行业有望站稳脚跟的最重要迹象也许是得到石油业的接纳。Occidental热衷于DAC。埃克森美孚表示，将在2022至2027年期间投入170亿美元用于“低排放投资”，其中一部分将用于CCS。它在美国的主要竞争对手雪佛龙（Chevron）正在加州的一个油田引进Svante公司的碳捕获项目。正如微软的交易显示，欧洲的石油同行希望将北海的部分海床转化为一个巨大的碳汇。挪威国家石油和德国油气公司Wintershall已经获得许可证，将从德国工业捕获的碳储存在北海的某些地方。Wintershall的技术主管雨果·迪克格拉夫（Hugo Dijkgraaf）认为，到2040年，他的公司每年可以减少高达3000万吨的碳排放。他表示，指导思想是“从一家石油和天然气公司转变为一家天然气和碳管理公司”。

世界石油巨头沙特阿美石油公司（Saudi Aramco）所在的沙特阿拉伯提出了在未来12年内将CCS产能提高4倍的目标。它位于朱拜勒工业城（Jubail Industrial City）的大型储存设施预计将于2027年投入使用。阿联酋石油巨头阿布扎比国家石油公司（ADNOC）则希望到2030年将产能增加5倍，达到每年500万吨。

石油商的批评者称，这些公司之所以对除碳热情高涨，更多是为了在越来越关注气候的消费者眼中改善自身形象，同时寻求在更长的时间里开采更多原油。这当然有一定道理。但考虑到世界迫切需要同时在源头捕获碳排放和实现大规模的负排放，这些拥有庞大资本预算和工程地质等有用专业知识的大型石油公司愿意参与进来，依然应该表示欢迎。 ■



A giant sucking sound

Can carbon removal become a trillion-dollar business?

Quite possibly—and not before time

“TODAY WE SEE the birth of a new species,” declared Julio Friedmann, gazing across the bleak landscape. Along with several hundred grandes, the energy technologist had travelled to Notrees, a remote corner of the Texas oil patch, in late April. He was invited by 1PointFive, an arm of Occidental Petroleum, an American oil firm, and of Carbon Engineering, a Canadian startup backed by Bill Gates. The species in question is in some ways akin to a tree—but not the botanical sort, nowhere to be seen on the barren terrain. Rather, it is an arboreal artifice: the world’s first commercial-scale “direct air capture” (DAC) plant.

Like a tree, DAC sucks carbon dioxide from the air, concentrates it and makes it available for some use. In the natural case, that use is creating organic molecules through photosynthesis. For DAC, it can be things for which humans already use CO₂, like adding fizz to drinks, spurring plant growth in greenhouses or, in Occidental’s case, injecting it into oilfields to squeeze more drops of crude from the deposits.

Yet some of the 500,000 tonnes of CO₂ that the Notrees plant will capture annually, once fully operational in 2025, will be pumped beneath the plains in the service of a grander goal: fighting climate change. For unlike the carbon stored in biological plants, which can be released when they are cut down or burned, CO₂ artificially sequestered may well stay sequestered indefinitely. Companies that want to net out some of their own carbon emissions but do not trust biology-based offsets will pay the project’s managers per stashed tonne. That makes the Notrees launch the green shoot of something else, too: a real industry.

Carbon Engineering and its rivals, like Climeworks, a Swiss firm, Global Thermostat, a Californian one, and myriad startups worldwide, are attracting capital. Occidental plans to build 100 large-scale DAC facilities by 2035. Others are trying to mop up CO₂ produced by power plants and industrial processes before it enters the atmosphere, an approach known as carbon capture and storage (CCS). In April ExxonMobil unveiled plans for its newish low-carbon division, whose long-term goal is to offer such decarbonisation as a service for industrial customers in sectors, like steel and cement, where emissions are otherwise hard to abate. The oil giant thinks this sector could be raking in annual revenues of \$6trn globally by 2050.

The boom in carbon removal, whether from the air or from industrial point sources, cannot come fast enough. The UN-backed Intergovernmental Panel on Climate Change assumes that if Earth is to have a chance of warming by less than 2°C above pre-industrial levels, renewables, electric vehicles and other emissions reductions are not enough. CCS and sources of “negative emissions” such as DAC must play a part. The Department of Energy calculates that America’s climate targets require capturing and storing between 400m and 1.8bn tonnes of CO₂ annually by 2050, up from 20m tonnes today. Wood Mackenzie, an energy consultancy, reckons various forms of carbon removal account for a fifth of the global emissions reductions needed to emit no net greenhouse gases by 2050. If Wood Mackenzie is right, this would be equivalent to sucking up more than 8bn tonnes of CO₂ annually. That means an awful lot of industrial-scale carbon-removal ventures (see chart 1).

For years such projects were regarded as technically plausible, perhaps, but uneconomical. An influential estimate by the American Physical Society in 2011 put the cost of DAC at \$600 per tonne of CO₂ captured. By comparison, permits to emit one tonne trade at around \$100 in the EU’s emissions-trading system. CCS has been a perennial disappointment. Simon Flowers of

Wood Mackenzie says the power sector has spent some \$10bn over the years trying to get it to work, without much success.

Backers of the new crop of carbon-removal projects think this time is different. One reason for their optimism is better and, crucially, cheaper technology (see chart 2). The cost of sequestering a tonne of CO₂ beneath Notrees has not been disclosed, but a paper from 2018 published in the journal Joule put the price tag for Carbon Engineering's DAC system at between \$94 and \$232 per tonne when operating at scale. That is much less than \$600, and not a world away from the EU's carbon price.

CCS, which should be cheaper than DAC, is also showing a bit more promise. Svante, a Canadian startup, uses inexpensive materials to capture CO₂ from dirty industrial flue gas for around \$50 a tonne (though that excludes transport and storage). Other companies are converting the captured carbon into products which they then hope to sell at a profit. CarbonFree, which works with US Steel and BP, a British oil-and-gas company, takes CO₂ from industrial processes and turns it into speciality chemicals. LanzaTech, which has a commercial-scale partnership with ArcelorMittal, a European steel giant, and several Chinese industrial firms, builds bioreactors that convert industrial carbon emissions into useful materials. Some make their way into portable carbon stores, such as Lululemon yoga pants.

All told, carbon capture, utilisation and storage (CCUS in the field's acronym-rich jargon) may attract \$150bn in investments globally this decade, predicts Wood Mackenzie. Assessing current and proposed projects, the consultancy reckons that global CCUS capacity—which on its definition includes CCS, the sundry ways to put the captured carbon to use, as well as DAC—will rise more than sevenfold by 2030.

The second—possibly bigger—factor behind the recent flurry of carbon-removal activity is government action. One obvious way to promote the

industry would be to make carbon polluters pay a high enough fee for every tonne of carbon they emit that it would be in their interest to pay carbon removers to mop it all up, either at the source or from the atmosphere. A reasonable carbon price like the EU's current one may, just about, make CCS viable. For DAC to be a profitable enterprise, though, the tax would probably need to be a fair bit higher, which could smother economies still dependent on hydrocarbons. That, plus the dim prospects for a global carbon tax, means that state support is needed to bridge the gap between the current price of carbon and the cost of extracting it.

The emerging view among technologists, investors and buyers is that carbon removal will develop like waste management did decades ago—as an initially costly endeavour that needs public support to get off the ground but can in time turn profitable. Policymakers are coming over to this view. Some of the hundreds of billions of dollars in America's recently approved climate handouts are aimed at bootstrapping the industry into existence. An enhanced tax credit included in one of the laws, the Inflation Reduction Act, provides up to \$85 per tonne of CO₂ permanently stored, and \$60 per tonne of CO₂ used for enhanced oil recovery, which also sequesters CO₂ (albeit in order to produce more hydrocarbons). Clio Crespy of Guggenheim Securities, an investment firm, calculates that this credit increases the volume of emissions in America that are “in the money” for carbon removal more than tenfold. The EU's response to America's climate bonanza is likely to promote carbon removal, too. Earlier this year the EU and Norway announced a “green alliance” to boost regional carbon-capture plans.

Buyers of carbon credits are starting to line up. Tech firms, keen to burnish their progressive credentials, are leading the way. On May 15th Microsoft said it would purchase (for an undisclosed sum) 2.7m tonnes of carbon captured over a decade from biomass-burning power plants run by Orsted, a Danish clean-energy firm, and pumped underneath the North Sea by a consortium involving Equinor, Shell and TotalEnergies, three European oil

giants. On May 18th Frontier, a buyers' club with a \$1bn carbon-removal pot bankrolled mainly by Alphabet, Meta, Stripe and Shopify, announced a \$53m deal with Charm Industrial. The firm will remove 112,000 tonnes of CO₂ between 2024 and 2030 by converting agricultural waste, which would otherwise emit carbon as it decomposes, into an oil that can be stored underground.

Big tech is not alone. NextGen, a joint venture between Mitsubishi Corporation, a Japanese conglomerate, and South Pole, a Swiss developer of carbon-removal projects, intends to acquire over 1m tonnes in certified CO₂-removal credits by 2025, and sell them on to others. It has just announced the purchase of nearly 200,000 tonnes' worth of such credits from 1PointFive and two other ventures. The end-buyers include SwissRe and UBS, two Swiss financial giants, Mitsui OSK Lines, a Japanese shipping firm, and Boston Consulting Group. On May 23rd JPMorgan Chase, America's biggest bank, said it would spend over \$200m in the coming years on buying credits from carbon-removal firms.

Maybe the biggest sign that the carbon-removal business has legs is its embrace by the oil industry. Occidental is keen on DAC. ExxonMobil says it will spend \$17bn from 2022 to 2027 on "lower-emissions investments", with a slug going to CCS. Its main American rival, Chevron, is hosting Svante at one of its Californian oilfields. As the Microsoft deal shows, their European peers want to convert parts of the North Sea floor into a giant carbon sink. Equinor and Wintershall, a German oil-and-gas firm, have already secured licences to stash carbon captured from German industry in North Sea sites. Hugo Dijkgraaf, Wintershall's technology chief, thinks his firm can abate up to 30m tonnes of CO₂ per year by 2040. The idea, he says, is to turn "from an oil-and-gas company into a gas-and-carbon-management company".

Saudi Arabia, home to Saudi Aramco, the world's oil colossus, has a goal of increasing CCS capacity fivefold in the next 12 years. Its mega-storage

facility at Jubail Industrial City is expected to be operational by 2027. ADNOC, Aramco's Emirati counterpart, wants to increase its capacity sixfold by 2030, to 5m tonnes a year.

The oilmen's critics allege that their enthusiasm for carbon removal is mainly about improving their reputations in the eyes of increasingly climate-conscious consumers, while pumping more crude for longer. There is surely some truth to this. But given the urgent need to both capture carbon at source and achieve voluminous negative emissions, the willing involvement of giant oil firms, with their vast capital budgets and useful expertise in engineering and geology, is to be welcomed. ■



【首文】叹为观止

苹果Vision Pro是台神奇的设备。现在想想它有什么用吧

“空间计算”的意义

在展示自家新电子产品方面，苹果独树一帜。但苹果老板库克在6月5日发布的新设备被标榜为具有更重大的意义。他表示，Vision Pro这款带流线型玻璃外罩的头显代表着“一个全新的空间计算平台”，意义堪比当年麦金塔电脑和iPhone的面世。苹果传递的信息很清晰：在桌面和移动计算之后，下一个科技大时代将是空间计算，或称增强现实，也就是把计算机图形叠加在用户周围的现实环境上。

这场发布会让人叹为观止，但奇怪的是，也让人觉得平平无奇。苹果这款头显充满创新设计，让市面上其他头显黯然失色。它去掉了难用的操纵手柄，加上了手势和眼球追踪功能。用户得到的是逼真的人形，而非只有半身的虚拟化身，他们的眼睛也会显示在头显的外罩上，让人看起来不那么拒人于千里之外。这款产品到处闪耀着苹果那用户友好设计的魔法。

但是，关于这台神奇设备的应用场景，苹果的建议却乏味到匪夷所思：戴着它看照片吧——照片幅面变大啦！戴着它使用微软Teams吧——不过是在虚拟屏幕上哟！用它打FaceTime视频通话吧——对方的对话窗口会飘在空中，而不是拿在你手上！苹果的设想似乎是把2D应用都投射到虚拟屏幕上（并为此收取3499美元）。就这？

给点耐心。库克说得对，空间计算是一种新平台。但探索利用它还需要时间。遥想16年前iPhone刚发布时，就和Vision Pro一样，在技术上很耀眼，但最初的用途乏善可陈——只是从之前的平台继承而来的打电话、写邮件、浏览网页、听音乐。多年后，开发者才发现移动计算的杀手级用例：群聊、打车、短视频、休闲游戏、移动支付，还有种种其他用途，让人们如今甘愿花至少1000美元购买一台iPhone（2007年其499美元的首发价格曾被认为高得离谱）。

其他平台也一样花了那么久才发挥出潜力。电视制作人一开始拍摄的是舞台表演。互联网的先驱们最早不过是在网络上分享文件，后来网络越织越大，用途越来越广。苹果最初发布自家的智能手表时，人们觉得这东西百无一用，直到消费者认定它是一款健康和健身设备。现在它每年的销量达5000万块。

没有人知道空间计算的杀手级用例会可能是什么，甚至有没有也是个问题，但看起来很可能是有的。也许是在商业上（外科医生、工程师和建筑师已开始尝试该技术），或者是在教育上（苹果演示了“天文馆”的应用），也可能是在娱乐上（迪士尼客串登场，展示了沉浸式观看电影和体育赛事的功能）。Vision Pro甚至可能变成一款高端色情影像头显，前提是苹果放松对这类内容的限制。借助人工智能，程序员将能够在全部上述领域乃至其他许多领域制作出逼真到有点瘆人的内容。

加快这一进程的方法是把硬件送到开发者手上，而这才是Vision Pro的真正使命。这种昂贵的第一代设备的销量不会大，苹果也不在乎这一点。它的目标是要把产品送到能琢磨出空间计算用途的人手上。苹果享有独特优势。作为苹果在头显领域的主要竞争对手，Meta缺乏苹果与开发者之间的那种联结，开发者喜欢为苹果的一流硬件（还有最富裕的消费群体）制作软件。

这款不无缺陷但出类拔萃的Vision Pro头显表明，把空间计算化为现实的技术战役已胜利在望。下一场竞赛是发掘其用途。苹果刚刚打响了发令枪。 ■



Mind-goggling

Apple's Vision Pro is an incredible machine. Now to find out what it is for

The meaning of "spatial computing"

NO ONE SHOWS off a new gadget quite like Apple. But the device that Tim Cook unveiled on June 5th was billed as something more significant. The Vision Pro, a pair of sleek glass goggles, represents “an entirely new spatial-computing platform”, said Apple’s boss, comparing its launch to that of the Macintosh and the iPhone. Apple’s message is clear: after desktop and mobile computing, the next big tech era will be spatial computing—also known as augmented reality—in which computer graphics are overlaid on the world around the user.

The presentation was both jaw-droppingly impressive and oddly underwhelming. The Vision is stuffed with innovations that eclipse every other headset on the market. Clunky joysticks are out, hand gestures and eyeball tracking are in. Instead of legless avatars, users get photorealistic likenesses, whose eyes also appear on the outside of the glasses to make wearing them less antisocial. The product is dusted with Apple’s user-friendly design magic.

Yet the company had strangely uninspiring suggestions for what to do with its miraculous device. Look at your photos—but bigger! Use Microsoft Teams—but on a virtual screen! Make FaceTime video calls—but with your friend’s window in space, not the palm of your hand! Apple’s vision mainly seemed to involve taking 2D apps and projecting them onto virtual screens (while charging \$3,499 for the privilege). Is that it?

Patience. Mr Cook is right that spatial computing is a new platform, but it will take time to exploit. Consider the iPhone’s launch, 16 years ago. Like the

Vision, its technology sparkled, but its dull initial uses were inherited from earlier platforms: make calls, write emails, browse the web, listen to music. It was years before developers found mobile computing's killer use-cases: group chats, ride-hailing, short video, casual gaming, mobile payments and all the other things that today persuade people to spend \$1,000 or more on an iPhone (whose \$499 launch price in 2007 was considered shocking).

Other platforms have taken just as long to reach their potential. Television producers began by filming people appearing on stage. Internet pioneers started off by sharing files, before spinning the web and much more. Apple's own smartwatch was a damp squib until consumers decided that it was a health and fitness device. It now sells 50m watches a year.

No one yet knows what spatial computing's killer use-case might be—or if it even has one, though that seems likely. It could be commercial (surgeons, engineers and architects have dabbled in the tech) or educational (Apple previewed a “planetarium” in its demo) or in entertainment (Disney made a cameo with ideas for immersive cinema and sports coverage). Vision Pros could even become high-end porn goggles, if Apple relaxes its ban on such things. Artificial intelligence will allow programmers to make eerily realistic content in all these categories, and many more.

The way to speed up this process is to get the hardware into the hands of developers—and that is the real purpose of the Vision. Apple will not sell many of the expensive first-generation units, and doesn't care. Its aim is to get the product to the people who will work out what spatial computing can do. It is uniquely well placed. Meta, its chief rival in the headset game, lacks Apple's links with developers, who like making software for Apple's best-in-class hardware (and its richest-in-class consumers).

The flawed but extraordinary Vision shows that the technological struggle to make spatial computing a reality is being won. The next race is to discover

what it is for. Apple has just fired the starting gun. ■



离水之鱼

养鱼业的未来在陆地

新系统不仅减少污染，还能让鱼类养殖不受地域限制【新知】

位于北极圈内的挪威北部海岸岩石密布，天气寒冷，通常被认为不太适合农业生产。但在谢斯塔峡湾（Skjerstad Fjord）沿岸一条断头路的尽头，却坐落着世界上最先进的养殖场之一，这就是萨尔滕·斯莫尔特（Salten Smolt）公司。不过，该公司出产的不是农作物和奶牛，而是鱼。在它7000平方米的主楼里安装着很多水箱，每年能繁育八百万条鲑鱼苗（大西洋鲑的幼鱼）。

养鱼业是世界上增长最快的食物生产方式。人类约17%的蛋白质摄入量来自海产品（在亚洲和非洲的一些地方，这一比例接近50%）。据富国俱乐部经合组织估计，由于人口增长和收入增加，到这个十年末，全球鱼类消费量将从2020年的1.58亿吨上升到1.8亿吨。

但海洋的馈赠终究是有限的。据世界银行估计，目前，全球90%的渔场都处于充分或过度捕捞状态。因此，自1990年以来鱼类消费的增长几乎全都依靠水产养殖（见图表）。而且日后的增长也几乎都得依靠这一途径。

不过，与陆地耕种一样，水产养殖也会破坏环境。很多养殖使用围网——这些围网要么被敷设在河流里，要么在外海里。鱼吃剩的饵料和排泄物会污染周边水域。如果围网破裂，出逃的养殖鱼会破坏本地生态系统。内陆的“流水式”养殖场需要源源不断地从河流或水井中获取淡水，这会与人争夺饮用水源。高密度敷设养鱼场有可能导致从开放水域涌入的病虫害在本地大暴发。这就需要使用抗生素和其他药物来保持鱼的健康。

萨尔滕·斯莫尔特这样的新兴养鱼场正是要解决这些问题。它利用一种叫做“循环水养殖系统”（简称RAS，发音为“Rass”）的技术。RAS系统不是依靠天然水的持续流动来保持鱼的健康，而是在陆地上用水箱养鱼，水箱中的水不断被清洁和循环利用。它有三大优势。与传统的水产养殖系统相

比，RAS养殖场可以做到：大幅减少用水量；更精心的饲养；以及在世界任何地方饲养难伺候的品种。

RAS养殖场本质上就是个放大了许多倍的家庭水族箱：每个RAS系统都包括一个可供鱼游动的水箱，和一套处理鱼排泄物的水清洁组件。其中许多技术是现有污水处理技术的再应用。

首先要清除的是固态废弃物，其中大部分是粪便和残饵。这一过程以机械手段完成——利用一个圆锥形的容器、重力作用和一套孔径越来越小的过滤网。接下来要处理的废弃物大部分是氨。氨是鱼新陈代谢的副产品，鱼通过鳃把它们排出体外，过多的氨会产生毒性。因此，这些富含氨的水会被输送经过添加有很多种细菌的生物滤池，只要有足够的氧气，这些细菌就会将氨转化为亚硝酸盐和硝酸盐。后续步骤可以去除其他污染物，如磷和重金属等。

水处理得越干净，能够再循环利用的水就越多，需要从外部调运的水也就越少。要做到全闭环是不切实际的，至少目前还不可行。但是最先进的系统，比如萨尔滕·斯莫尔特的系统，可以减少99%以上的用水量。传统的鲑鱼养殖法每生产一公斤鲑鱼要消耗约五万升水，而采用RAS系统可能只需要150升。这样做的结果是，RAS养殖场“不对野生环境造成侵扰，这样（养殖的鱼）就不会传播病原体或污染水道”，洛杉矶附近一家采用RAS系统的养虾场TransparentSea的创始人史蒂夫·萨顿（Steve Sutton）表示。

把废弃物集中到一处自有优势。传统养鱼场排放到环境中的废弃物里含有大量有价值的营养物，这是传统水产养殖业错过的最大商机之一，另一家挪威水产养殖公司Nofitech的研究主管卡利·阿特拉马达尔（Kari Attramadal）表示。硝酸盐可以作为水培作物的养料。萨尔滕·斯莫尔特的生产部经理约翰·塞勒布兰特（John Sælebrant）说，该公司将鱼的粪便和残饵都一并回收并干燥，然后做成农业用肥。

要让鱼在养殖水箱里存活，就必须严格控制整个系统。一旦出差错，可能要付出高昂的代价。阿特拉马达尔表示，如果增氧系统失灵，鱼在八分钟

内便会开始死亡。不过，因为需要细致的监测，也就相应提升了对鱼类养殖环境的微调能力。这让RAS系统可以把陆地上的那种精准农业搬到水里来。

例如鲑鱼更喜欢冷水。内部气候受控的水箱能够全天候提供理想的温度，而不用担心水流、潮汐或天气等情况，从而加快鱼的生长速度。加拿大新斯科舍省（Nova Scotia）的创业公司ReelData利用RAS水箱中的摄像头和传感器提供的数据来估计鱼的饥饿程度、体重，甚至评估它们承受的压力。该公司表示，其技术可以将养殖场的生产率提高20%之多。

而且，由于RAS系统不依赖自然环境，原则上可以建在任何地方。另一家挪威公司Atlantic Sapphire在美国迈阿密附近建造了一个大西洋鲑养殖场，位于这种鱼的自然活动区以南一千英里处。靠近大城市缩短了鱼上餐桌前的运输距离。挪威RAS供应商Pure Salmon Technology正在日本建造一个养殖场。该公司认为，尽管RAS系统的运行需要额外的能源成本，但运输成本的降低会让生产每公斤鲑鱼的碳足迹减少超过一半。

与所有新技术一样，RAS系统一开始也会遇到一些麻烦。例如，2021年，Atlantic Sapphire位于佛罗里达的养殖场的过滤系统出现问题，导致50万条鱼死亡，约占总数的5%。（该公司将这一事件描述为“在RAS快速发展的早期阶段”的一次“昂贵的教训”。）

最大的劣势是成本。所用的管道、水泵和监控系统使得RAS养殖场的资金成本明显高于传统养殖场。（目前许多现有的RAS系统都侧重于养殖相对昂贵的鲑鱼，这正是原因之一。）即使在全国约一半鲑鱼养殖场都使用RAS的挪威，也只是在鲑鱼生长的第一阶段使用它。之后幼鱼仍然会被放到传统的开放水域围网中长至成年。

挪威税制的变化可能会改变这种情况，水产养殖市场分析公司Sphere Research的马特·克雷兹（Matt Craze）表示。还有其他可以降低成本的方法。一些公司正在尝试混合使用传统系统和RAS。混合系统省去了废弃物处理设备中更昂贵的组件，但仍然可以显著减少用水总量。规模经济也会

有所帮助。克雷兹认为，虽然小型RAS养殖场的养殖成本可能比传统水产养殖场贵一倍，但大型养殖场如果能解决林林总总的小问题，最终应该能和传统养殖场的成本持平。

但就目前而言，RAS仍然只是个“小鱼苗”。荷兰非营利组织水产养殖管理委员会（Aquaculture Stewardship Council）的研究负责人凯瑟琳·斯坦伯格（Kathrin Steinberg）表示，在经过该委员会认证的养殖场中，只有不到5%使用了RAS。但她也表示，随着全球对鱼类的需求不可抑制地增长，这一比例正在上升。 ■



Fish out of water

The future of fish farming is on land

New systems cut pollution and allow fish to be raised anywhere in the world

THE RUGGED, chilly coast of northern Norway, beyond the Arctic Circle, is not usually thought of as prime agricultural land. But far down a dead-end road on the shores of Skjerstad Fjord sits Salten Smolt, one of the most advanced farms in the world. Rather than crops or cows, though, the firm produces fish. Inside its 7,000 square metre main building are tanks capable of producing 8m smolt—juvenile Atlantic salmon—every year.

Fish farming is the fastest-growing form of food production in the world. Seafood accounts for around 17% of the world's protein intake (in some parts of Asia and Africa, the number is nearer 50%). The OECD, a rich-country club, reckons that, thanks to population growth and rising incomes, global consumption of fish will reach 180m tonnes by the end of the decade, up from 158m tonnes in 2020.

But the ocean has only so much to give. The World Bank reckons that 90% of the world's fisheries are being fished either at or over their capacity. Aquaculture has therefore accounted for nearly all the growth in fish consumption since 1990 (see chart). It will have to account for almost all the growth to come, too.

As with farming on land though, aquaculture can cause environmental damage. Many farmed fish are grown in net pens, either in rivers or the open ocean. Uneaten food and fish waste can pollute the surrounding waters. When net pens break, escaped farmed fish can damage the local ecosystem. Inland “flow-through” farms require continuous streams of freshwater from rivers or wells, competing with those who might wish to drink it instead.

Rearing lots of fish in close proximity risks outbreaks of diseases and parasites, which sweep in from the open water. That requires antibiotics and other drugs to keep the fish healthy.

It is these sorts of problems that newer fish farms, like Salten Smolt, hope to solve. It makes use of a technology called “recirculating aquaculture systems”, or RAS for short (pronounced “Rass”). Rather than relying on a constant flow of natural water to keep fish healthy, a RAS system grows fish on land in tanks whose water is continuously cleaned and recycled. That offers three big advantages. Compared with standard aquaculture systems, RAS farms use far less water, can take better care of their fish, and can allow picky species to be raised anywhere in the world.

RAS farms are, in essence, much bigger versions of home aquariums. Each consists of a tank in which the fish swim, and a set of water-cleaning components to dispose of the waste that they produce. Much of the technology is recycled from the sewage-treatment industry.

Unwanted solids—fish faeces and uneaten feed, mostly—are removed first. This is done mechanically, using a conical tank, gravity and a series of increasingly fine mesh filters. Most of the remaining waste is ammonia. Fish secrete the stuff through their gills, as a byproduct of their metabolisms, and too much is toxic. The ammonia-laden water is therefore pumped through colonies of bacteria which, given enough oxygen, will convert the ammonia into nitrite and nitrate. Further steps can remove other contaminants such as phosphorus and heavy metals.

The cleaner the water, the more can be recirculated, and the less is needed from outside. A completely closed loop is impractical, at least for now. But state-of-the-art systems, such as Salten Smolt’s, can reduce water usage by more than 99%. Standard salmon-farming consumes about 50,000 litres of water for each kilogram of salmon produced. A RAS system might need

just 150. The upshot, says Steve Sutton, the founder of TransparentSea, a RAS shrimp farm near Los Angeles, is that RAS farms “leave the wild environment alone so that [farmed fish] don’t spread pathogens or pollute the waterways”.

Concentrating the waste in one place offers advantages of its own. One of the biggest missed opportunities with standard aquaculture, says Kari Attramadal, head of research at Nofitech, another Norwegian aquaculture firm, is that the waste released into the environment from standard fish farms contains plenty of valuable nutrients. Nitrates can be used as food for hydroponically grown crops. John Sällebrant, Salten Smolt’s production manager, says that the firm recovers and dries fish faeces, as well as uneaten feed, for conversion into agricultural fertiliser.

Keeping fish alive in artificial tanks relies on keeping tight control of the entire system. Errors can be costly. If the oxygenation system fails, says Dr Attramadal, fish can start to die within eight minutes. But that need for careful monitoring also offers the ability to fine-tune the environment in which the fish are being raised. That allows RAS systems to perform an aquatic version of what, on land, is called precision agriculture.

Salmon, for instance, prefer cold water. A climate-controlled tank is able to provide the ideal temperature at all times, without worrying about currents, tides or weather, boosting the speed with which the fish grow. ReelData, a startup based in Nova Scotia, uses data from cameras and sensors in RAS tanks to estimate how hungry fish are, how much they weigh and even to assess how stressed they are. The firm says its technology can raise a farm’s productivity by up to 20%.

And because they do not rely on the natural environment, RAS systems can, in principle, be built anywhere. Atlantic Sapphire, another Norwegian firm, has built an Atlantic salmon farm near Miami, a thousand miles south of the

fish's natural range. Being close to big cities reduces the distance that fish have to travel before arriving on a dinner plate. Pure Salmon Technology, a Norwegian RAS provider, is building a farm in Japan. It reckons that lower transport costs will more than halve the carbon footprint of each kilogram of salmon, despite the extra energy costs involved in running a RAS system.

As with any new technology, there have been teething troubles. Half a million fish, or about 5% of the total, died at Atlantic Sapphire's plant in Florida in 2021, for instance, after problems with its filtration systems. (The firm describes the incident as a piece of "expensive learning" to be "seen in the context of RAS having been in the early stages of its rapid development".)

The biggest downside is cost. All those pipes, pumps and monitoring systems mean that capital costs are significantly higher for RAS farms than for standard ones. (That is one reason why many existing systems focus on salmon, a comparatively pricey fish.) Even in Norway, where about half the country's salmon farms use RAS, it is limited to the first stage of the fish's life. Juvenile fish are still grown into adults in standard open-water pens.

Tax changes in Norway may change that, says Matt Craze of Spheric Research, a firm of aquaculture market analysts. And there are other ways to keep costs down. Some firms are experimenting with hybrid systems. These dispense with the more expensive bits of waste-management kit, but can still cut overall water usage significantly. Economies of scale will help, too. Mr Craze reckons that, while smaller RAS farms might produce fish at twice the price of standard aquaculture, bigger ones should, if they can iron out the gremlins, eventually be able to match them.

For now, though, RAS remains a tiddler. Kathrin Steinberg, head of research at the Aquaculture Stewardship Council, a Dutch non-profit organisation, says that less than 5% of the farms certified by her organisation make use of it. But with the world's demand for fish rising inexorably, that share, she

says, is growing. ■



微型工具箱

为什么中国政府可能难以重振经济

低通胀应该会让事情容易一些，但官员们还有其他担忧

中国在疫情后的经济复苏步伐本应震撼世界，结果它却走得颤颤巍巍。被压抑的需求初步释放后，4月的经济数据不及预期。中国股市应声下跌，政府债券收益率下降，人民币贬值。现在，中国的贸易加权汇率和去年11月实施封控时一样疲软。

5月的数据会好看一些吗？在5月的最后一天，国家统计局公布了采购经理人指数（PMI）。该指数显示，服务业产出增长慢于4月，制造业活动连续第二个月收缩。商业期刊《财新》发布的另一个制造业指数更令人鼓舞一些，可能是因为其中内陆重工业的权重较小，而这部分能从一轮消费主导的复苏中获得的提振可能较少。

两组采购经理人指数还显示制造商的原材料购入价格和产品售出价格均有所下降。一些经济学家现在认为，与一年前相比，5月的生产者价格——即“出厂价”——可能下降了4%以上。这种幅度的下降正在损害工业利润，继而又会阻碍制造业投资。这引发了人们对陷入通缩螺旋的担忧。

因此，中国经济面临越来越大的“二次探底”风险，野村证券的陆挺表示。两个季度之间的增长可能会下降到接近于零，尽管与一年前相比较的GDP整体增长率仍然可观。

在世界其他地方，增长疲软伴随着令人不安的通胀。这让政策制定者更难知道该怎么办。但中国增长停滞和通胀下降的问题都指向同一个方向，那就是采取更宽松的货币政策和更松弛的财政立场。

一些投资者担心中国政府担忧得不够。人民银行似乎并不紧张通缩的问题。即使没有太多刺激措施，政府也很可能在今年达成5%的温和增长目标，但这仅仅是因为去年的经济非常疲弱。

摩根士丹利的邢自强预测这种态度很快就会改变。他指出，在2015年和2019年，当制造业PMI连续几个月低于50时，政策制定者迅速做出了反应。他确信人行将在7月降低银行存款准备金率，说不定还会更早。他还认为，为支持发展目标而放贷的中国政策性银行将增加基础设施投资信贷。这应该足以让经济放缓变成一个“小插曲”。

其他人没那么乐观。陆挺认为，政府会采取行动，但小调整无法长久驱散阴霾。而更大力度的动作面临着其他障碍。官员可以降低利率，但这会挤压银行的盈利能力，而银行肯定已经在担心在房地产贷款上的损失。他们可以向地方政府转移更多资金，但许多地方政府过去曾将资金浪费在规划不当的基础设施上。他们可以直接向家庭发放现金，但创建相关机制需要时间。过去，政府可以通过房地产和基础设施投资来快速刺激经济。陆挺指出，后来政府的“工具箱就变得越来越小了”。 ■



Tiny toolbox

Why China's government might struggle to revive its economy

Low inflation should make things easier. But officials have other concerns

CHINA'S POST-COVID recovery was supposed to be world-shaking. Instead, it looks merely shaky. After the initial release of pent-up demand, economic data for April fell short of expectations. In response China's stocks faltered, yields on government bonds fell and the currency declined. The country's trade-weighted exchange rate is now as weak as it was in November, when officials were locking down cities.

Will the data for May look better? On the last day of the month the National Bureau of Statistics reported its purchasing-managers indices (PMIs). They showed that services output grew more slowly than in April and manufacturing activity shrank for the second month in a row. Another manufacturing index by Caixin, a business publication, was more encouraging, perhaps because it gives smaller weight to inland heavy industry, which may benefit less from a consumption-led recovery.

Both sets of PMIs also suggest the prices manufacturers pay for inputs and charge for outputs have declined. Some economists now think producer prices—those charged at the “factory gate”—may have fallen by more than 4% in May, compared with a year ago. Such price cuts are hurting industrial profits, which is in turn hampering manufacturing investment. This has raised fears of a deflationary spiral.

As a result, China's economy faces the growing risk of a “double dip”, says Ting Lu of Nomura, a bank. Growth from one quarter to the next may fall close to zero, even if headline growth, which compares GDP with a year earlier, remains respectable.

Elsewhere in the world, weak growth is accompanied by uncomfortable inflation. This makes it harder for policymakers to know what to do. But China's problems of faltering growth and falling inflation point in the same direction: towards easier monetary policy and a looser fiscal stance.

Some investors worry that China's government is not worried enough. The central bank seems unconcerned about deflation. Even without much stimulus, the government is likely to meet its modest growth target of 5% this year, simply because the economy last year was so weak.

That stance will change soon, predicts Robin Xing of Morgan Stanley, a bank. In 2015 and 2019, he points out, policymakers were quick to respond when the manufacturing PMI fell below 50 for a few months. He is confident China's central bank will cut reserve requirements for banks in July, if not before. He also thinks China's policy banks, which lend in support of development objectives, will increase credit for infrastructure investment. That should be enough to make the slowdown a "hiccup".

Others are less optimistic. The government will act, argues Mr Lu, but small tweaks will not lift the gloom for long. A bigger response faces other obstacles. Officials could cut interest rates, but that would squeeze the profitability of banks which must already worry about losses on property loans. They could transfer more money to local governments, but many have misspent funds on ill-conceived infrastructure in the past. They could hand out cash directly to households, but creating the apparatus to do so would take time. In the past, the government could quickly stimulate the economy through property and infrastructure investment. Since then, notes Mr Lu, its "toolbox has become smaller and smaller". ■



继续求职

中国年轻人想要工作。为政府工作

当前青年失业率高得吓人

中国向来不缺吸睛的统计数据。但5月16日公布的一个官方数字还是格外引人注目：4月，中国16至24岁的城镇青年失业率超过20%。

这个数字令人诧异，原因是多方面的。在中国，年轻人口开始短缺。政府在努力提高出生率，但成效不大。中国经济的未来有赖于人口受教育程度的提高，这样可以提升劳动力的素质，以弥补数量的下降。中国也非常擅于调配人力等资源。然而，它正在浪费大批它有史以来受到最好教育的人群。

青年失业率如此之高，令人惊讶也令人费解。中国在去年12月突然结束新冠清零政策，全面重启经济，但在这样的背景下，青年失业率竟然上升了。在整体失业率略微下降（从2022年4月的6.1%下降至一年后的5.2%）的同时，青年失业率却跃升，而且很可能还会在接下来几个月进一步上升。今年大学应届毕业生人数将达到创纪录的1160万，比2019年增加近40%。管理学专业的王丽丽（音译）就是其中一员，她今年将从一所排名中国前100位的大学毕业。“就业市场很糟糕，”她哀叹，“许多毕业生都非常焦虑。”

相对于中国4.86亿的城镇劳动人口，失业青年的数量（在今年前三个月约为630万）并不算多。但是，花旗银行的余向荣及其同事指出，这个人群备受关注。大学生感到焦虑和失望，这种情绪通过社交媒体传播，可能会“影响整个社会的信心”，政府智库国务院发展研究中心的卓贤及合著者在一篇文章中写道。

尽管这个问题在疫情之后凸显，但疫情是原因之一。疫情爆发后，许多中国大学生选择继续升学。例如，教育部在2020年要求各大学扩招硕士研究生20%以上。这导致随后几年进入劳动力市场的应届毕业生数量激增。

中国重启经济可能吸引了很多已退出就业市场的人返回，而企业还没准备好吸收这么多人。时机、技能和期望的不匹配加剧了这一瓶颈。去年，一些毕业生推后找工作，为考研或考公做准备。但那会儿雇主由于担心冬季出现新一波疫情，想要尽早招人补缺。推迟求职的毕业生因此错过了最好的招聘月份，许多人现在要和2023年毕业的应届生竞争职位。

他们当中有些人拿到的学位与经济的新需求脱节。像阿里巴巴这类平台、恒大这类房地产公司、新东方这类在线辅导机构曾经是毕业生的梦想雇主，可是等学生们修完学士学位，这些机构已经在政府那里失宠了。

如今，中国领导层担心在房地产和教育等领域出现所谓的“资本无序扩张”，也对科技公司的市场支配力和文化影响力心存顾忌。这类企业的招聘因而放缓。据招聘门户智联招聘的调查，今年只有5.5%的应届毕业生期望进入教培行业。

正如王丽丽（化名）所说，一些毕业生现在采取“广撒网”的策略，到处投送简历。政府积极引导人才进入“硬科技”行业，如航空航天、生物技术和电动汽车。咨询公司牛津经济研究院（Oxford Economics）的卢姿蕙表示，中国最新的五年计划大力推动这些行业，其增长快于工业整体增速。就业形势或将随之而变。智联招聘近期的调查显示，今年的工科应届毕业生中已有57%收到录用通知，而文科生只有41%。

中国劳动力市场的怪现象之一是受教育程度较低的年轻人倒不容易失业。职校毕业生或仅有高中学历的年轻人可能掌握更多实用技能，也更迫切需要工作。“人人都说学位是块垫脚石，”一位运气不佳的毕业生在网上评论道（由媒体观察网站“中国数字时代”译成英语），“但我慢慢意识到它更像是一个我走不下来的高台。”

学生的志向可能也在变。今年智联招聘的调查显示，选择在国内或国外继续学习深造的毕业生比例下降了近一半。学生也力求安稳，以国企为求职首选的人数比例已连续三年上升，达到47%。而优先考虑外资企业或国内民营企业的仅占27%。剩下的约25%希望投身政府机构或事业单位。

面对创下新高的青年失业率，政府的反应可能会加强这些趋势。中国国务院已敦促地方政府在预算允许的范围内吸纳尽可能多的毕业生。它还呼吁企业为失业青年创造至少100万个实习机会，可以获得补贴和减税优惠。该倡议是面向所有企业的，但最可能听命的是国企。这些举措可能把中国受教育程度较高的人群导向其经济中最低效的部分。

但对年轻人来说，政府的权宜之计至少能缓解一些担忧和困惑。比如王丽丽，过去两年她一边学习，一边在一家外资公司实习。她说这让她“每天都有事可做”，最后还收获了满意的工作——做人力资源。幸运的话，她将在长期的职业生涯中帮助中国更好地利用这类资源。 ■



The job search goes on

China's young want to work. For the government

Youth unemployment is now shockingly high

CHINA IS A land of remarkable statistics. But an official figure published on May 16th still managed to stand out. The unemployment rate among China's urban youth, aged between 16 and 24, exceeded one in five in April.

The figure boggles the mind for a variety of reasons. China is running short of young people. It is trying, without much success, to raise the birth rate. Its economic future hangs on increased education, which could improve the quality of its workers even as their quantity declines. China is also famous for mobilising resources, including manpower. Yet it is wasting large numbers of the best-educated cohort it has ever produced.

Youth unemployment is puzzling, as well as surprising. It has increased even as China's economy has reopened after the sudden end of its zero-covid regime in December. It has jumped up while the overall unemployment rate has edged downwards (from 6.1% in April 2022 to 5.2% a year later). And it is likely to rise further in the next few months. This year, a record 11.6m students will graduate from university, an increase of almost 40% since 2019. They include Wang Lili, who will leave one of China's top-100 universities this year with a degree in management. "The market is terrible," she laments. "Many graduates are very anxious."

The number of unemployed youth (about 6.3m in the first three months of this year) is small relative to China's 486m-strong urban workforce. But they attract most of the attention, points out Xiangrong Yu of Citigroup, a bank, and his colleagues. The anxiety and disappointment felt by college students—and spread through social media—could "affect the confidence of

the entire society”, write Zhuo Xian and his co-authors at the Development Research Centre (DRC), a government think-tank.

Although the problem has outlasted the pandemic, it is partly caused by it. When covid struck, many Chinese chose to extend their studies. In 2020, for example, the Ministry of Education told universities to increase the number of Master’s students by over 20%. That has created a bulge of newly minted graduates entering the labour force in subsequent years.

China’s reopening may have tempted many of those who had dropped out of the job market to re-engage before firms were ready to hire them. The bottleneck has been aggravated by mismatches in timing, skills and aspirations. Some graduates delayed their job hunt last year to prepare for entrance exams for higher degrees or the civil service. But employers last year wanted to fill their ranks early because of fears of a winter covid wave. So later job-seekers missed the best recruitment months and many are now competing for the same jobs as students leaving university in 2023.

Some of them boast qualifications that are out of sync with the new demands of the economy. Platforms like Alibaba, property firms like Evergrande, and online tutors like New Oriental were once dream employers for graduates. But in the time it takes to earn a bachelor’s degree, they have lost favour with the government.

China’s leaders now fear what they call the “disorderly expansion of capital” in sectors like property and education, as well as the market power and cultural reach of tech firms. Recruitment has therefore slowed. Only 5.5% of students graduating this year expect to go into the education and training industries, according to a survey by Zhaopin, a recruitment portal.

Some graduates now adopt a “spray and pray” approach, as Ms Wang (not her real name) puts it, submitting applications willy-nilly. The government

is keen to steer talent into “hard tech” industries, such as aerospace, biotechnology and electric vehicles. They are promoted in the latest five-year plan and have grown faster than industry as a whole, says Louise Loo of Oxford Economics, a consultancy. Employment may follow. According to the recent Zhaopin survey, 57% of engineers graduating this year had already received a job offer, compared with only 41% of their counterparts in the humanities.

One of the oddities of China’s labour market is that less-educated youth are less likely to be unemployed. Youngsters with vocational qualifications or just a high-school education may have more practical skills and a more burning need for a job. “Everyone says a degree is a stepping stone,” said one hapless graduate in an online comment translated by China Digital Times, a media-monitoring website, “but I’m slowly coming to realise it’s more like a pedestal I can’t get down from.”

Students’ aspirations may be changing. The proportion choosing to continue their studies (at home or abroad) fell by almost half in this year’s Zhaopin survey. Students are also keen on stability and security. The share who rank state-owned enterprises (SOEs) as their first choice has increased for three years in a row to 47%, compared with 27% who favour a foreign-financed or domestic private firm. The remaining quarter wish to work for the government or public institutions.

The government’s response to record youth unemployment may reinforce these trends. The State Council, China’s cabinet, has urged local governments to recruit as many graduates as their budgets allow. It has also called on enterprises to create at least 1m internships for unemployed youth, in return for subsidies and tax breaks. The offer is open to all firms, but SOEs are most likely to heed the call. These initiatives risk drawing some of China’s better-educated minds into some of the least efficient parts of its economy.

But for young folk, stop-gap measures do at least alleviate some of the worry and confusion. Ms Wang, for example, has combined her studies over the past two years with an internship at a foreign firm. That gave her “something to do every day”, she says, and also led to a satisfying job offer—in human resources. With luck, she will enjoy a long career helping China use those resources better. ■



【首文】婴儿荒经济

全球生育率暴跌，带来深远经济影响

如何能改变严峻的世界人口轨迹？

自工业革命以来的大约250年里，世界人口和财富一样呈现爆炸式增长。然而，在本世纪结束前，地球上的人口数量可能会出现自黑死病以来首次减少。根本原因并非死亡人数激增，而是出生人数锐减。世界大部分地区的生育率（每名妇女平均生育的子女数量）正在急剧下降。人们对这种趋势或许并不陌生，但对其程度和后果却所知甚少。在人工智能（AI）激发一些领域乐观情绪高涨之时，婴儿荒的威胁笼罩在世界经济的未来之上。

2000年，全球生育率为每名妇女生育2.7个孩子，稳稳高于保持人口稳定的“更替率”2.1个。如今生育率是2.3，而且还在下降。GDP最高的15个国家的生育率都低于人口更替率。这包括美国和大部分发达国家，但也包括中国和印度——这两个国家都不是富裕国家，但加起来占了全球人口的三分之一以上。

结果就是，在世界大部分地方，新生儿越来越少而老人越来越多。老龄化国家的典型例子不再只有日本和意大利，现在还包括巴西、墨西哥和泰国。到2030年，东亚和东南亚一半以上的人口将超过40岁。随着老年人过世而没有被充分更替，人口很可能将减少。除非洲外，世界人口预计将在2050年代达到峰值，到本世纪末时将比现在还少。即使在非洲，生育率也在快速下降。

不管一些环保人士怎么说，人口减少会带来各种问题。世界人口远未饱和，而年轻人减少会造成诸多经济困难。一个显而易见的问题是越来越难以赡养世界上的退休老人。退休人口依赖劳动年龄人口的产出，无论是由政府向劳动人口征税来支付公共养老金，还是提取储蓄来购买商品和服务，抑或是依靠亲属提供无偿照护。但是，目前在富裕国家每个65岁以上老人对应大约三个20至64岁的人，而到2050年将对应不到两个。其影响

是税收提高、退休年龄推迟、储蓄实际回报降低，可能还会发生政府预算危机。

劳动人口与退休人口的比率过低只是生育率暴跌造成的问题之一。年轻人拥有更高水平的心理学家所说的“流体智力”，即通过创造性思考以全新方式解决问题的能力。

这种年轻人的活力是对年长劳动者知识积累的补充。它也带来变革。最年轻的发明家申请的专利涉及突破性创新的几率要高得多。人口更年老的国家更缺乏进取心，更不愿意冒险——而且事实证明连它们的年轻人也是如此。老年选民也使政治僵化。因为在经济增长时，老年人比年轻人受益更少，所以他们向来不太乐于支持促进增长的政策，尤其是建设住房。在老龄化社会中，创造性破坏往往更为少见，这抑制了生产率提升，这些抑制综合起来会导致错失巨大的机会。

考虑到上述种种，很容易将低生育率看成是一个有待解决的危机。然而，这种现象的许多底层原因本身却是好事。人们在富裕起来之时往往更少生孩子。今天，他们面对的是“事业还是家庭”这种不同的权衡，这些选项往往比以前的更好。民粹主义保守派宣称低生育率是社会失败的标志，呼吁回归传统家庭价值观，他们是错的。有更多选择是好事，也没有谁有义务生儿育女。

自由主义者的第一反应是鼓励更多移民，倒是更体面一些。但还是开错了药方。如今，发达国家的移民数量创下历史新高，有助解决个别国家的劳动力短缺问题。但是生育率下降是全球性的，这意味着除非有某种改变，否则到本世纪中叶，整个世界很可能将面临受过教育的年轻劳动人口短缺的问题。

这种改变可能是什么呢？在民意调查中，人们常常表示他们本来想要更多孩子。这种愿望与现实之间的差距在一定程度上可能是因为想要生育子女的人——他们实际上是在补贴未来没有孩子的退休人口——无法负担抚养更多孩子的成本，或者是因为其他政策上的失败，例如住房短缺或生育医

疗不足。然而，即使这些问题得到解决，经济发展仍然可能导致生育率降至更替率以下。鼓励成家育儿的政策一直效果不佳。新加坡提供慷慨的补助、退税和育儿补贴，但生育率只有1.0。

在生育率不提高的情况下，释放世界贫困人口的潜力可以缓解受过教育的年轻劳动力不足的问题。三分之二的中国儿童生活在农村，大多在条件极简陋的学校就读；在印度，同样比例的25至34岁人口没有完成高中教育。未来几十年，非洲的年轻人口将继续增长。提高他们的技能本身是好事，同时还可能让更多的年轻移民进入原本将停滞不前的经济体，发挥创新者的作用。但是，促进发展很难——而且一个地区越快富裕起来，也就越快老龄化。

因此，最终世界将不得不接受年轻人口减少的现实——而且可能还要接受总人口的萎缩。考虑到这一点，AI近来的进展可谓恰逢其时。一个大量运用AI、生产率超高的经济体可能更容易赡养更多退休人口。最终，AI可能会自己产生想法，减少对人类智能的需求。与机器人技术相结合后，AI还可以降低照顾老人的劳动强度。这样的创新必然有着巨大的需求。

如果技术真的能帮助人类度过婴儿荒，那也将符合历史规律。过往意想不到的生产率进步意味着人口定时炸弹并未引爆，例如托马斯·马尔萨斯（Thomas Malthus）在18世纪预测的大饥荒就没有出现。新生儿减少意味着人类才智减少。但人类才智也许能解决这个问题。■



The baby-bust economy

Global fertility has collapsed, with profound economic consequences

What might change the world's dire demographic trajectory?

IN THE ROUGHLY 250 years since the Industrial Revolution the world's population, like its wealth, has exploded. Before the end of this century, however, the number of people on the planet could shrink for the first time since the Black Death. The root cause is not a surge in deaths, but a slump in births. Across much of the world the fertility rate, the average number of births per woman, is collapsing. Although the trend may be familiar, its extent and its consequences are not. Even as artificial intelligence (AI) leads to surging optimism in some quarters, the baby bust hangs over the future of the world economy.

In 2000 the world's fertility rate was 2.7 births per woman, comfortably above the "replacement rate" of 2.1, at which a population is stable. Today it is 2.3 and falling. The largest 15 countries by GDP all have a fertility rate below the replacement rate. That includes America and much of the rich world, but also China and India, neither of which is rich but which together account for more than a third of the global population.

The result is that in much of the world the patter of tiny feet is being drowned out by the clatter of walking sticks. The prime examples of ageing countries are no longer just Japan and Italy but also include Brazil, Mexico and Thailand. By 2030 more than half the inhabitants of East and South-East Asia will be over 40. As the old die and are not fully replaced, populations are likely to shrink. Outside Africa, the world's population is forecast to peak in the 2050s and end the century smaller than it is today. Even in Africa, the fertility rate is falling fast.

Whatever some environmentalists say, a shrinking population creates problems. The world is not close to full and the economic difficulties resulting from fewer young people are many. The obvious one is that it is getting harder to support the world's pensioners. Retired folk draw on the output of the working-aged, either through the state, which levies taxes on workers to pay public pensions, or by cashing in savings to buy goods and services or because relatives provide care unpaid. But whereas the rich world currently has around three people between 20 and 64 years old for everyone over 65, by 2050 it will have less than two. The implications are higher taxes, later retirements, lower real returns for savers and, possibly, government budget crises.

Low ratios of workers to pensioners are only one problem stemming from collapsing fertility. Younger people have more of what psychologists call "fluid intelligence", the ability to think creatively so as to solve problems in entirely new ways .

This youthful dynamism complements the accumulated knowledge of older workers. It also brings change. Patents filed by the youngest inventors are much more likely to cover breakthrough innovations. Older countries—and, it turns out, their young people—are less enterprising and less comfortable taking risks. Elderly electorates ossify politics, too. Because the old benefit less than the young when economies grow, they have proved less keen on pro-growth policies, especially housebuilding. Creative destruction is likely to be rarer in ageing societies, suppressing productivity growth in ways that compound into an enormous missed opportunity.

All things considered, it is tempting to cast low fertility rates as a crisis to be solved. Many of its underlying causes, though, are in themselves welcome. As people have become richer they have tended to have fewer children. Today they face different trade-offs between work and family, and these are mostly better ones. The populist conservatives who claim low fertility is a

sign of society's failure and call for a return to traditional family values are wrong. More choice is a good thing, and no one owes it to others to bring up children.

Liberals' impulse to encourage more immigration is more noble. But it, too, is a misdiagnosis. Immigration in the rich world today is at a record high, helping individual countries tackle worker shortages. But the global nature of the fertility slump means that, by the middle of the century, the world is likely to face a dearth of young educated workers unless something changes.

What might that be? People often tell pollsters they want more children than they have. This gap between aspiration and reality could be in part because would-be parents—who, in effect, subsidise future childless pensioners—cannot afford to have more children, or because of other policy failures, such as housing shortages or inadequate fertility treatment. Yet even if these are fixed, economic development is still likely to lead to a fall in fertility below the replacement rate. Pro-family policies have a disappointing record. Singapore offers lavish grants, tax rebates and child-care subsidies—but has a fertility rate of 1.0.

Unleashing the potential of the world's poor would ease the shortage of educated young workers without more births. Two-thirds of Chinese children live in the countryside and attend mostly dreadful schools; the same fraction of 25- to 34-year-olds in India have not completed upper secondary education. Africa's pool of young people will continue to grow for decades. Boosting their skills is desirable in itself, and might also cast more young migrants as innovators in otherwise-stagnant economies. Yet encouraging development is hard—and the sooner places get rich, the sooner they get old.

Eventually, therefore, the world will have to make do with fewer youngsters—and perhaps with a shrinking population. With that in mind,

recent advances in AI could not have come at a better time. An über-productive AI-infused economy might find it easy to support a greater number of retired people. Eventually AI may be able to generate ideas by itself, reducing the need for human intelligence. Combined with robotics, AI may also make caring for the elderly less labour-intensive. Such innovations will certainly be in high demand.

If technology does allow humanity to overcome the baby bust, it will fit the historical pattern. Unexpected productivity advances meant that demographic time-bombs, such as the mass starvation predicted by Thomas Malthus in the 18th century, failed to detonate. Fewer babies means less human genius. But that might be a problem human genius can fix. ■



网络犯罪

《奇幻熊网络钓鱼》讲述黑客演化史

斯科特·夏皮罗提出一些对抗网络攻击的想法【《奇幻熊网络钓鱼》书评】

《奇幻熊网络钓鱼》，斯科特·夏皮罗著。Farrar, Straus and Giroux出版社，432页；30美元。艾伦·莱恩出版社，25英镑。

在1928年，许多国家签署了《凯洛格-白里安公约》（Kellogg-Briand pact），宣布战争为非法。尽管常被嘲笑为无可救药的理想主义，但它却产生了重要的影响。在此之前，战争一直是各国解决纷争的合法手段；经济制裁反而是非法的。第二次世界大战后，这份文件成为纽伦堡审判的法律基础。联合国宪章的一版草案中几乎一字不差地照搬了它的条款。

如今，计算机黑客行为在国际法中的地位也同样不合逻辑。间谍行为基本上是合法的；干涉他国内政不合法。然而，网络间谍活动到什么程度才算是网络犯罪甚至网络战争呢？如果界定含糊其词，那要防止网络攻击就更难了。这些攻击可以由一个国家授命，由另一个国家的平民实施，利用第三国的电脑去致使第四国的电脑瘫痪，步步隐秘。在一些人看来，有“网络”这个前缀意味着与之相关的错误行为可以不受法规的约束，就像以前的战争那样。

耶鲁大学法学院教授、曾是电脑程序员的斯科特·夏皮罗（Scott Shapiro）特别适合攻克这些难题。他也是2017年出版、讲述《凯洛格-白里安公约》历史的《国际主义者》（The Internationalists）一书的作者之一。他的新书从法学角度检视了代表不同类型的威胁的五次典型攻击事件，详实呈现了互联网面对入侵和攻击时的脆弱。

首先讲述的是“莫里斯蠕虫”（Morris Worm），这是互联网上的第一个蠕虫病毒（一段能自我复制的代码，在计算机之间悄悄传播）。它诞生于1988年一名美国研究生误入歧途的实验，利用了联网计算机的开放性特点。接下来是“黑暗复仇者”（Dark Avenger），这个在1990年代出现的病

毒会摧毁计算机数据。第三个事件是2005年帕丽斯·希尔顿（Paris Hilton）手机数据遭到攻击，泄露了这位名媛的裸照。黑客并没有去破解手机，而是侵入了存储照片的云服务器。

这本书中最骇人听闻、令人不安的攻击是最后两次，均发生在2016年。先是美国民主党全国委员会和希拉里·克林顿的总统竞选活动遭到黑客攻击，几万封私人电子邮件被泄露。通过此次事件最终追查到了“奇幻熊”（Fancy Bear）——美国安全研究人员给一个俄罗斯军事黑客组织起的名字。该组织通过“钓鱼”邮件诱骗人们点击链接或透露密码，从而窃取密码。七年前，这让政府大吃一惊；如今，这可能被视为一种敌对行为。

夏皮罗的最后一个例子是Mirai僵尸网络（僵尸网络是由机器人或被入侵的计算机组成的网络）。其代码曾一度操纵着30多万台计算机，主要是安防摄像头等联网设备。大多数网络可以抵御每秒1千兆比特的流量攻击，Mirai僵尸大军的流量却超过了600千兆比特。

罪魁祸首是三名年轻男子，他们兜售攻击网站的服务，最低要价仅100美元。一名机敏勇武的FBI特工抓到他们之后，意识到他们不是邪恶的罪犯，只是不善社交的青少年。在他的调教下，三人认罪并帮助FBI打击网络犯罪（特别是基于他们的代码的新型僵尸网络），从而避免了牢狱之灾。

作者巧妙地把对两种“码”（code）的思考融合在一起：软件代码和法律条文。他把实施攻击的计算机程序称为“下码”（downcode）；而他所说的“上码”（upcode）则包括那些放任攻击发生的法律、社会规范和心理。他指出，要对抗黑客攻击就必须两者兼顾。他的叙述在技术解释、法律推理以及笛卡尔和图灵等思想家的智慧之光之间穿梭自如。

作者发现，上述黑客攻击有一些共同特点。罪魁祸首常常是封闭狭隘的年轻人（其利用的资源微不足道，并不依靠国家机构）。相比肇事者花费的力气，所造成的破坏大得不成比例。而且这些攻击极其难以避免或起诉。

可惜，书中并没有提出对付黑客攻击的办法。但夏皮罗至少成功地让非专

业读者理解了这个话题。本着《凯洛格-白里安公约》的精神，他提出了一些提高系统安全性的建议，例如废除网络设备上的默认密码。换言之，他着眼于加强“上码”，从而削弱恶意的“下码”。 ■



Cybercrime

“Fancy Bear Goes Phishing” charts the evolution of hacking

Scott Shapiro offers some ideas on how to combat it

Fancy Bear Goes Phishing. By Scott Shapiro. Farrar, Straus and Giroux; 432 pages; \$30. Allen Lane; £25

IN 1928 MANY countries signed the Kellogg-Briand pact, which outlawed war. Though often derided as hopelessly idealistic, it had important consequences. Until then, war had been a lawful way for states to settle their differences; by contrast, economic sanctions were illegal. After the second world war, the document served as the legal basis for the Nuremberg trials. A draft of the United Nations charter included its terms almost verbatim.

The status of computer hacking in international law is now similarly irrational. Espionage is basically legal; interfering in the internal affairs of another state is not. Yet when does cyber-espionage tip into cybercrime or even cyber-warfare? If definitions are slippery, preventing cyber-attacks is even harder. They can be ordered by one country, perpetrated by a civilian in a second, using computers in a third to disable those in a fourth, with tracks hidden along the way. To some, the prefix “cyber” suggests the associated wrongs are as resistant to regulation as old-fashioned war can seem to be.

Scott Shapiro, a professor at Yale Law School and erstwhile computer programmer, is well-placed to tackle these quandaries. He is also the co-author of “The Internationalists”, a history of the Kellogg-Briand pact published in 2017. His new book chronicles the internet’s vulnerability to intrusion and attack by forensically examining five hacks that typify different kinds of threat.

It begins with the Morris Worm, the internet’s first worm (ie, a self-

replicating piece of code that slithers from computer to computer). It came about in 1988 through an experiment-gone-wrong by an American graduate student, which exploited the openness of networked computers. Next comes Dark Avenger, a virus that destroyed computer data in the 1990s. Third is the hack in 2005 of Paris Hilton's mobile-phone data, which revealed nude photos of the celebrity. The hacker didn't compromise the phone but rather servers in the cloud on which the images were stored.

The book's most outrageous and troubling attacks are its last two, both in 2016. First, the hack of the Democratic National Committee and Hillary Clinton's presidential campaign, through which tens of thousands of private emails were leaked. That was traced to Fancy Bear, the name security researchers gave to a Russian military hacking unit. It stole passwords using "phishing" emails, which lure people into clicking links or divulging passwords. Seven years ago this took authorities by surprise; now it might be seen as a hostile act.

Professor Shapiro's final example is the Mirai botnet (a botnet is a network of robots, or compromised computers). At one point its code commandeered more than 300,000 computers, mainly in online devices such as security cameras. Most networks can handle an attack of 1 gigabit-per-second of traffic; Mirai's army amassed over 600 gigabits.

The three young men who were responsible had been offering to take down websites for as little as \$100. They were caught by an enterprising FBI agent who realised they weren't evil criminals but socially awkward teenagers. Under his mentorship, they confessed and avoided prison by helping the FBI fight cybercrime—notably the new botnets based on their code.

The author masterfully blends consideration of two sorts of code, software and legal. "Downcode" is his name for the computer programs that run the attacks; what he calls "upcode" includes the laws, social norms and

psychology that let the raids happen. Combating hacks means dealing with both, he notes. His narrative zips between technical explanations, legal reasoning and the ideas of thinkers including René Descartes and Alan Turing.

The hacks have common features, it transpires. Insular young men are often responsible (using meagre resources, not state bureaucracies). The scale of the damage is disproportionate to the effort the perpetrators expend. And the attacks are extremely hard to prevent or prosecute.

A solution to hacking is not available, alas. But Professor Shapiro at least succeeds in making the subject intelligible to non-specialist readers. And in the spirit of the Kellogg-Briand pact, he offers suggestions to help make systems secure, such as doing away with default passwords on networked devices. He aims, in other words, to strengthen the “upcode” and so weaken malicious “downcode”. ■



神经科学与人工智能

人工大脑帮助科学家研究生物大脑

模型并不完美，但不影响它们发挥用处

过去十年，人工智能（AI）的发展突飞猛进，这主要归功于机器学习的进步，即计算机通过处理大量数据教会自己复杂任务，无需人类直接编程。这种方法推动了计算机视觉、语言翻译，以及近期GPT-4等聊天机器人所具有的类人对话技能的快速发展。

这种学习由名为“人工神经网络”（以下简称ANN）的软件模型完成。一般的说法是，ANN的设计灵感大致来自人脑的神经元网络。但在这样的描述之后通常都会紧跟一道声明——计算机科学家和神经科学家都会紧张地跳出来，指出这个类比其实非常粗略，ANN充其量只是真正大脑的卡通漫画版，并不能体现这种生物器官的复杂性。

事实的确如此。但一些神经科学家开始发现，即使是卡通版也可以很有用。最厉害的ANN，也就是在识别对象或响应文本提示等任务上表现最接近人类水平的那些，其内部运作方式似乎与大脑有一些惊人的相似之处。换言之，在生物学的启发下创造了ANN的程序员现在正反过来回馈生物学，用他们的创造向神经科学家提供有关生物大脑的有用信息。

一项比较大脑和ANN的开创性研究于2014年发表在《美国国家科学院院刊》（Proceedings of the National Academy of Sciences）上。麻省理工学院的神经科学家丹尼尔·亚明斯（Daniel Yamins）和同事训练一个ANN，让它从照片中识别指定目标，例如一只猫。研究人员比较了该电子网络的内部运作和接受同样任务的猕猴脑内的活动（这些猕猴的脑部植入了电极）。

ANN由大量人工神经元构成。与生物大脑的神经元一样，这些人工神经元可开可关，可放电可沉默。它们通过相互连接的分层网络连在一起。低层神经元的活动可以影响高层神经元的放电模式。

亚明斯的测试是做图像识别，这在生物大脑中是逐层进行的。一层神经元检测明暗区域等简单特征，高一层的神经元把这些特征组织成边缘，再高一层的神经元把边缘接合为形状。这一提取过程不断推进，直到最后大脑判断所看到的是一只猫、一只狗还是一根香蕉。

具有某些共同特征的图像会触发相似的神经元簇放电。假如某一组神经元在看到猫的时候放电，另一组与之部分重叠的神经元就很可能在看见狗的图片时放电。研究人员认为，对猫和狗的图片都有反应的神经元呈现了两种图片中共有的特征，比如毛皮、四条腿和一条尾巴。

亚明斯和同事比较了猕猴大脑和“硅脑”的内部运作，发现猕猴和计算机在描绘图像时有惊人的相似之处。“这篇论文是颠覆性的。”麻省理工学院的另一位教授南希·坎维舍（Nancy Kanwisher）说，她的职业生涯多半都在研究人类视觉系统，如今她正在自己的一些研究中使用ANN。“（人工）网络的设计完全不是为了与人脑一致，而仅仅是为了解决问题，但我们看到了这种惊人的相似性。”

从那时起，每当某个ANN模型在某项任务上有接近人类的表现时，神经科学家便迫不及待要将其与自然大脑做比较。他们发现经过语音识别和语言处理训练的ANN（如转录软件中使用的ANN）与人类听觉皮层有相似之处。

在文本处理上也存在同样的模式。一篇在2021年发表的论文对人脑活动和许多不同商用语言模型做了比较。研究发现其中最先进的ANN（当时是由OpenAI推出的GPT-2）最接近人类大脑活动。模型越擅长完成某些任务，它和人脑在做同样任务时的相似之处似乎就越多。

还有另一个例证显示把ANN与自然神经网络做类比有其用处：对前者的研究可用来对后者做可检验的预测。哥伦比亚大学和麻省理工学院的研究人员在2022年发表了一篇论文，发现一个经过图像识别训练的ANN生成了一组专门给食物分类的人工神经元。在该论文发表之时，还没有任何人发现人脑的视觉系统中有类似的区域。但今年，同一实验室的研究人员宣布在

人脑中发现了一个区域，其中包含的一些神经元在人看到食物图片时确实更常放电。

要说人工大脑可以揭示有关生物大脑的有用信息，最有力的证据也许是软件和人脑看来能直接交互。伦敦大学学院的神经科学家尼古拉斯·塞克斯顿（Nicholas Sexton）和布拉德利·洛夫（Bradley Love）最初对生物大脑和ANN之间所谓的相似性相当怀疑。他们认为，仅仅发现有类似的行为模式并不足以证明ANN和大脑以相同的方式解决问题。要证明这种相似性具有实质意义，他们建议探究是否能把大脑活动输入ANN中。

2022年，他们在《科学进展》（Science Advances）上发表了一篇论文，做的正是这样一项研究。研究人员把检查人脑的核磁共振扫描仪记录的数据输入到一个接受过图像识别训练的ANN中，这是为了让ANN通过人类的眼睛来“看见”事物。果然，如此热连接后的ANN能解析来自生物视觉系统任何层次的数据，不过解析最好的是较高层次的数据，也就是已经由人脑做过一定处理的数据。举例来说，向这套计算机模型展示正在看一张灰狗图片时的人脑活动，模型会表示看到一只灰狗，而非其他物体，当时的准确率接近70%。

硅脑能轻松接受由生物大脑做过一定处理的数据，表明某种程度上这两个系统在执行同样的认知任务。这个发现也许能应用于脑机接口，也就是让生物大脑直接与机器对话的设备。例如，连接到摄像头的ANN或许可以把经部分处理的视觉信息输入大脑。这可能有助治疗因大脑视觉系统受损而导致的某些失明。欧美多个不同研究小组已着手在猕猴身上试验这个想法。

即便是ANN最狂热的追捧者也不会说它能完美模拟人脑。有些ANN会犯人类永远不会犯的错误，例如，给ANN展示一张图片，上面是一只有着大象皮肤的猫，模型就更有可能把它识别为大象。但从来没有哪个科学模型是完美的。问题在于它是否有用。神经科学的棘手问题之一是，因为伦理和实际操作的原因，有些实验难以进行。捣弄ANN可能是个有用的替代方案。

无论如何，生物大脑和硅脑之间的对比研究还在产出有趣的成果。在5月发表的一篇论文中，得克萨斯大学奥斯汀分校的研究人员用一个人工神经网络来监测核磁共振扫描仪中受试者的大脑信号。仅仅利用核磁共振搜集的数据，这个ANN就能粗略概述和描绘出受试者正在听的故事、看的电影或者想的一句话。“我念研究生的时候就梦想有这样的机器出现，”洛夫说，“当时我还以为要几百年后我们才会有这么厉害的东西。”■



Neuroscience and AI

Artificial brains are helping scientists study the real thing

No model is perfect. But that doesn't stop them being useful

THE STRIKING progress in artificial intelligence over the past decade is mostly down to advances in machine learning, whereby computers teach themselves complicated tasks by crunching large quantities of data, rather than having to be programmed directly by humans. This approach has driven rapid progress in computer vision, language translation and, most recently, the human-like conversational skills of chatbots such as GPT-4.

The learning is done by software models called “artificial neural networks” (ANNs). The standard description of an ANN is that it is loosely inspired by the networks of neurons in the human brain. It is de rigueur to follow that description with an immediate disclaimer, in which both computer scientists and neuroscientists jump in nervously to point out that the analogy is very rough, that ANNs are mere cartoons of real brains (if even that) and that they fail to capture the complexity of the biological organ.

All that is true. But some neuroscientists are beginning to find that even cartoons can be useful. The inner workings of the best ANNs—those that are closest to matching human performance on tasks like identifying objects, or responding to text prompts—appear to have some remarkable similarities to the workings of brains. Having taken inspiration from biology, in other words, programmers are now returning the favour, with their creations telling neuroscientists useful things about biological brains.

The seminal study comparing brains and ANNs was published in Proceedings of the National Academy of Sciences in 2014. Daniel Yamins, a neuroscientist at the Massachusetts Institute of Technology (MIT), and his

colleagues trained an ANN to pick out objects from photographs—a cat, for instance. The researchers compared what was going on inside the electronic network to what was happening inside the brains of macaque monkeys that had been set the same task, and whose brains had been wired with electrodes.

ANNs are built up from large numbers of artificial neurons that, just like their natural counterparts, can be on or off; firing or silent. These neurons are linked together in layered, interconnected networks. Activity in lower layers can affect how neurons in the higher layers fire.

Dr Yamins's test involves image recognition, which in natural brains proceeds hierarchically. One layer of neurons will detect simple features such as patches of light or dark. A higher layer organises those into edges; a still higher layer combines the edges into shapes. That process of increasing abstraction continues until, eventually, the brain decides whether it is looking at a cat, a dog or a banana.

Images that share some characteristics provoke similar clusters of neurons to fire. If a certain set of neurons fires when looking at a cat, another, partially overlapping set is likely to fire in response to a picture of a dog. The neurons that respond to both images are thought to be representing features—fur, four legs and a tail, say—that are present in both pictures.

When Dr Yamins and his colleagues compared what was going on inside the macaque brains to the silicon ones, they found arresting parallels between how the monkeys represented images and how the computers did. “The paper was a game-changer,” says Nancy Kanwisher, another professor at MIT who has spent much of her career studying the human visual system, and who now uses ANNs in some of her research. “The [artificial] network was not in any way designed to fit the brain. It was just designed to solve the problem and yet we see this incredible fit.”

Since then, whenever an ANN model has close to human performance on a task, neuroscientists have been eager to compare it with natural brains. They have found similarities between ANNs trained to recognise speech and process language, such as those used in transcription software, and the human auditory cortex.

The pattern holds for written language too. One paper published in 2021 compared human brain activity against many different commercial language models. It found that the most sophisticated ANN—at the time OpenAI's GPT-2—was the closest match for human brain activity. The better models get at solving certain tasks, the more similar they seem to get to the human brain doing the same.

Another indication that the analogy between artificial neural networks and natural ones is useful is that the study of the former can make testable predictions about the latter. A paper published in 2022, by researchers at Columbia University and MIT, found that an ANN trained on image-recognition tasks produced a group of artificial neurons devoted to classifying foodstuffs specifically. When the paper was published there was, as far as anyone knew, no analogous area of the human visual system. But the following year researchers from the same laboratory announced that they had discovered a region of the human brain that does indeed contain neurons that fire more often when a person is shown pictures of food.

Perhaps the strongest evidence for the claim that artificial brains can reveal useful things about biological ones is the apparent ability for software and wetware to interact with each other directly. Nicholas Sexton and Bradley Love, a pair of neuroscientists of University College London, started out rather sceptical about the supposed resemblance between natural and artificial neural networks. Simply seeing similar patterns of activity, they argued, was not enough to claim that ANNs and brains were solving problems in the same way. To prove that the correspondence was

meaningful, they suggested investigating whether it was possible to feed brain activity into an ANN.

In 2022 they published a paper in *Science Advances* that did just that. The researchers fed an ANN trained to recognise images data recorded by an MRI scanner examining human brains. The idea was to try to let the ANN “see” through human eyes. Sure enough, the hotwired ANN was able to interpret data from any of the hierarchical layers of the biological visual system—though it did best with data from the higher levels, which had already been partly processed by the brain in question. If the computer model was shown brain activity from a human that was looking at a picture of a greyhound, for example, then it would say that it was looking at a greyhound—as opposed to some other object—almost 70% of the time.

The fact that a silicon brain can happily accept half-chewed data from a biological one suggests that, on some level, the two systems are performing the same sort of cognitive task. That insight might prove useful for brain-computer interfaces, which are devices that aim to allow biological brains to talk directly to machines. An ANN linked up to a camera, for instance, might be used to feed partly processed visual information into the brain. That might help treat some forms of blindness caused by damage to the brain’s visual system. Several different research groups in Europe and America are already testing that idea in experiments on macaques.

Even those most enthusiastic about ANNs do not argue they are perfect analogues of the human brain. Some make mistakes that humans never would—give an ANN a picture of a cat but with the skin of an elephant, for example, and the model is more likely to identify it as an elephant. But no scientific model is ever perfect. The question is whether it is useful. One of neuroscience’s problems is that experiments are difficult to run, for both ethical and practical reasons. Poking and prodding ANNs could offer a useful alternative.

In any case, comparing biology and silicon continues to produce intriguing results. In a paper published in May researchers from the University of Texas at Austin used a neural network to monitor brain signals from participants in an MRI scanner. Using just data from the MRI, the ANN could produce a rough summary of a story that the test subject was listening to, a description of a film they were watching, or the gist of a sentence they were imagining. “When I was in graduate school I would dream about something like this existing,” says Dr Love. “I thought it would be hundreds of years until we had something that works this well.” ■



梧桐

美国信贷周期处于危险关头

欢迎来到庞大债务的糟糕时代

法国经济学家托马斯·皮凯蒂（Thomas Piketty）的巨著《21世纪资本论》（Capital in the Twenty-First Century）长达20.4万字，比荷马史诗《奥德赛》还长。但该书的中心论点可以概括为一个只有三个符号的表达式： $r > g$ 。只要资本的实际回报率“ r ”超过实际经济增长率“ g ”（皮凯蒂通过计算认为20世纪的经济发展正是如此），不平等应该就会扩大。

这个信息简洁明了，皮凯蒂因而赢得广泛赞誉，经济学表达式也重新流行起来。一个具广泛影响力的表情是 $i > g$ ，它是皮凯蒂法则的一个变式。它指的是名义利率（即无风险收益）超过名义增长的情况。该表达式体现的忧心结论与债务有关。在 $i > g$ 的世界里，债务人赚取的收入、工资或税收的增长将慢于其借贷的利息累积，意味着债务水平可能迅速膨胀。

对美国和大多数西方国家来说， $i > g$ 的世界是陌生的。自2009年底以来，名义经济增长一直高于名义利率（除了2020年上半年，当时新冠疫情令经济崩溃）。如今美国即将跨越这道门槛。在2023年第一季度，尽管年化实际经济增长只有1.1%，但通胀过高让名义GDP的年化增长率升至5.1%，大致与当前联邦基金利率一致。数据公司彭博采访了一组经济学家，他们预计美国今年第二季度的经济增长率将下滑至仅为0.4%，通胀率为3.3%。预计名义增长仅为3.7%，远低于约5.2%的名义利率。

“经济周期进入了考验时刻，”法国巴黎银行的卡尔·里卡多纳（Carl Riccadonna）指出，“到了这个点，公司营收增长会慢于融资成本增长。”工资增长将滞后于债务增长。政府债务增速将超越税收。这样的情形持续一个季度也许还能接受。不幸的是，经济学家预计这将持续一年或更长时间。

确切的影响取决于债务随利率上升而重新定价的程度。绝大多数美国房主

担负的房贷是30年固定利率。这样的优厚贷款将保护他们免受工资增长放缓和利息支出上升的两面夹击。然而，背负信用卡循环信贷和私人学生贷款等其他类型债务的消费者将感受到压力。

许多公司的债务兼有固定利率和浮动利率，因此多少可以避免一些冲击。但其债务期限往往比抵押贷款短得多。企业固定利率债务有很大一部分将在2024年到期。准备再融资的公司眼下坐立不安。投资银行杰富瑞

(Jefferies) 的拉斐尔·贝哈拉诺 (Raphael Bejarano) 指出，过去一年发债非常之难，许多企业的财务人员都吓到了。“他们中许多人都为自家将在2024年到期的大笔债务发愁，试图稍微提前一些为其中一部分完成展期，即便利率更高。”他说。他们真正担心的是根本无法展期。

风险最大的公司有许多是近期被私募股权大亨收购的公司。这些私募大亨投资的公司往往背负采用浮动利率的私人信贷。在2008年上一个大信贷周期中，许多私募股权公司通过与贷款机构（多为银行）协商，得以最终完成过度杠杆化的收购。但这次它们面对的是私人信贷机构，许多这些机构也雇有庞大的私募股权团队，尤其乐意向过度杠杆化的公司下手。5月16日，私募巨头KKR持有的Envision Healthcare（KKR在2018年向其投资35亿美元，当时估值100亿美元）申请破产并由贷方接管，这可能是未来趋势的一个信号。

仔细观察现况会欣慰地发现，利率高企已经持续了一段时间，而美国经济的表现还相当不错，连银行倒闭似乎也只是皮肉伤，并不致命。但这都是在不同的背景下发生的。在额定资本还有高回报时，承受高成本要容易得多。而这种情况不会再持续太久了。 ■



Buttonwood

The American credit cycle is at a dangerous point

Welcome to a bad time for big debts

THE CELEBRATED tome “Capital in the Twenty-First Century”, by Thomas Piketty, a French economist, runs to 204,000 words—longer even than Homer’s “Odyssey”. But the book’s central argument can be distilled to a single, three-character expression: $r > g$. As long as “ r ”, the real rate of return to capital, exceeds “ g ”, the real rate of economic growth—as Mr Piketty calculated it did over the course of the 20th century—then inequality will supposedly widen.

The simplicity of the message won Mr Piketty widespread acclaim. It also spawned a resurgence in the popularity of economic expressions. An influential one, $i > g$, is a variation on the Piketty rule. It applies when nominal interest rates (or risk-free returns) exceed nominal growth. The troubling conclusion from this expression applies to debt. In an $i > g$ world, growth in the revenues, wages or tax receipts that a debtor earns will be slower than the interest accumulating on their borrowing, meaning debt levels have the potential to explode.

An $i > g$ world is unfamiliar to America and most of the West. Since the end of 2009 nominal growth has been higher than nominal rates (aside from the first half of 2020, when the covid-19 pandemic crashed the economy). Now America is about to cross the threshold. In the first quarter of 2023, despite annualised real economic growth of only 1.1%, Troublesomely high inflation meant that nominal GDP rose at an annualised rate of 5.1%, roughly in line with today’s federal funds rate. A panel of economists surveyed by Bloomberg, a data firm, anticipate that in the second quarter of the year growth will slip to just 0.4% and inflation to 3.3%. Nominal growth is

forecast to be just 3.7%—well below nominal rates of around 5.2%.

“This is when the rubber really meets the road for the economic cycle,” notes Carl Riccadonna of BNP Paribas, a bank. “This is the point at which, if you’re a business, your revenues are now growing more slowly than your cost of financing.” Wage growth will lag debt growth. Government debts will grow faster than tax receipts. A single quarter of this might be bearable. Unfortunately, economists expect the situation to last a year or more.

The precise impact depends on the extent to which debt reprices as interest rates rise. The vast majority of American homeowners have 30-year fixed-rate mortgages. This generous financing will protect them against a pincer-like combo of slowing wage growth and rising interest expenses. Nevertheless, consumers carrying other kinds of debt—including revolving credit-card balances and private student loans—will feel the pinch.

Many companies hold a mix of fixed- and floating-rate debt, meaning they will also be somewhat insulated. But the maturities of their debts tend to be much shorter than those of mortgages. A large portion of corporate fixed-rate debt is due to roll over in 2024. Companies that are preparing to refinance are getting nervous. Raphael Bejarano of Jefferies, an investment bank, points out that many corporate treasurers have been spooked by just how difficult it has been to issue debt over the past year. “Many of them are looking at their big maturities in 2024 and trying to roll some of that debt a little earlier, even at higher rates,” he says. What they really fear is being unable to roll their debt over at all.

The most-exposed companies include many that have been recently snapped up by private-equity barons. Private-credit loans taken on by their firms’ portfolio companies tend to have floating rates. During the last major credit cycle, in 2008, many private-equity firms were able to hang on to their overleveraged acquisitions by negotiating with lenders, which were mostly

banks. This time around they will be going toe-to-toe with private-credit lenders, many of which also employ hefty private-equity teams and will be more than happy to take on overleveraged firms. In a sign of what may be to come, on May 16th KKR, a giant private-assets firm, allowed Envision Healthcare, a portfolio company in which it invested \$3.5bn at a \$10bn valuation in 2018, to fall into bankruptcy and be seized by its lenders.

When surveying this scene, it is reassuring to note that interest rates have been high for a while, the American economy has fared pretty well and even bank failures seem to have represented a flesh wound rather than a fatal one. But all of this has happened in a different context. It is far easier to swallow a high cost of capital when it is matched by high returns on said capital. And that will not be the case for much longer. ■



巴托比

为何企业团建如此浮夸？

公司夏令营日益创意万千。大可不必

冰浴、红外桑拿、漂流、飞钓、箭术工作坊、威士忌品鉴、日出瑜伽、飞碟射击、卡丁赛车，到挪威山地骑行，去爱尔兰训鹰，在阿尔伯塔攀登冰川，围着篝火齐声唱Kumbaya。这些看似纷繁不一的活动有一个共同点：它们全是当代公司外出团建的真实例子。

作为本专栏的特邀撰稿人，一想到做完PowerPoint演示后还要玩角色扮演和强制性游戏，笔者尴尬症都要发作了，还是更希望能自然而然地加深同僚之情。然而，高管务虚会已成为商界的一种年度传统活动。其用意是让员工从日常工作释放出来，让他们建立同事情谊并培养创造力。这种形式愈演愈烈。

一年一次精彩刺激的外出活动也许有助在劳动力市场吃紧时留住高管（而且比涨薪留人要省钱）。在远程工作的时代，没有了办公室里的万千细微互动，团建旅行开始发挥某种结构性作用。突然间，外出团建不再可有可无，而是占据了企业人力资源战略中接近核心的位置。不参加是不行的。那同事们头一回面对面竟是穿着人字拖，又会如何？

最早时是烧烤和垒球比赛。“退修营”在格调和花费上都提高了一个档次。1985年，乔布斯离开苹果创办另一家公司，仅三个月后，他就带着员工到圆石滩（Pebble Beach）做了首次户外团建。随着企业心理学在上世纪90年代蓬勃发展，这种形式开始“安营扎寨”。到2015年，据称优步花了600万美元请碧昂斯到拉斯维加斯的一次公司活动中为员工（优步司机不在其列）表演，这位流行歌手的酬劳似乎不是以现金支付，而是这家当时正如日中天的创业公司的股票。打着科技公司招牌的办公室租赁公司WeWork曾在世界各地举办喧闹的夏季团建活动，鼓励员工在电子音乐中整夜跳舞。

优步自2019年上市以来表现乏善可陈，现在的管理层已经不再执着于请一线明星助阵团建了。WeWork在2019年下半年上市失败，之后其热衷开派对的创始人兼CEO亚当·诺伊曼（Adam Neumann）被赶出公司，此后WeWork修改了员工娱乐政策。但是，公司外出团建之风反倒是刮得更强劲了。

为了与众不同，公司尽可能把自己的营地团建安排得独家又别致。请不起流行歌星的公司可以请宇航员来为高管们讲讲太空生活的故事——来的不是碧昂丝，却可能对那些技术宅员工很有吸引力。许多组织者选择野外活动，也许是相信壮丽的自然景观会释放人的真性情。世界各地的酒庄如今都在扩大规模，方便接待以酿酒课程为特色的团建，让员工们踩葡萄榨汁。美国蒙大拿州一个牧场为企业客户提供彩弹射击、夺旗和套假牛的活动。品牌战略机构Butchershop在哥斯达黎加举行了第二次团建峰会，活动包括滑索、骑马穿越丛林和悬崖跳水。

公司要让团建活动令人难以忘怀，一个万无一失的方法是把参与者置于逆境。合力对抗恶劣天气想来能培养团队精神，但狂热的组织者有时会玩过火。一家欧洲大公司在隆冬时节把高管们送到北极圈，让他们在严寒里苦熬多日，还没有衣服可换。踩热炭这种古老仪式被改用作团建项目，导致苏黎世一家瑞士广告公司的25名员工受伤。

除了消耗预算和宝贵时间，多日外出团建有何成效并不清楚。脚上带着冻疮或灼伤回到办公桌旁不太可能提高工作效率。即便幸免于受伤，你也可能已经对那个喝多了发表了一通伤感独白的同事失去了敬重之情。与同事一起踏火前行也许是为促进精神疗愈，并把雇员和老板放到平等——且同样烫脚的——位置。然而，真正能让团队凝聚力量的是“赴汤蹈火”式的奋斗经历。它不会发生在企业务虚会上，而只会在多年的并肩共事之后形成。 ■



Bartleby

Why are corporate retreats so extravagant?

Companies' summer camps get unnecessarily creative

ICE BATHS, infrared saunas, white-water rafting, fly-fishing, archery workshops, whisky tastings, yoga at sunrise, shooting clay pigeons, go-kart races, mountain-biking in Norway, falconry in Ireland, climbing up a glacier in Alberta, singing “Kumbaya” around a campfire. These seemingly disparate activities have one thing in common: all of them are real examples of the contemporary corporate off-site.

Your columnist, a guest Bartleby, cringes at the idea of PowerPoint presentations followed by role-playing exercises and mandatory games. She prefers to let the ties with her colleagues deepen in organic ways. Still, the executive retreat has become an annual business tradition. The idea is that, by disconnecting employees from their day-to-day routine, companies can build camaraderie and foster creativity. And it has grown in importance.

A splashy, exciting getaway once a year may help retain executives in a tight labour market (and is cheaper than fatter monthly pay cheques). In the era of remote work—without the thousands of micro-interactions that happen in the office—team-building trips have also gained a structural role. Suddenly, off-sites are no longer an afterthought but lodged near the heart of corporate HR strategy. Not participating is not an option; so what if co-workers end up meeting in person for the first time wearing flip-flops?

It used to be barbecues and softball games. Retreats moved things a notch higher in style and expense. Just three months after Steve Jobs left Apple and started another company in 1985, he whisked his employees to Pebble Beach for their first off-site. As corporate psychology boomed in the 1990s,

team-building retreats became entrenched. By 2015 Uber was reportedly offering Beyoncé \$6m to perform for its employees (no, not the drivers) at a corporate event in Las Vegas (the pop star was apparently paid in the then-hot startup's stock rather than cash). WeWork, an office-rental firm with tech pretensions, used to host raucous summer retreats around the world; employees were encouraged to dance the night away to electronic music.

Given Uber's lacklustre ride since its initial public offering in 2019, current management has gone easy on A-listers. WeWork revised its staff-entertainment policies after its party-loving founder and CEO, Adam Neumann, was forced out in the wake of its abortive IPO later that year. But the trend for the corporate getaway has, if anything, intensified.

To stand out, companies try to make their retreats as bespoke and exotic as possible. Those firms that cannot afford pop stars can have an astronaut regale executives with tales of life in space—not Queen Bey, exactly, but potentially entralling to the nerdier elements of the workforce. Many organisers opt for the great outdoors, perhaps in the belief that the sublime will unleash authenticity. Wineries around the world are now expanding to accommodate retreats featuring winemaking lessons; employees stomp grapes. A Montana ranch offers corporate clients paintball, flag-capturing and dummy-cattle-roping. Butchershop, a brand-strategy agency, held its second summit in Costa Rica; activities included zip-lining, horseback riding through the jungle and jumping off a cliff into the water.

A sure-fire way for a business to make its retreat memorable is to thrust participants into adversity. Battling the elements together is supposed to foster team spirit, but zealous organisers have occasionally been known to overdo it. One large European company sent executives to the Arctic Circle in midwinter. They endured frigid temperatures for days, without a fresh change of clothes. Walking on hot coals—an ancient ritual recast as a team-building exercise—led to the injury of 25 employees of a Swiss ad agency in

Zurich.

It is unclear what many days away achieves, except for straining the expense budget and consuming valuable time. Returning to your desk with frostbite or burnt feet is unlikely to boost your productivity. Even if you escape injury you may have lost esteem for the co-worker who drank too much and delivered a maudlin monologue. Walking on fire with colleagues may be meant to encourage spiritual healing and to put employees and bosses on equal—and equally uncomfortable—footing. Yet it is walking through metaphorical fire which actually causes teams to bond. That happens not at a corporate retreat but after years of working together. ■



【首文】英伟达，不可挡？

AI热助推英伟达市值暴涨。它能守住优势地位吗？

竞争和监管可能会构成威胁——但那都是以后的事

创新浪潮常常造就巨头。微软乘上了台式电脑的热潮，就像苹果搭上智能手机风潮一样。人工智能（AI）很可能是下一个重大技术变革，它将改变企业运营和社会运作的方式。如果是这样，许多销售AI底层软件和硬件的公司将有所斩获。但没有哪家公司比生产专用AI芯片的美国公司英伟达（Nvidia）处于更有利的位置。上周，其市值一度超过1万亿美元。AI会将英伟达一举送入科技巨头王国吗？

围绕AI的喧嚣让这个问题很难回答。自AI驱动的聊天机器人ChatGPT于去年11月发布后，人们对英伟达的兴奋之情开始升温。从那时起，各种各样的公司都推出了融入了AI的产品，更推动了热度高涨。英伟达的老板黄仁勋毫不意外信心满满，大谈一个“新的计算时代”。投资者似乎也同样欢欣鼓舞。自今年年初以来，英伟达的股价已经翻了一倍多。

这种兴奋情绪在很大程度上是合理的。英伟达的状况令人艳羡。其核心业务是设计高性能芯片。起初，这些产品的买家是视频游戏爱好者。这些芯片在训练AI模型方面也非常高效，一个蓬勃发展的新市场由此出现。但这家公司不只是靠运气。它每推出新一代芯片都能让性能提升许多倍。如今，它占据了AI专用芯片市场80%以上的份额。

英伟达也很有先见之明，它在两个领域的投资帮助巩固了自己的霸主地位。一个是高级网络。训练AI模型需要大量的处理能力，因此需要同时使用许多芯片——有时会用到数千个。这些芯片通过高性能的AI定制网络交换数据。如今英伟达控制着这个市场78%的份额，这与它在2019年收购了该领域的专门公司Mellanox息息相关。

英伟达的另一个强项是软件。它广受程序员欢迎的AI平台CUDA只能在英伟达的芯片上运行。在竞争对手都还没行动起来笼络开发人员的时候，它

就早早下大功夫鼓励他们使用它的软件，例如让AI研究人员免费使用英伟达芯片和软件。

然而，尽管有这些优势，英伟达的长期统治地位也并非万无一失。首先，AI引发的一些狂热可能会退烧。英伟达的前景越好，吸引的竞争对手就越多。创业公司以及AMD和英特尔之类的大型芯片制造商都希望从英伟达的网络和芯片业务中分一杯羹。其他公司则致力于开发开源和专有软件，这可能会削弱CUDA的影响力。不过，最大的挑战可能来自英伟达自己的客户。亚马逊和Alphabet的云计算部门都在设计自己的AI定制芯片。两家公司的规模和财力都足以使之成为可怕的竞争对手。

政府也构成了风险。监管机构担心AI给社会和国家安全带来危险，正在寻找控制这项技术的方法。去年，美国限制了向部分中国公司出售高性能芯片和芯片制造工具，削弱了英伟达在第三季度的销售。如果英伟达占据霸主地位，就更方便政客们采取行动了。

不过，就目前而言，前景一片光明。即使AI狂热降温，这项技术也必然比加密技术更有用处——英伟达先前也从加密技术的热潮中赚了一笔。监管可能会抑制增长，但不太可能完全扼杀增长。英伟达的竞争对手们都尚未推出将软件、芯片和网络捆绑在一起的AI产品。英伟达的主要优势在于它有能力将这些整合起来，创造一个有吸引力的生态系统。这听起来很像微软和苹果。 ■



Nvincible?

The AI boom has turbocharged Nvidia's fortunes. Can it hold its position?

Competition and regulation may pose a threat—but only eventually

WAVES OF INNOVATION often create giants. Microsoft rode the upsurge in desktop computers, as Apple did with the smartphone. Artificial intelligence (AI) may well be the next big technological shift, transforming the way businesses are run and society functions. If so, plenty of firms selling the software and hardware that underpin AI stand to gain. But none is better positioned than Nvidia, an American firm that makes specialist AI chips. Its market value briefly passed \$1trn last week. Will AI sweep Nvidia to big tech-dom?

The hype around AI makes the question hard to answer. Excitement about Nvidia began to mount in November, after the release of ChatGPT, an AI-powered chatbot. Since then all manner of firms have launched AI-infused products, adding to the fervour. Jensen Huang, Nvidia's boss, is unsurprisingly bullish, talking of a “new computing era”. Investors seem just as jubilant. Nvidia's share price has more than doubled since the start of the year.

Much of the excitement is justified. Nvidia is in an enviable position. Its core business is designing high-performance chips. At first it sold these to video-game enthusiasts. The chips were also highly efficient at training AI models, and a new, booming market emerged. But the firm has not just been lucky. With each generation of new chips, it has improved performance many times over. Today it holds over 80% of the market in specialist AI chips.

Nvidia also had the forethought to invest in two areas that helped cement

its supremacy. One is advanced networking. Because training AI models requires vast amounts of processing power, many chips—sometimes thousands—are used simultaneously. These chips exchange data along a high-performance, AI-tailored network. Today Nvidia controls 78% of that market, thanks to its purchase of Mellanox, a specialist, in 2019.

Nvidia's other strength is its software. CUDA, its AI platform, is popular with programmers and runs only on the company's chips. By, for instance, giving free access to its chips and software to some AI researchers, the firm focused on encouraging developers to use its software long before its competitors set out to woo them.

Despite all these advantages, however, Nvidia's lasting dominance is not assured. For a start, some of the frenzy around AI may die down. The juicier the firm's prospects, the more competitors it will attract. Startups and big chipmakers, such as AMD and Intel, want a share of Nvidia's network and chip businesses. Others are working on open-source and proprietary software that may weaken CUDA's hold. The biggest challenge, though, may come from Nvidia's own customers. The cloud-computing arms of both Amazon and Alphabet are designing their own AI-tailored chips. Both have the scale and the deep pockets to become fearsome rivals.

Governments also pose a risk. Regulators worried about the dangers AI poses to society and national security are searching for ways to control the technology. Last year America restricted the sale of high-performance chips and chipmaking tools to some Chinese firms, which dented Nvidia's sales in the third quarter. If Nvidia is dominant, politicians will find it easier to act.

Still, for now the future looks bright. Even if AI mania cools, the technology is bound to be more useful than crypto, another craze that Nvidia cashed in on. Regulation may crimp growth, but is unlikely to kill it. And none of Nvidia's rivals is yet offering AI products that bundle together software,

chips and networking. Nvidia's chief advantage lies in its ability to package these up and create an attractive ecosystem. That sounds a lot like Microsoft and Apple. ■



国际金融

数字支付系统能否帮助推翻美元的统治地位？

数字金融有可能降低全球对美元的依赖吗？

在2014年俄罗斯入侵乌克兰后，一场金融战打响了。西方银行卡网络退出俄罗斯，政客呼吁把该国踢出用于国际收支的SWIFT信息系统。俄罗斯的对策是建立一个属于俄罗斯央行的Mir银行卡网络。所以在俄罗斯2022年对乌克兰更大规模的入侵导致更多制裁后，其国内的商业几乎没有感受到任何影响。其他希望摆脱西方掌控的国家注意到了这一点。中国已经将西方信用卡网络拒之门外。印度的民族主义者大谈要通过支付系统UPI及其RuPay卡减少对西方的依赖。

一些国家希望数字支付平台能有助于减少对SWIFT系统和仍是全球主导货币的美元的依赖。印度已将UPI与新加坡的快速支付系统连接起来，并正在与其他30个国家协商，协助它们采用UPI模式，建立国际金融连接。印度一家领先的金融科技公司的高管表示，UPI最终可能成为“低价值跨境零售的支付网络”。

但最引发西方关注的还是中国在这方面的进展。中国于2015年推出了跨境银行间支付系统（CIPS），通过实时结算转移资金。到今年年初，它的参与机构已扩大到1430家，其中超过一半在中国境外。2021年处理业务量增长75%，2022年CIPS日均处理超过500亿美元。尽管这只有美国清算所CHIPS处理规模的四十分之一，但一旦发生制裁，它可以充当西方系统的一个替代品。据报道，法国曾用人民币结算液化天然气出口。巴西用人民币进行某些商品的贸易，俄罗斯也是如此。自2022年2月以来，人民币在贸易金融中的份额从2%增加至4.5%，翻了一倍多。

香港大学的道格拉斯·阿纳（Douglas Arner）认为，央行数字货币如果为跨境支付制定出共同标准，就可能构成更大的威胁。央行俱乐部国际清算银行（BIS）发起了一个名为mBridge的试验项目，使用分布式账本连接中

国、泰国和阿联酋的央行及香港金融管理局，结算跨境支付。对外贸易有时会很繁琐耗时，因为很少有银行在其他国家开设账户。汇款银行必须将资金转移给拥有海外账户的代理银行，这就推高了成本。

理论上来说，mBridge这样的系统可以降低成本。在2022年的一次试验中，这四方的20家银行在164笔支付中处理了约2200万美元。国际清算银行尚未透露其效率如何，事实上，因为mBridge没有足够的流动性，它不得不借助其平台之外的传统市场。但参与了该试验的汇丰银行的孙雷表示，该系统在技术上没有问题。仍存留的问题在于协调标准和找到足够的流动性。

其他人持怀疑态度。许多人认为，无论技术上有多好，除非中国开放资本账户，否则人民币无法进一步提升地位。一位中国分析师直截了当地表示：“中国人民银行知道数字人民币作为人民币国际化的工具是有局限性的。”即时结算技术也可能加大转账时出错的几率。

然而，曾在白宫制定制裁措施的达利普·辛格（Daleep Singh）表示，新的跨境支付系统肯定会降低在美元和SWIFT系统之外进行交易的成本。辛格不明白为什么美国会在央行数字货币（CBDC）的讨论方面放弃了“发言权”。正如两位经济学家吉塔·戈皮纳特（Gita Gopinath）和杰里米·斯坦因（Jeremy Stein）在2021年的一篇论文中所解释的那样，从历史上看，一种货币的主导地位始于贸易计价。随着该货币的受欢迎程度不断提高、资本市场不断变深厚，它作为储备货币的吸引力就变得更强。

人民币和任何其他货币都远未对美元构成真正的挑战。但如果数字金融降低了不使用美元的成本，可能会在美国引起一些担忧。■



International finance

Could digital-payments systems help unseat the dollar?

Might digital finance reduce the world's dependence on the dollar?

AFTER RUSSIA'S invasion of Ukraine in 2014, a financial battle began. Western card networks pulled out of Russia and politicians called for it to be cut off from the SWIFT messaging system for international payments. In response Russia built a central-bank owned card network called Mir. So when its bigger invasion in 2022 led to more sanctions, domestic commerce in Russia hardly felt it. Other countries wishing to escape Western dominance have taken note. China has shut out Western card networks. Indian nationalists talk up UPI and its RuPay card as ways to reduce dependence on the West.

Some hope that digital-payment platforms will help reduce dependence on SWIFT and the dollar, still the world's dominant currency. India has linked UPI with Singapore's fast payments system and is in talks with 30 other countries to help them adopt the UPI model, creating international financial links. It could eventually become a "network of low value cross-border retail payments", says one executive at a leading Indian fintech.

But it is Chinese efforts that attract most attention in the West. Its cross-border interbank payment system (CIPS), launched in 2015, uses real-time settlement to move money. It had expanded to 1,430 participants by early this year, more than half of them based outside China. Transaction volumes grew by 75% in 2021 and CIPS processed over \$50bn a day in 2022. Although that is 40 times smaller than CHIPS, an American clearing house, it offers an alternative to the Western system in the event of sanctions. France has reportedly used yuan to sell liquefied natural gas. Brazil uses the currency for some trade, as does Russia. The yuan's share of trade finance has more

than doubled from 2% to 4.5% since February 2022.

Douglas Arner of the University of Hong Kong thinks that central-bank digital currencies could pose a bigger threat by creating a common standard for cross-border payments. One trial by the Bank for International Settlements (BIS), a club of central banks, called mBridge, linked the central banks of China, Hong Kong, Thailand and the UAE using a distributed ledger to settle cross-border payments. Overseas trade can be cumbersome because few banks have accounts in other countries. A sender bank must transfer funds to a correspondent bank that has an overseas account, driving up costs.

In theory systems like mBridge could reduce costs. In a trial in 2022, 20 banks across the four places transacted some \$22m in 164 payments. The BIS has yet to disclose how efficient this was: indeed, it had to turn to traditional markets outside its platform because it did not have enough liquidity. But Mr Sun of HSBC, which joined the trial, says that the system worked technically. The questions left concern alignment of standards and finding enough liquidity.

Others are sceptical. Many argue that, however good the technology, the yuan cannot grow further unless China opens up its capital account. One Chinese analyst says flatly that “The PBOC is aware of the limits of the e-CNY as a tool for RMB internationalisation.” Instant-settlement technology can also make mistakes in transfers more likely.

Yet new cross-border payment systems will surely cut the cost of trading outside the dollar and SWIFT, says Daleep Singh, a former White House architect of sanctions. Mr Singh wonders why America has given up its “seat at the table” on CBDCs. As Gita Gopinath and Jeremy Stein, two economists, explain in a 2021 paper, a currency’s dominance historically begins with trade invoicing. As popularity grows and capital markets deepen, it becomes

more attractive as a reserve currency.

Neither the yuan nor any other currency is anywhere near being a serious challenger to the dollar. But if digital finance makes it less costly to avoid the greenback, that could cause some concern in America. ■



数字货币

央行数字货币仍是雷声大雨点小

央行数字货币的实际推广速度慢于预期

芬兰央行（Bank of Finland）在1992年推出了一张名为Avant的奇特卡片。它看起来像一张借记卡，但它是要复现金的特性。存储在Avant卡上的钱由芬兰央行而非商业银行背书，该行声称这让它成为世界上第一种央行数字货币（CBDC）。持卡人并没有该行账户，卡的货币价值是由插入卡中的实体芯片来追踪的。和使用现金一样，这意味着用户是匿名的。Avant卡运行了三年后被私有化，后来停用。与其他支付渠道（例如有奖励积分的信用卡）相比，它的普及率非常低，而且也没有赚到钱。

又过了30年，CBDC的想法才真正复兴。就在2016年之前，几乎都还没有哪家央行认真考虑CBDC。而现在大部分央行都在琢磨它。如今现金使用减少，而加密货币兴起，加上Facebook可能会推出数字货币Libra，都促使央行寻求方法，避免失去对其金融系统的控制。据大西洋理事会（Atlantic Council）估计，目前多达114个国家（占世界GDP的95%以上）已经启动或正在探索CBDC，而在2020年年中时还只有35个。至少有十个项目已经全面启动，其中中国的试点项目规模最大。

尽管来势汹汹，但仍有为数不多但在不断增多的政客和央行官员质疑发行CBDC的意义。去年1月，英国上议院的一份报告得出结论：“我们尚未听到令人信服的理由，说明英国需要一种零售型CBDC。”今年3月，瑞典央行（Riksbank）发布了一份900页的报告，认为发行电子克朗（瑞典是一个高度“无现金国家”）的理由并不充分。其他拥有先进银行和支付系统的国家也不认为CBDC具有什么明显的优点。

然而，如果全然不将CBDC放在眼里就错了。央行是任何金融体系的最终结算机构。“批发式”CBDC只限某些金融机构使用，它可以通过让金融科技公司直接接入央行（无需再接入普通商业银行）而让支付系统更具竞争

力。CBDC可能有助于升级跨境支付，让两种不同货币间的即时结算成为可能。即使对于拥有先进支付系统的国家，也可以通过CBDC来影响设计新奇货币的标准。CBDC有朝一日成为主流并非不可想象。尽管近来持怀疑论调，英国央行不喜炒作的副行长乔恩·康利夫（Jon Cunliffe）曾表示，很可能“英国未来会需要一种数字英镑”。

CBDC的影响在很大程度上将取决于其设计。所有CBDC都是央行的负债，这意味着它们不带有商业银行存款挤兑的风险。有些CBDC采用私有区块链，有些不用。然而，从巴哈马到中国再到尼日利亚，全面启动的CBDC和试点项目都遵循了一些共同原则。CBDC通常由商业银行充当中介，并与私营数字钱包供应商合作，从而减少了管理上的复杂度。最早推出的巴哈马沙元和尼日利亚的e-naira都对用户可以持有的数字货币数量设置了上限。规模最大的中国CBDC试点项目数字人民币也有类似的设置。所有CBDC都不计利息，而且交易费用为零，至少目前是这样。设置持有上限和零利率的原因是为了避免大量存款从商业银行流出而转入CBDC。

这些试验进展如何？沙元、数字人民币和e-naira尽管高调推出，但都还没怎么流行开来。3月，《南华早报》报道称，中国大多数商店都极少接受电子人民币付款。约有26个城市参与了试点。中国人民银行的数据显示，1月流通中的数字人民币仅约136亿元。截至2022年初共开立了2.61亿个钱包，但在2020年10月至2022年8月间数字人民币的累计交易额仅1000亿元。一些中国用户表示这是因为支付宝和微信支付已经很好用，所以很多零售商懒得再折腾数字人民币。

其他央行官员密切关注着事态发展。有一些已经完全放弃了发行CBDC的想法。丹麦（已经拥有高度数字化的支付系统）央行表示：“尚不清楚零售型CBDC如何……能让支付方式变得更便捷、更安全。”日本央行于2021年开始试行一种CBDC，但“没有发行计划”。芬兰可能还记着Avant的失败，也没有任何发行计划（尽管它支持发行数字欧元以改善整个欧洲的跨境支付）。某国央行的一位经济学家表示，关键在于CBDC的大部分潜在价值都可以在现有系统中实现。

什么因素可能会提高CBDC的接受度呢？一些政府通过激励措施普及CBDC。尼日利亚向使用e-naira支付人力车车费的人提供5%的折扣。与其他国家一样，尼日利亚这么做是为了推动金融普惠，因为该国大部分人口连银行账户都没有。中国已经在免费开通的数字人民币钱包中发放了“红包”。长期以来，它一直费劲劝导蚂蚁金服和腾讯等金融科技公司交出实时交易数据的访问权。这使它有动力把数字人民币放到商贸活动的中心。

其他人则关注可能让CBDC与众不同的特点。负责汇丰银行新兴支付业务的孙雷认为，尽管仅把CBDC用于支付可能与现有的批发支付系统无甚差别，但“可编程货币是独一无二的”。常驻上海的理奇·图林（Rich Turrin）所著的关于中国CBDC的《无现金》（Cashless）一书描述了在成都所做的一项实验：据新闻报道，六名农民获得了带有智能合约的数字人民币，规定只能用于农业用途。一些人认为，这可能是朝着对整个经济进行更精细、更高效控制的梦想迈出了一步。图林表示，CBDC还可能帮助各国执行跨境交易所需的信息传递和资金转移功能，有机会绕过美元体系。

然而，CBDC未来的各种可能性目前都还处于试验阶段。“现在还在发展初期。”图林承认。至少在这方面，它与加密行业没有什么不同。■



Digital money

Central-bank digital currencies are talked about more than coming to fruition

The roll-out of central-bank digital currencies is proving slower than expected

IN 1992 THE Bank of Finland, the country's central bank, launched a curious card called Avant. It looked like a debit card, except that it was meant to replicate the properties of cash. The money stored on an Avant card was backed by the Bank of Finland rather than a commercial bank, which made it, the bank claims, the world's first central-bank digital currency (CBDC). Cardholders did not have accounts with the bank. Instead their monetary value was tracked by chips physically inserted into them. As with cash, that meant that users were anonymous. Avant ran for three years before being privatised and later discontinued. It saw little uptake compared with other payment channels, such as credit cards with reward points. And it failed to make money.

It took another 30 years for the idea of central-bank digital money to be seriously revived. As recently as 2016, almost no central banks were seriously looking at CBDCs. Now most are. Declining cash usage, the rise of cryptocurrencies and Facebook's possible launch of a digital currency called Libra all pushed central banks to look for ways to avoid losing control of their financial systems. Fully 114 countries, representing over 95% of world GDP, have now launched or are exploring CBDCs, up from only 35 in mid-2020, reckons the Atlantic Council. At least ten have fully launched, with China being the largest to run a pilot.

Despite the hype, a small but growing group of politicians and central bankers are questioning the purpose of CBDCs. In January 2022 a report by Britain's House of Lords concluded that "We have yet to hear a convincing

case for why the UK needs a retail CBDC.” In March Sweden’s Riksbank released a 900-page report concluding that the case for an e-krona (in a place with a high degree of cashlessness) was not strong. It has been joined by others that see little advantage in pursuing a CBDC, given the advanced nature of their banking and payment systems.

Yet it would be wrong to write off CBDCs. Central banks are the ultimate settlement institution of any financial system. A “wholesale” CBDC, accessible only to certain financial institutions, could make payments systems more competitive by giving fintechs access to central banks directly rather than through banks. CBDCs might help upgrade cross-border payments, making possible instant settlement across pairs of currencies. Even for countries that have advanced payment systems, there is a case for a CBDC to influence standards governing the design of newfangled currencies. It is not inconceivable that CBDCs could one day go mainstream. Despite recent scepticism, the hardly hypeish deputy governor of the Bank of England, Sir Jon Cunliffe, has said it is likely that a “digital pound will be needed in the UK.”

The impact of CBDCs will depend greatly on their design. All are liabilities of a central bank, meaning they do not come with the risk of deposit runs on commercial banks. Some use private blockchains, others do not. Yet the fully launched CBDCs and pilots, from the Bahamas to China to Nigeria, have converged on a few common principles. They are typically intermediated by commercial banks and work with private wallet-providers, limiting the complexity of managing them. The Bahamian sand dollar and Nigeria’s e-naira, the earliest to launch, have caps on how much users can hold. China’s e-CNY, the largest-scale CBDC pilot, is similar. None bear interest and all have zero transaction fees, at least for now. The reason for usage caps and zero interest is to avert large outflows of deposits from commercial banks into CBDCs.

How are the experiments faring? The sand dollar, e-CNY and e-naira have seen little uptake despite high-profile launches. In March the South China Morning Post reported that most shops in China rarely take payments in e-CNY. Some 26 cities are participating in the pilot. Data from the PBOC, China's central bank, found that only some 13.6bn yuan (\$2bn) was in circulation in January. A total of 261m wallets were created by the start of 2022, yet only 100bn yuan (\$14bn) was transacted between October 2020 and August 2022. The reason, say some Chinese users, is that Alipay and WeChat Pay already work well, so many retailers cannot be bothered with e-CNY.

Other central bankers are watching with interest. Some have dropped the idea altogether. The central bank of Denmark (which already has a highly digitised payments system) has said “It is not clear how a retail CBDC...can contribute to better and more secure access to payments.” The Bank of Japan started piloting a CBDC in 2021 but “has no plans to issue” it. Finland, perhaps remembering Avant, also has no plans (though it supports a digital euro to improve cross-border payments across Europe). The problem, says an economist at one central bank, is that most of the potential value of a CBDC can be realised within the existing system.

What might drive more adoption? Some governments are encouraging CBDCs through incentives. Nigeria is offering 5% discounts to those who use the e-naira to pay for rickshaws. Like others, it is motivated by the need for greater financial inclusion, as much of its population is unbanked. China has handed out “red envelopes” with free e-CNY. It has also long struggled to coax fintech firms such as Ant and Tencent to hand over access to real-time transaction data. That gives it an incentive to put the e-CNY in the centre of commerce.

Others focus on what might make CBDCs special. Lewis Sun, who heads emerging payments for HSBC, a bank, thinks that although using CBDCs for

payments alone may not be that different from existing wholesale payment systems, “Programmable money is unique.” Rich Turrin, a Shanghai-based author of the book “Cashless” about China’s CBDC, describes an experiment in the province of Chengdu, where reports suggest six farmers were given e-CNY with smart contracts stipulating that it could be used only for farming purposes. Some think this could be a step towards a dream of fine-grained more efficient control over the entire economy. CBDCs could also help countries perform the messaging and movement of funds required for cross-border transactions, possibly bypassing the dollar system, suggests Mr Turrin.

Yet these possible futures all remain experiments for now. “It is still early days,” admits Mr Turrin. In that, at least, it is not unlike the crypto industry. ■



机器人画派

AI创作的艺术正在形成自己的风格

AI模型不仅能反映它们在训练集图片中看到的东西，还会放大其所见

今年的索尼世界摄影奖（Sony World Photography Awards）于4月将创意类一等奖颁发给了鲍里斯·埃尔达格森（Boris Eldagsen）。他的作品是一幅两名女性的黑白人像，风格空灵而复古，给评委留下了深刻的印象。然而，埃尔达格森拒绝领奖，并透露他用以创作的工具不是相机，而是人工智能（AI）。这位德国艺术家说，他“参赛就是瞎捣乱”，想看看能不能骗过评审团。

“生成式”AI模型可以做出足以乱真的仿作，无论是复古风格的人像还是更现代的图像——比如教皇匪夷所思地身穿巴黎世家的羽绒服，这张“照片”最近骗过了一半的推特用户。不过它们生成完全原创作品的能力如何尚不得而知。“就目前来看，AI艺术无比微不足道。”《艺术新闻》（Art Newspaper）的一位专栏作家最近忿忿地说。它本质上是衍生性质的，基于数以百万计用以训练它的图像，依照指令把这些图像吃下肚、消化和反刍。“AI创作流程的一个特征就是抄袭。”美国作家协会（Writers Guild of America）宣称。该协会与其他众多创意工作者工会一样，认为生成式AI模型就是十足的山寨工厂。

也许如此。然而有迹象表明，AI模型正在形成自己的艺术风格，而不仅仅是停留在画不止有五个指头的手上（AI在早期常会生成这样的大作）。生成式模型识别并强调它们在训练数据中看到的模式，因而与其说它是当代风格的镜子，不如说是这些风格的放大镜。一个机器人艺术流派正在慢慢兴起。

计算机从事艺术创作已有一段时间。五年前，佳士得拍卖了第一件由AI创作的作品《贝拉米画像》（Edmond de Belamy），仿佛是一幅模糊的18世纪的油画。尽管这幅画尚未完工，画的也有一丝像非人类，但这个新鲜玩

意还是拍出了432,500美元的高价。“虽然这幅画可能并不是一个戴着扑粉假发的男人画的，”佳士得表示，“但它正是我们250年来一直在卖的那种艺术品。”

科技自那以后已取得了长足的进步。Midjourney和DALL-E等开放平台可以根据简单的文字提示在几秒钟之内生成图像。如此“创作”不需要任何艺术技巧，但要得到好的成品还是有诀窍的。“我制作的图像不是我的作品。我的作品是给出的那个提示。”纽约设计师尼克·圣皮埃尔（Nick St Pierre）表示。去年，当他发觉AI要来砸自己的饭碗，便倒戈加入了AI这一边。上图就是他使用Midjourney制作的，经过了数百次迭代，最终使用的提示是这样的：

35mm底片，1990年代的动作电影剧照，一个在酒品店里浏览酒瓶子的大胡子男人的特写。小心身后！！！（背景动作启动）……一辆白色奔驰皮卡撞破了一家商店的窗户，在背景中爆炸……碎玻璃四处飞溅，燃烧的碎片闪着光芒，照亮了霓虹闪烁的夜晚，90年代CGI效果，极尽逼真

从上世纪90年代的动作电影到教皇的八卦狗仔照片，AI对创作任何风格的任何图像都有求必应，这似乎与独特AI风貌的期待相矛盾。然而，AI的某些特色似乎特别突出。一个是怀旧风。AI模型能够再现它们被灌输的风格，这使得它们擅长模拟旧媒体的特色，有时还可以用现代的形式重现过去的事件。最近一组疯传的照片想象了前现代的人玩现代自拍的样子，画面上，维京人或穴居人对着镜头咧嘴笑。

和以前的艺术时代一样，什么样的题材最流行取决于委托创作的人。西方的画廊里挂满了富有的白人和他们的财产的画像，不是因为这些东西画成油画很好看，而是因为金主们最喜爱的主题就是这些。Midjourney上有很多以公主战士为主题的动画，也是一样的原因。

AI模型似乎也偏爱特定的技法。德国波鸿鲁尔大学（Ruhr University Bochum）的研究员罗兰·迈耶（Roland Meyer）研究了Midjourney今年早些时候制作的图片，注意到一种常见的风格。许多图片都“闪闪发光，仿

佛由内而外被照亮”。这些图片将这种独特的布光结合以一种让温暖的大地色调与蓝绿色系金属色调撞色的色彩模式。许多图片还展示了摄影师所说的“高动态范围”，也就是说画面中的光线强度变化很大，局部阴影很深，其他区域亮度很高。

这些特征并非巧合。迈耶将这种独特的“光晕”归因于AI模型处理光照的方式。AI没有使用光线追踪等数字艺术技巧，即用计算机计算光如何从特定的角度落到物体上，而是根据训练数据中的图像（光源来自许多不同角度）来想象物体被照射后的样子。迈耶表示，出于这个原因，即使是如照片般真实的AI图像，其打光似乎也更类似于绘画，而不是写实摄影。

与此同时，最受青睐的配色方案通常是将蓝绿色或绿松石色与橙色或品红搭配。这反应了一种在Instagram上继而在整个互联网上流行起来的审美趣味，这种喜好很可能在训练数据中得到了充分体现。（现代的智能手机相机同样也让高动态范围照片充斥网络。智能手机通过以不同曝光度拍摄多张图像，再将它们拼合在一起，而达成这种效果。）

随着AI模型的更新升级，它们的作品也会发生变化。Midjourney的创始人兼老板大卫·霍尔兹（David Holz）反对存在单一AI风格的观点。他说，今年3月发布的Midjourney最新版本克制了上一版本的某些倾向。“在过去的12个月里，我们图片的风格已经发生了五次根本性的变化，在相当长一段时间内还会继续变化。”霍尔茨坚称。“人们想要多样性。”

在模型不断发展和改进的过程中，它们仍将依赖于人类生成的训练数据。伦敦皇家艺术学院（Royal College of Art）摄影专业负责人詹姆斯·库普（James Coupe）表示：“从来没有什么艺术藏品是中性的。”他正在该机构建立一个AI实验室。“一个社会的意识形态建设和政治承诺不断变化，而图像档案就是其索引。”而不管训练数据是什么样，“我们终究会得到某种为最多人接受的艺术风格。”他将AI生成的图像与1990年代两位俄罗斯概念艺术家维塔利·科马尔（Vitaly Komar）和亚历山大·梅拉米德（Alexander Melamid）的一个项目作比。这两位艺术家调查了14个国家的大众品味，并根据调查结果制作了艺术品。几乎人人都喜欢平庸的19世

纪风格的风景画。

生成式AI模型正通过识别和浓缩训练数据中的流行风格来发挥类似的作用。迈耶认为，它们总结视觉风格或时代特色的能力可能会使它们成为艺术史学家强有力的分析工具。正如他所说，它们的弱点和优势都在于它们是“平庸套路的探测器”。 ■



The robotic school

Art made by artificial intelligence is developing a style of its own

AI models not only reflect but magnify what they see in the images they are fed

FIRST PRIZE in the creative category of this year's Sony World Photography Awards was presented in April to Boris Eldagsen, who impressed judges with his ethereal, vintage-style portrait of two women in black and white. Mr Eldagsen, however, turned down the prize and revealed that his image had been created not by a camera but by artificial intelligence (AI). The German artist said he had "applied as a cheeky monkey", to see if he could fool the panel.

"Generative" AI models make convincing mimics, whether they are producing vintage portraits or more modern images—like a purported photo of the pope in an improbable Balenciaga puffer jacket, which recently tricked half of Twitter. Yet their ability to produce original work is less clear. "AI art has so far been exceptionally trivial," a columnist in the Art Newspaper recently huffed. It is intrinsically derivative, based on the millions of training images that are consumed, digested and regurgitated to order. "Plagiarism is a feature of the AI process," declared the Writers Guild of America, one of many creative-workers' unions that sees generative AI models as mere copycats.

Perhaps so. Yet there are signs that AI models are developing an artistic style of their own—and not just in drawing hands with more than five digits, as was common in their early output. By identifying and accentuating the patterns they see in their training data, generative models are not so much mirrors of contemporary styles as they are magnifying lenses. Slowly, a robotic school of artwork is emerging.

Computers have been making art for some time. Five years ago Christie's auctioned its first work created by artificial intelligence, "Edmond de Belamy", a blurry approximation of an 18th-century oil painting. Despite being unfinished and faintly alien-looking, the novelty fetched \$432,500. "It may not have been painted by a man in a powdered wig," Christie's said, "but it is exactly the kind of artwork we have been selling for 250 years."

Technology has since come far. Open platforms such as Midjourney and DALL-E generate images in seconds based on simple written prompts. No artistic skill is required, though there is a knack to getting good results. "The image I produce isn't my work. My work is the prompt," says Nick St Pierre, a designer in New York who got into AI last year when he saw it coming for his job. The image above, which he made using Midjourney, took hundreds of iterations, ending up with this prompt:

35mm, 1990s action film still, close-up of a bearded man browsing for bottles inside a liquor store. WATCH OUT BEHIND YOU!!! (background action occurs)...a white benz truck crashes through a store window, exploding into the background...broken glass flies everywhere, flaming debris sparkles light the neon night, 90s CGI, gritty realism

The ability to order any image in any style, from action movies of the 1990s to papal paparazzi shots, seems incompatible with the idea of a distinctive AI look. Yet certain traits seem to predominate. One is nostalgia. The ability of AI models to recreate the styles they have been fed makes them adept at simulating the look of old media, or sometimes recreating past events in modern guise. One recent viral series imagined modern-day selfies taken in pre-modern times, with Vikings or cavemen grinning for the camera.

As in previous eras of art, the prevailing subject matter is determined by whoever commissions the work. Western galleries groan with pictures of rich white men and their property, not because they looked good in oil

paint but because these were the themes dearest to the hearts of patrons. Midjourney's output is big on anime warrior princesses for the same reason.

AI models seem to favour particular techniques, too. Examining images produced by Midjourney earlier this year, Roland Meyer, a researcher at Ruhr University Bochum in Germany, noticed a common look. Many would "shine and sparkle, as if illuminated from within". They combined this distinctive lighting with a colour palette that contrasted warm earthy tones with blue or green metallic ones. Many also displayed what photographers call "high dynamic range", meaning a wide variation in light levels within the image, with pools of deep shadow and other areas brightly lit.

These traits are not coincidental. Mr Meyer attributes the distinctive "glow" to the way AI models handle lighting. Rather than using digital art techniques such as ray tracing, in which a computer calculates how light will fall on an object from a particular angle, AI imagines how things will look based on the images in its training data, which have been illuminated from many different angles. For this reason, even photo-realistic AI images seem to be lit in a way more akin to painting than to naturalistic photography, Mr Meyer says.

The favoured colour schemes, meanwhile, often pair teal or turquoise with orange or magenta. That reflects a taste popularised on Instagram and from there across the internet, which is likely to have been well-represented in training data. (High dynamic range has been made similarly ubiquitous online by modern smartphone cameras, which produce such effects by taking several images at different exposures and stitching them together.)

With updates to AI models come changes to their oeuvre. David Holz, the founder and boss of Midjourney, rejects the idea that there is a single AI style. The latest version of the program, released in March, has reined in some of the tendencies of the previous one, he says. "The look of our images

has radically changed five times now over the past 12 months and will continue to do so for quite some time," Mr Holtz insists. "People want diversity."

As the models evolve and improve, they will remain reliant on man-made training data. "No collection is ever neutral," says James Coupe, head of photography at the Royal College of Art in London, where he is setting up an AI lab. "Image archives are indexes of a society's changing ideological investments and political commitments." And whatever the training data, "we are going to end up with a style that is a kind of lowest common denominator of art." He compares AI-generated images to a project in the 1990s by a pair of Russian conceptual artists, Vitaly Komar and Alexander Melamid. They surveyed public tastes in 14 countries and produced artworks based on the results. Nearly everyone went for banal 19th-century-style landscapes.

By identifying and condensing prevailing styles in their training data, generative-AI models are playing a similar role. Mr Meyer thinks their ability to summarise visual styles or eras could make them powerful tools of analysis for art historians. Both their weakness and their strength is that, as he puts it, they are "cliché detectors". ■



巴托比

职场福利哪样好？

待福利衰退过后，福利复苏自会到来

当公司勒紧裤腰带时，首先砍掉的是非必要支出。Meta去年取消了员工的免费洗衣服务。谷歌在今年1月宣布的一轮裁员中裁掉了27名内部按摩理疗师。另一家科技公司Salesforce已经中止了与加州一家“健康疗养院”的合同，以前员工可以结伴去那里胡天胡地。砍掉这类福利的现象被称为“福利衰退”。虽然经济不景气时福利会被砍掉，但待到经济好转时又会回归。最终，你还是会读到谈论“福利复苏”的文章。那么，什么才是好的福利？

是否可有可无是关键之一。福利不像工资或医保计划，不能削减的就不是福利了。人们对非必要待遇的认知也可能随时间推移而不断变化。疫情前，能时不时在家工作算是一种福利。但如果现在谁还这么认为，那就是完全没跟上白领世界的巨大变化。同理，现在被砍掉的许多福利是为疫情前的世界设计的，那会儿员工都还要在拥挤的办公室里待上一整周。谷歌在3月提醒员工，公司正在重新研究零食吧和自助餐厅的服务，因为出勤模式已经改变。

很难知道哪些福利对员工更有价值。直接去问他们未必能得到好的答案。去年，软件公司Trusaic委托发起了一项投票调查，询问其美国员工希望得到什么福利，人气最高的答案是宿醉后的休假。有些福利在理论上让人非常向往，但在实践中却可能不大好办。包括高盛和奈飞在内的几家公司都吹嘘自己允许员工无限期休假。但其他公司已经放弃了这项政策，因为缺乏明确的规则让员工拿不准自己真能随性享受多少假期；有些人休假的时间反而比推行固定假期制度时还少。

福利应该强化公司文化，而不是被自己的文化抵消而形同虚设。如果公司给员工开的薪资普遍低于市场，就不该为他们提供理财咨询服务。如果公

司让员工一直工作到筋疲力尽，就不必再提供教人专注当下的“正念”课程。福利应该能鼓舞尽可能多的人。塞满高热量食品的零食柜在一些人眼中是甜蜜天堂，在另一些人看来却是肥胖地狱。如果一项福利会引发争议，恐怕就不太合适。

以何种方式来提供福利也很重要。行为经济学家理查德·塞勒（Richard Thaler）提出了心理账户的概念，描述人们如何在不同情境下赋予金钱不同的价值。例如，小件商品的折扣让人感觉划算，但给大件商品抹去相同的金额就没有同样的效果。与简单地派发福利相比，帮助员工为他们很不想花钱的东西买单也会更有效果。

在《混合信号》（Mixed Signals）这本关于激励的有趣的新书中，尤里·格尼兹（Uri Gneezy）描述了他与三名学者在新加坡进行的一个实验。出租车司机只要完成一定量的运动就可以得到奖励。一些司机得到100美元现金，另一些得以在他们极不情愿地向出租车公司缴纳的费用中减免同等数额的钱。事实证明，缴费减免对司机的激励作用要大得多。帮助员工支付宠物保险或偿还学生贷款的雇主也许真的找对了方向。

另外，能被注意到的福利更有效果。福利待遇若是随时随地唾手可得，员工可能很快就会习以为常。本杰瑞（Ben and Jerry's）的员工每天可享用三品脱冰淇淋和冻酸奶，这项福利也许不再让员工眼前一亮，但员工的体型却可能要让人眼前一黑。有时限的季节性福利是个好办法：例如，一些公司让员工在夏季的周五下午提前下班。夏天白天长、天气炎热，这种福利可能有助于留住优秀员工。

任何雇主都不该错将福利与员工真正重视的事物混为一谈。关于员工最看重什么的研究揭示了同样的重点：有趣的工作，上司的认可，满意的工资。至于办公环境，像自然光照这样的基本条件也比按摩更重要。但福利可以起到一些辅助作用。如果你打算大撒福利，诀窍就是找到一些非必要却有意义的东西。 ■



Bartleby

What makes a good office perk?

After the perkcession ends, a perkcovery will surely follow

WHEN COMPANIES tighten their belts, they look first to discretionary spending. Meta got rid of free laundry for its workers last year. In January Google announced a round of lay-offs that included 27 in-house massage therapists. Salesforce, another tech firm, has axed its contract with a Californian “wellness retreat”, where employees would have done God-knobs-what with each other. The chopping of such benefits has been christened the “perkcession”. But just as perks get cut in bad times, so they return in the good. Eventually you can expect to read articles about a “perkcovery”. What makes a good perk?

Dispensability is part of the point. This is not like a salary or a health-care plan; if it cannot be cut, it is not a perk. Views on what counts as a discretionary benefit can shift over time. Before the pandemic being allowed to work from home every so often was seen as a perk. Anyone who still describes it that way has failed to grasp how much the world has changed for white-collar workers. By the same token many of the perks that are now being cut were designed for a pre-pandemic world of long weeks in full offices. In March Google warned that services at snack bars and cafeterias were being reviewed because attendance patterns had changed.

Working out which perks are valuable to workers is hard. Asking employees may not always yield good answers. A poll conducted last year for Trusaic, a software firm, asked American workers what perks they would like to see introduced: the top answer was hangover leave. Perks that sound great in theory may not work out that well in practice. Several firms, Goldman Sachs and Netflix among them, tout the fact that they offer members of

staff unlimited holidays. But other companies have abandoned the policy because the absence of clear rules leaves employees unsure how much time they can really take off; some take less than they did under a fixed allocation of vacation days.

Perks should reinforce a culture, not be undermined by it. Firms should not be offering employees access to advice on financial well-being if they pay worse than everyone else. They should not be touting mindfulness courses if they expect employees to work until they drop from exhaustion. And perks should be motivating to the widest possible group. Snack cupboards filled with calorific goodies are some people's version of a sugary paradise, and others' idea of obesogenic hell. If your perk is a source of controversy, it's probably not right.

The framing of a perk matters, too. Mental accounting is a concept that was coined by Richard Thaler, a behavioural economist, to describe how people put different values on money depending on context. A discount on a small purchase feels more significant than the same amount off a big-ticket item, for example. Helping people with things they resent paying for can also be more effective than doling out treats.

In "Mixed Signals", an enjoyable new book on incentives, Uri Gneezy describes an experiment he conducted with three academics in Singapore, in which taxi drivers there were rewarded if they did a certain amount of exercise. Some drivers were given \$100 in cash and others were given a credit equal to the value of a much-disliked rental fee they had to pay to the firm that owned the taxi. The rental credit proved much more motivating to drivers. Employers who offer help with pet insurance or student-loan debt repayments may be onto something.

Perks also work best if they are noticed. Employees can quickly become habituated to something that is unvaryingly available. Ben and Jerry's offers

its staff three pints of ice cream and frozen yogurt a day; that risks being a benefit which fades into the background, even if its employees are less likely to. Time-limited seasonal benefits are a good answer to this: some firms let their people knock off early on Friday afternoons during the summer, for example. By the time the days lengthen and the weather warms, that perk might help to keep good employees in their posts.

No employer should mistake perks for the things that really matter to their staff. Research into what workers value most reveals the same priorities: stimulating work, being recognised by their managers, good wages. When it comes to office environments, too, basics like natural light count for more than a massage. But perks can help at the margins. If you are going to dole them out, the trick is to find something that is both discretionary and meaningful. ■



中国特色电影

好莱坞正败走中国

国产电影的崛起抵挡了西方文化的影响

一九八六年，法国哲学家雷吉斯·德布雷（Régis Debray）写道：“摇滚乐、录像带、牛仔裤……蕴藏的力量，比整个苏联红军都大。”人们普遍认为，西方的音乐、电影等文化输出传递的软实力对苏联解体起到了助推作用。如今人们正在把中美关系和冷战相提并论，中国领导人迫切希望取代西方的影响。“当今世界，要说哪个国家能够（文化）自信的话，”中国国家主席习近平曾说，中国“是最有理由自信的”。

虽然软实力很难衡量，但观影偏好方面的数据可以揭示它的走向。社交网站豆瓣上的影评显示，在中国国内市场，天平正朝着习乐见的一边倾斜。过去十年里，西方电影在中国的观看量占比看起来已然下降。

豆瓣是中国的一个影评网站。尽管中国每年只允许电影院公映34部外国电影，但豆瓣用户已经给上万部外国电影打分——想来看的是盗版片。

豆瓣列出了2010至2022年间制作的2.6万部电影，我们下载了所有这些电影的评分和观看量。在这一整个时期，英语国家制作的英语电影总共占到所记录观看量的43%。中国电影排名第二，占36%，接下来是日本（6%）和韩国（5%）电影。

然而，这些数字在此期间经历了很大的变化。从2010年到2021年，中国电影的观看比例从21%上升到55%，而英语电影则从53%下降到28%。之所以有这样的变化，主要是由于每部中国电影的观看量激增，而不是因为列出的中国电影数量增加。（2022年，由于新冠清零政策限制了电影制作，中国电影的观看量占比下降，但接下来应该还会恢复到疫情前的水平。）

观看量的上升主要来自热门影片：2021年，观看量居前2%的中国电影占到总观看量的22%，而2010年这一比例为10%。其中有些电影带有明显的

民族主义，甚至近乎政治宣传。《战狼2》是中国有史以来票房第二高的电影，讲述了一名前特种部队士兵在非洲与一个残酷的美国雇佣兵头目作战的故事。电影中的经典台词是“犯我中华者，虽远必诛”。

并不是所有中国电影剧本都这么用力过猛。豆瓣用户所看的中国电影虽然越来越多，但并没有对它们赞叹不已。这些年里国产电影的平均评分在下降，并且在五星评分上比英语电影低半颗星。虽然宣发、演员阵容或豆瓣用户行为变化等许多其他因素都可能影响评分和观看量，但从这样的低评分来看，尽管中国可能在自己国内顶住了西方的软实力，但其文化输出还没有准备好在海外赢得满堂彩。 ■



Film with Chinese characteristics

Hollywood is losing the battle for China

The rise of domestic cinema counters Western cultural influence

IN 1986 RÉGIS DEBRAY, a French philosopher, wrote that “there is more power in rock music, videos, blue jeans...than in the entire Red Army.” Western soft power, conveyed via cultural exports like music and cinema, is widely credited with helping to end the Soviet Union. Now that relations between China and America are eliciting cold-war comparisons, Chinese leaders are eager to displace Western influence. “Of all the nations in the world,” Xi Jinping, China’s president, has said, China “has the most reasons to be culturally confident.”

Soft power is hard to measure, but data on viewing preferences can reveal which way it is trending. And film reviews on Douban, a social network, suggest that in China’s domestic market, the scales are tipping in Mr Xi’s favour. During the past decade, Western cinema’s share of viewership in China appears to have declined.

Douban is a Chinese site where users can review films. Although China lets cinemas show just 34 foreign titles per year, users have rated thousands of foreign films, presumably using pirated versions.

We downloaded scores and view counts for all 26,000 films listed on Douban produced in 2010-22. Over this period, “Anglo” films—in English, from English-speaking countries—made up 43% of recorded views. China ranked second, at 36%, followed by Japan (6%) and South Korea (5%).

However, these figures have changed sharply over time. From 2010 to 2021, China’s share rose from 21% to 55%, while that of Anglo films fell from 53% to 28%. This shift was mainly due to a surge in the number of views each

Chinese film receives, rather than to an increase in the number of Chinese titles listed. (In 2022 China's shares dipped because its zero-covid policy limited film production, but its numbers are likely to return to prior levels.)

Much of the rise in viewership came from blockbusters: the most-viewed 2% of Chinese films accounted for 22% of total views in 2021, compared with 10% in 2010. Some are overtly nationalistic and border on propaganda. “Wolf Warrior 2”, China’s second-highest-grossing film ever, chronicles a former special-operations soldier doing battle in Africa with a ruthless American mercenary leader. Its tagline was “anyone who offends China, no matter how remote, must be exterminated.”

Not all Chinese scripts are so heavy-handed. But Douban users are not impressed by the growing number of domestic films they watch. Local titles’ average rating has fallen over time, and is half a star lower on a five-star scale than that of Anglo films. Many other factors, such as marketing, casts or changes in Douban users’ behaviour, could affect ratings and view counts. But such poor scores suggest that although China may be fending off Western soft power at home, its cultural exports are not ready to gain traction abroad. ■



梧桐

如何投资人工智能

是投资未上市的创业公司还是公开市场？

对押注科技公司的投资者来说，过去这18个月可谓异常艰难。日本投资公司软银（SoftBank）仍在承受利率走高、公司估值走低的转变带来的痛苦，尽管它曾是2010年代风险投资热潮的代表，为追求快速扩张的公司提供资本。不过在其个人魅力十足的创始人孙正义的执掌下，这家公司正对一个领域跃跃欲试：投资人工智能（AI）。

ChatGPT等生成式AI平台取得的进展让几乎所有投资者都在讨论该如何理解和看待这个新兴行业，以及它可能会给哪些公司带来转机。孙正义认为它与互联网早期有相似之处。生成式AI可能会带来新一批上市公司，并为下一代超高市值科技公司的诞生打下基础。

投资者面临两个问题。首先是哪些前沿技术会让市场领先者大赚一笔。这已然是个难题。第二是谁会获取前沿技术带来的价值，是风险资本支持的创业公司，还是老牌科技巨头？这个问题也不比前一个简单。没有人知道是拥有最先进的聊天机器人好，还是拥有大量的客户好——在一项创新技术上占得先机与能够从中赚钱是两码事。事实上，革命性创新的许多价值往往被老牌巨头获取。

Alphabet、亚马逊和Meta位居美国市值最高的七家公司之列，三者的总市值达3.4万亿美元。它们成立于1994年至2004年间，兴起时正值互联网技术刚刚起步，人们在网上花的时间越来越多。中国电子商务巨头阿里巴巴的情况也类似（软银在阿里巴巴发展初期以2000万美元入股，巩固了孙正义作为投资者的声名）。看准技术趋势，同时开发最好的平台——这样的操作为早期（甚至不算很早期）的投资者带来了巨大价值。传统公司很难跟上潮流。

这一回的故事也会是这么书写吗？管理学大师克莱顿·克里斯滕森

(Clayton Christensen) 在互联网巨头刚刚崭露头角时就率先提出了一个创新理论，可以为我们提供有用的指导。他指出，小公司往往能在老牌巨头们绕着走的低端或者全新市场打开局面。这些老牌巨头通常专注于为现有客户和业务线部署新技术。它们并非能力不济或对技术进步一无所知，而是从利润最大化的角度来走一条看似正确的道路。等到反应过来却为时已晚，根基受损。

像孙正义这样为AI创业公司的前景振奋的投资者自然是觉得一个颠覆性创新的时代正在到来。但是，近来人们对生成式AI平台的兴奋之情大多聚焦于它们有潜力成为一项可部署的新技术，而不是催生可能开辟全新市场的公司。在近年的其他技术创新方面，老牌企业占得了上风。风险投资家埃拉德·吉尔（Elad Gil）指出，之前在范围更广的机器学习（生成式AI是其中一部分）领域取得的进展，其价值几乎全部归了老牌企业。早期互联网创业公司从中受益，微软以及英伟达、美光等芯片公司也得到了好处。机器学习的早期阶段并没有在各个利基市场里造就堪比亚马逊或谷歌的上市公司。

克里斯滕森的见解清楚地表明，革命性的技术创新最终并不总在商业上具有革命性。不过，老牌科技公司目前正在AI上投入巨资，这表明如果AI技术最终真的能革新商业，它们应该处于有利地位。如果对跟踪现有上市科技公司的广义指数基金和只专注于AI的非上市创业公司分别做等量投资，前者的回报可能最终会超过后者。

创新的颠覆性为什么时有时无？对其中缘由做讨论的往往多是商科和管理学学生，而不是选股者。但弄清创新是否具有颠覆性，对于评估目前尚未上市的AI公司中是否会出现市值数千亿美元的下一代上市科技公司至关重要。就目前情况来看，AI技术的市场价值最终似乎更有可能为现有科技巨头锦上添花。 ■



Buttonwood

How to invest in artificial intelligence

Private startups or public markets?

IT HAS BEEN a torrid 18 months for investors who bet on tech. SoftBank, a Japanese investment firm that epitomised the 2010s boom in venture capital for companies with rapid-growth ambitions, is still smarting from the shift to a world of higher interest rates and lower corporate valuations. But there is one area in which the firm, run by Son Masayoshi, its charismatic founder, wants to peek above the parapet: investments in artificial intelligence (AI).

The advances of generative-AI platforms, such as ChatGPT, have left just about every investor discussing what to make of the incipient industry, and which firms it might upturn. Mr Son sees parallels with the early period of the internet. Generative AI could provide a new pipeline of initial public offerings—and the foundation for the next generation of mega-cap tech firms.

Investors face two questions. The first is which frontier technologies will make market leaders a fortune. That is difficult enough. The second, establishing whether the value will accrue to upstarts backed by venture capital or existing technology giants, is at least as tricky. Nobody knows if it is better to have the best chatbot or plenty of customers—having a head start in a whizzy new tech is not the same as being able to make money from it. Indeed, lots of the value of revolutionary innovation is often captured by existing giants.

Alphabet, Amazon and Meta are three of the seven largest listed companies in America, worth a combined \$3.4trn. They were founded between 1994

and 2004, emerging at a time when internet technology was new and people were spending an increasing amount of time online. Alibaba, a Chinese e-commerce giant, is another similar example (SoftBank's early \$20m stake in the company helped cement Mr Son's reputation as an investor). Spotting tech trends, and developing the best platforms, generated a gargantuan amount of value for early and even not-so-early investors. Legacy firms struggled to jump on the bandwagon.

Will the story be the same this time around? The insights of Clayton Christensen, a management guru who pioneered a theory of innovation just as the internet giants were bursting onto the scene, can provide a useful guide. Christensen noted that smaller companies often gain traction in low-end markets and entirely new ones, which the largest incumbents eschew. The incumbents focus on deploying new technology for their existing customers and lines of business. They are not incompetent or ignorant of technological progress. Instead, they follow the seemingly correct path from a profit-maximising perspective—until it is too late and they are fatally undermined.

Investors like Mr Son, excited about the future of startups that focus on AI, are implicitly presuming that a period of disruptive innovation is under way. But most of the recent excitement about generative-AI platforms has focused on their potential as a new technology to be deployed, not as companies which could open up brand new markets. In the case of other recent technological innovations, incumbents have won the day. Elad Gil, a venture capitalist, has noted that the value of previous advances in machine learning, the broader category of which generative AI is a part, have accrued almost entirely to incumbents. The early internet startups have benefited, as have Microsoft and chip firms like Nvidia and Micron. The earlier stages of machine learning produced no listed firms that might be considered the Amazon or Google of their niche.

Christensen's insights make clear that revolutionary innovation does not always end up being revolutionary in business terms. Yet existing tech firms are now spending enormous sums on AI, suggesting they should be well-placed if the tech does turn out to revolutionise business. It is possible an investment in a broad index fund tracking existing listed tech firms will end up outperforming the equivalent investment in private, strictly AI-focused startups.

Theories about why innovation is sometimes disruptive and sometimes not are more often discussed by students of business and management than stockpickers. But the difference between the two possibilities is crucial in assessing whether the next generation of listed tech companies, with market capitalisations in the hundreds of billions of dollars, is to be found among private AI firms. As things stand, it looks more likely that the market value of the technology will end up as a new string to the bow of already giant tech firms. ■



虫饲牛肉

啤酒废料变牛肉？昆虫来帮忙

人不喜欢吃昆虫。牲畜就没那么挑食了【新知】

有些想法一直没有真正流行起来，吃昆虫就是其中之一。尽管联合国十年前就认可了这一想法，但至少在西方，昆虫基本上还是没有摆上超市货架。面对对此不感兴趣甚至感到恶心的民众，科学家们一直在探索其他选择。一个选项是把昆虫喂给不像人那么挑食的牲畜。

当然，昆虫自己也需要吃东西。到目前为止，人们大多用鸡吃剩的饲料来喂养昆虫。但这种饲料供应有限，如果要让用昆虫饲养家禽这一产业蓬勃发展，就需要新的饲料来源。丹麦的奥尔堡大学（Aalborg University）的生物化学家尼尔斯·埃里克森（Niels Eriksen）在《应用昆虫学》（Applied Entomology）上发表了一篇论文，建议用酿啤酒的废料喂养昆虫。

全世界每年消费约1850亿升啤酒。每酿造一升啤酒会产生三到十升废水，其中充满废弃的大麦和酵母。这种混合物富含蛋白质，但缺乏碳水化合物——尤其与鸡饲料相比。大多数可用作饲料的昆虫在野生环境中都靠腐败水果中的碳水化合物生长。因此，不清楚昆虫是否真的会把啤酒废料当作丰盛美食。

研究人员使用了黑水虻的幼虫，它们是“昆虫修复”领域的主力军。这些幼虫被分成三组，分别喂给它们啤酒废料、鸡饲料，以及两者的混合物。研究人员监测了它们的体重增长以及呼出的二氧化碳量，这有助于评估它们的代谢情况。

这些幼虫不论是啤酒废料还是鸡饲料都吃得很欢，并且不管吃的是其中哪种，都长得同样好。埃里克森把一些昆虫碾碎并对得到的糊状物进行化学分析。他发现对于牲畜而言，不同组别的昆虫的营养价值几乎没有差别。这一结果证实了埃里克森的一个直觉。虽然黑水虻幼虫在野生环境下喜欢

吃腐败水果，但它们也可以吃腐肉。和啤酒废料一样，腐肉也富含蛋白质，且碳水化合物含量低。

这项实验的影响可能不止于酿酒业。屠宰场的骨粉、甜菜废料以及其他发酵工业（比如生产生物乙醇）的废料都同样供应充足且富含蛋白质。现在看来，所有这些似乎都可以被用于通过昆虫做养分循环。不过，消费者是否愿意吃“虫饲牛肉”还需拭目以待。 ■



Bug-fed steak

Insects could help turn beer waste into beef

People do not like eating insects. Livestock are less picky

EATING INSECTS is one of those ideas that never quite seems to catch on. The United Nations endorsed the idea a decade ago, but, in the West at least, bugs remain mostly absent from supermarket shelves. Faced with an indifferent—or disgusted—public, scientists have been exploring other options. One is to feed the insects instead to livestock, which are not so picky.

Of course, the insects need to eat, too. To date, they have mostly been reared on leftover chicken feed. But the supply of that is limited, and if insect-reared meat is to take off, new sources will be needed. In a paper in Applied Entomology, Niels Eriksen, a biochemist at Aalborg University, suggests feeding them on the waste products of the beer industry.

The world knocks back around 185bn litres of beer every year. Each litre produces between three and ten litres of wastewater full of discarded barley and yeast . The mix is rich in protein but deficient in carbohydrates, especially compared with chicken feed. Most insects grown for feed depend, in the wild, on the carbohydrates found in rotting fruit. Whether insects would actually consider brewery waste a square meal was, therefore, unclear.

The researchers used the larvae of the black soldier fly, a workhorse of the “entomoremediation” world. The juvenile insects were divided into three groups, which were offered beer waste, chicken feed or a mixture of both. The researchers monitored both their weight gain and the amount of carbon dioxide they exhaled, which helped assess the insects’ metabolic

performance.

The larvae happily consumed both brewery waste and chicken feed, and grew equally well on either food source. When Dr Eriksen ground some up and chemically analysed the resulting paste, he found few differences in how nutritious the insects would be to farm animals. The results confirmed one of Dr Eriksen's hunches. Although black soldier fly larvae favour rotting fruit in the wild, they are capable of eating carrion too. Like beer waste, it too is rich in protein and low in carbohydrates.

The experiment may have implications beyond the brewing business, too. Bone meal from slaughterhouses, sugar-beet waste and waste from other fermentation industries (such as those that produce bioethanol) are all likewise plentiful and protein-rich. All now look to be reasonable targets for nutrient recycling by insects. Whether consumers will be willing to eat insect-reared beef, though, remains to be seen. ■



DNA的天罗地网

人类到处播撒遗传信息

凭借这些信息足以轻松识别个人【新知】

在基因时代，有两件事大大便利了生态学家的工作。一是每个有机体都有自己的化学身份证件，也就是它们的基因组。二是它们在经过的每个地方都会留下这些身份证件。尿液、粘在树篱上的皮毛，甚至脱落的皮肤细胞——所有这些都把DNA沉积到环境中。低成本的基因测序让科学家能够从土壤、沙子、水之类的地方收集这种“环境DNA”（eDNA），并且用它来跟踪物种生活的地点。

“每个有机体”当然也包括人类。在5月15日发表在《自然——生态与进化》（Nature Ecology & Evolution）期刊上的一篇论文中，来自美国和欧洲的一批研究人员报告说，这种eDNA调查也收集到了大量的人类DNA。任何拥有合适设备的人都可以读取这些DNA，并且有可能匹配到个人。

这些研究人员的初衷并不是研究这种他们称之为“人类基因混获”的现象。这项研究工作始于佛罗里达州的惠特尼海龟医院（Witney Sea Turtle Hospital），当时是在调查一种海龟的病毒性疾病。研究人员从海龟的养殖箱里提取水的样本，也从海龟筑巢的海水和海滩上取样，寻找病毒DNA。

他们知道会把其他物种的DNA也一并打捞上来。但没想到会发现如此大量的人类DNA，惠特尼医院的生物学家、该论文的作者之一杰西卡·法雷尔（Jessica Farrell）说。尽管许多采样地点并不靠近城镇，但在他们查看的每个样本中都发现了人类遗传物质。

出于好奇，他们扩大了搜索范围。在佛罗里达和爱尔兰，他们都在河流中发现了人类DNA，而在流经城镇的河段中，人类DNA的浓度尤其高。他们在沙滩上发现了人类DNA，甚至在有人工作过的房间的空气里也有。人类DNA也并非无处不在：在深海中、远离人烟的海滩上就检测不到。但只要

有人的地方，似乎就有人类的DNA。

从某种意义上说，这并不奇怪。但随着基因测序技术的进步，靠样本中的信息足以推断出能对应到个人的很多事情。因为有来自Y染色体的DNA，研究人员可以从中识别出男性。他们可以推断出一个人的祖先，甚至发现影响疾病易感性的突变。该论文的另一位作者大卫·达菲（David Duffy）说，他们找到的DNA的数量和质量“远远超过”被纳入美国失踪人口数据库的最低要求。出于道德原因，达菲和他的同事们没有在研究中识别个人。但他们毫不怀疑这是可以做到的。

所有这些都提出了让人不安的问题。最直接的问题可能事关科学家自身。大多数国家对采集人类DNA的规定都远比对其他DNA严格。如果研究海龟或任何其他有机体的eDNA也难免会收集到人类遗传信息，生态学家将不得不更加小心地对待手中的数据。

更长远来说，研究人员猜想了一种各样的用途。警察可能会通过全面检查房间空气来帮助确定犯罪嫌疑人的行踪。在新冠疫情的推动下，许多国家开始监测废水中的基因来追踪病毒。研究人类DNA，尤其是具体到街道的水平，可能带来医疗健康方面的益处，比如快速发现人们基因组中的致癌突变。它还可以让政府建立起详尽到令人不安的人口状况资料。

就目前而言，这一切似乎都是异想天开。但自世纪之交以来，基因组测序的成本已经下降到之前的十万分之一。想要投机式地分析遍布环境中的人类DNA只会变得越来越便宜、越来越容易。生态学家可以证明，它为人类提供了另一种手段来追踪他们的同类究竟是谁——以及他们在搞什么名堂。 ■



The DNA dragnet

Humans shed genetic information everywhere they go

There is enough of it to easily identify individuals

IN THE GENETIC age, ecologists' jobs are made much easier by two things. One is that every organism carries its own chemical identity card, in the form of its genome. The second is that they drop these ID cards everywhere they go. Urine, bits of fur stuck to a hedge, even shed skin cells: all deposit DNA into the environment. Cheap gene sequencing allows scientists to harvest this "environmental DNA" (eDNA) from soil, sand, water and the like, and use it to keep track of which species are living where.

"Every organism," of course, includes humans. In a paper published on May 15th in *Nature Ecology & Evolution*, a group of researchers from America and Europe report that such eDNA surveys pick up large quantities of human DNA too. That DNA can be read—and potentially matched with individuals—by anyone with the right equipment.

The researchers did not set out to study "inadvertent human genetic bycatch", as they call the phenomenon. The work began at the Witney Sea Turtle Hospital in Florida, during an investigation into a viral turtle disease. The researchers sampled water from the turtle's tanks, as well as from ocean water and beaches upon which the creatures nested, looking for viral DNA.

They expected to sweep up DNA from other species during their trawl. What was surprising, according to Jessica Farrell, a biologist at the Witney Hospital and one of the paper's authors, was just how much human DNA they found. Even though many of their sampling sites were not near towns and cities, they found human genetic material in every sample they examined.

Intrigued, they expanded their search. In both Florida and in Ireland they found human DNA in rivers, with concentrations especially high as they flowed through towns. They found it in beach sand, and even in air from rooms in which humans had been working. Human DNA is not quite everywhere: it was not detectable in deep-ocean water, or on remote beaches closed to the public. But anywhere that humans are, their DNA appears to be as well.

In one sense, that is unsurprising. But advances in gene-sequencing meant there was enough information in the samples to deduce plenty of things about the humans in question. The researchers could pick out males thanks to DNA from the Y chromosome. They could infer an individual's ancestry, and even spot mutations that affect susceptibility to disease. David Duffy, another of the paper's authors, said the amount and quality of the DNA they recovered "far exceeded" the minimum necessary to be included in America's database of missing people. Dr Duffy and his colleagues did not try to identify individuals in their study, for ethical reasons. But they had no doubt it could be done.

All this raises uncomfortable questions. The most immediate probably apply to scientists themselves. Most countries have far stricter rules governing the collection of human DNA than of other sorts. If studying eDNA in turtles—or any other organism—necessarily involves gathering human genetic information too, ecologists will have to be more careful with their data.

In the longer run, the researchers speculate about all sorts of uses. Police might trawl room air to help establish a crime suspect's movements. Prompted by covid-19, many countries are beginning to use genetic surveillance of waste-water to track viruses. Crunching the human DNA too, especially at the level of individual streets, might have health benefits, such as quickly spotting cancer-causing mutations in people's genomes. It could

also allow governments to build up uncomfortably detailed pictures of their populations.

For now, all that may seem fanciful. But the cost of genome sequencing has fallen a hundred-thousand-fold since the turn of the century. Opportunistically analysing the human DNA that suffuses the environment is only going to get cheaper and easier. As the ecologists can attest, it offers another way for humans to keep track of who, exactly, their fellow humans are—and what they are up to. ■



气味影像2.0

如何把气味带入元宇宙

VR爱好者开始关注一种引人遐思但被忽视的感官感受【新知】

这是众多一直没能真正成功的发明之一。1960年，观看电影《神秘香气》（Scent of Mystery）的观众体验到了“气味影像”（Smell-O-Vision）的神奇之处。这套系统安装在电影院的座位下方，在剧情的紧要时刻释放出30种不同的气味，包括咸咸的海风和葡萄酒香。但它不是那么好用。坐在楼上包厢的观众抱怨气味传来得太晚。其他人感觉气味太淡，或者是恼人地久久不散。新颖有余但效果不佳，“气味影像”从未在好莱坞真正扎根。

今时今日，位居娱乐最前沿的是电子游戏和虚拟现实（VR）而非电影。目前有几个研究团队正尝试把气味引入虚拟世界。香港城市大学的于欣格和北京航空航天大学的李宇航本月稍早时在《自然-通讯》（Nature Communications）上发表了一篇论文，介绍了两种可穿戴的“嗅觉界面”：第一种大小如创可贴，可以贴在用户鼻子下方的皮肤上，像一撇假胡子；第二种功能更强，是个可灵活调节的面罩。

两者都通过加热已浸渍各种香水的石蜡片发挥作用。该系统的低配版含有两块这类石蜡片，高配版有九块。研究人员称，它们可在短短1.44秒内生成一种香味，如薄荷味或绿茶味。面罩上的九块石蜡片可以混合作用，生成数百种气味。

在把研究成果推向市场方面，佛蒙特州的创业公司OVR比李宇航和于欣格更快一步。该公司的头戴设备使用了一套可以重复充装的气味盒系统，可以制造数千种气味。其最新产品“ION3”将于今年晚些时候发布，能极其便捷地与现有游戏创作工具结合起来。

能产生合适的气味可以使虚拟世界更引人入胜。众所周知，气味引人遐思。在人的大脑中，处理气味的区域与处理情感和记忆的区域直接相连。

但所涉科学原理颇棘手。颜色波长或声音频率的混合可预测，气味则没那么简单。只要改变一个化学键，气味就会从甜变酸臭。气味VR的发展是否会好过气味电影，还有待观察。但也许有一天，用户可以暂停画面，滑动屏幕，闻一闻虚拟玫瑰的香气。 ■



Smell-O-Vision 2.0

How to bring scents to the metaverse

VR enthusiasts turn their attentions to an evocative, but neglected, sense

IT WAS one of those many inventions that never quite took off. In 1960, audiences watching the film “Scent of Mystery” got to experience the wonders of “Smell-O-Vision”. Mounted under the cinema seats, the system pumped out 30 different scents—from salty ocean breezes to whiffs of wine—at crucial moments in the plot. The system had its quirks. Those in the balcony complained that the smells reached them too late. Others found the scents to be too faint, or else irritatingly persistent. More novel than effective, Smell-O-Vision never really took root in Hollywood.

These days the cutting-edge of entertainment is video games and virtual reality, not films. Several groups are trying to bring scents to virtual worlds. In one paper published earlier this month in *Nature Communications*, Xinge Yu at City University of Hong Kong and Yuhang Li at Beihang University describe two wearable “olfaction interfaces”. The first is the size of a plaster, and is affixed to the skin, like a fake moustache, under the user’s nose. The second, more capable version is a flexible face mask.

Both rely on heating tiny tiles of paraffin wax that have been impregnated with various liquid perfumes. The smaller version of the system uses two such tiles; the bigger one has nine. The researchers claim that they can generate a scent, such as mint or green tea, in as little as 1.44 seconds. The nine generators on the mask can combine to produce hundreds of possible odours.

Drs Li and Yu have been beaten to market by OVR, a startup based in Vermont. Its headset uses a system of refillable cartridges, each of which

can make thousands of scents. The firm's newest product, the "ION3", will be released later this year, and can be tied into existing game-creation tools with minimal fuss.

Getting smells right could make virtual worlds more compelling. Odours are famously evocative. The part of the brain that processes them connects directly to parts associated with emotions and memory. But the science is tricky. Unlike colour or sound, where wavelengths and frequencies combine in predictable ways, smell is not so straightforward. Altering a single chemical bond can shift a scent from sweet to rancid. Whether smelly VR will do better than smelly films remains to be seen. But perhaps one day users will be able to stop, swipe and smell the virtual roses. ■



山峦起伏

中国经济多久会见顶，顶点又会有多高？

对人口、生产率和价格的不同假设会导致不同的估算【深度】

中国经济今年已经从新冠“清零”政策带来的封锁、隔离和其他限制中解脱。但中国并没有摆脱对其经济增长更长远前景的担忧。中国的人口在缩减。它史诗般的房地产繁荣期已经结束。党对电子商务公司的监管打击吓坏了那些它曾经奉为上宾的科技亿万富翁。曾当过教师、后来成为中国最著名企业家之一的马云又回到了讲台上——不过是在日本。

如今在党眼里，安全重于繁荣，形象重于增长，坚定的自力更生重于千丝万缕、微妙脆弱的相互依存——而正是这种相互依存成就了中国经济昔日的成功。外国投资者现在变得更加谨慎，设法把供应链迁离中国或至少让它分散多元化。美国也在竭力限制中国获得一些“基础技术”。互惠互利的经济关系已经被互相猜忌的地缘政治取代。

所有这些让许多分析师一边上调了中国经济增长今年的预期，一边又下调了对它的长期预期。一些人发问，中国经济增速快于美国的情况还能再持续多久？这个问题的答案影响的远不止是工厂订单或个人收入。它将塑造世界秩序。

此前，无论是在中国国内还是国外，人们都一致认为中国经济将很快超过美国。这继而会让中国成为世界超级军事强国，并因此取代美国成为世界最强大的国家。现在这仍然是个普遍观点。北大知名经济学家姚洋认为，中国的GDP将在2029年之前超过美国。

但其他一些人认为，中国相对于其竞争对手的经济影响力已经接近峰值。美国两位政治学家哈尔·布兰兹（Hal Brands）和迈克尔·贝克利（Michael Beckley）认为，中国的崛起已经趋于停滞。他们所称的“中国见顶”时代已经逼近——而这个顶峰远远不如大多数人原来预测的那么宏伟。

2011年，高盛预测中国GDP将在2026年超过美国，并在本世纪中叶超出美国50%——当时没有显现见顶的迹象。去年年底，高盛重新审视了自己的预测。现在它认为中国经济要到2035年才会超过美国，并且在其鼎盛期也只会超过美国14%（见图表）。

澳大利亚智库洛伊研究所（Lowy Institute）的罗兰·拉贾（Roland Rajah）和甯淑仪（Alyssa Leng）去年所做的一项预测引发广泛反响，其中对中国峰值的预测看上去和高盛的类似。其他人则认为中国的巅峰甚至会更低。研究公司凯投宏观（Capital Economics）认为，中国经济永远不会成为世界第一。中国的经济规模会在2035年达到美国的90%，然后便开始萎缩。如果说有哪项预测最能代表“中国见顶”论，那就是它了。

是什么让人们降低了对中国经济的预期？预期降低多少比较合理？答案取决于三个变量：人口、生产率和价格。先说人口。根据官方统计数据，中国劳动力人口已经达到峰值。中国15到64岁的人口是美国的4.5倍。根据联合国的预测“中值”，这部分人口到本世纪中叶将只有美国的3.4倍。而到本世纪末将降至1.7倍。

但是，过去十年里中国的人口结构前景并没有发生太大变化，即便对中国经济增长的预测已经下调了。事实上，高盛的新预测对中国劳动力人口降幅的估计比之前的预测更温和，因为健康水平的改善或许可以延长年长员工的工作年限。高盛现在认为，从2025年到2050年，中国的劳动力供给将下降约7%。

对观点影响最大的变数不是人口，而是生产率。2011年时，高盛曾认为，未来20年，中国的劳动生产率将以平均每年约4.8%的速度增长。现在，高盛认为这一增速将在3%左右。凯投宏观的马克·威廉姆斯（Mark Williams）持类似观点。他表示，中国将走下“亚洲佼佼者的道路，转而走上一个相当不错的新兴经济体的道路”。

有充分的理由对中国的劳动生产率感到悲观。人口老龄化将令中国不得不把更多的经济力量投入到养老服务上，这会减少对新设备和产能的投资。

再者，经过几十年的快速资本积累，新投资的回报正在减少。例如，与京沪高铁相比，一条穿越西藏山区的新高铁线带来的收益要少得多，成本却要高得多。

中国当局正试图加强对各级地方政府的约束，中国很多值得商榷的基础设施都是地方政府建造的。遗憾的是，他们似乎同样热衷于把自己的意志强加给该国的民营企业。凯投宏观指出，不同于其他地方，在中国，企业规模越大，资产回报率越低，“达到一定规模后，企业既要考虑满足消费者的需求，也要费同样多的心思满足政府官员的需求”。

阻碍中国企业发展的不光是它们自己的政府。去年10月，美国对销售到中国的先进计算机芯片实施了管制。此举将损害中国的手机、医疗设备和汽车等制造企业。高盛并没有把这一损害计入其长期预测，但它估计这可能会令中国的GDP在这个十年末相比本可能的情况减少2%左右。

这场科技战可能会加码。国际货币基金组织的迭戈·塞代拉（Diego Cerdeiro）与他的合著者设想并研究了一种情境：美国削减自己与中国的技术贸易，并说服其他经合组织成员国效仿自己的做法，同时迫使经合组织以外的国家在这场科技战中选边站。在这种极端情境下，未来十年中国的经济规模可能比正常情况下缩减9%左右。换句话说，认为中国的生产率增长可能更接近3%而不是5%并非无稽之谈。

当然，所有对经济未来走势的预测都不能全信。预测经常出错。生产率或人口演变的微小差异经过多年叠加和相互作用可能会产生截然不同的结果。

价格——尤其是货币的相对价格——也对预测结果有很大影响。汇率的意外变动可能会使相对经济实力的预测显得非常可笑。目前，在美国需要花费100美元的等量商品和服务在中国只需要大约60美元。这表明人民币被低估了。凯投宏观认为人民币被低估的情况会持续下去。而高盛则认为这种低估程度会缩小——要么因为人民币升值，要么因为中国的物价涨速快于美国。在高盛看来，这一过程会让中国的GDP到本世纪中叶增加约

20%。

如果中国的物价或汇率不像高盛预期的那样上涨，那么中国的GDP可能永远不会超过美国。如果中国的劳动生产率增速比高盛设想的慢仅仅0.5个百分点，那么在其他所有因素不变的情况下，中国的GDP也永远不会超过美国（见图表）。如果美国的劳动生产率增速比设想的快0.5个百分点

（正如凯投宏观的预测），中国的GDP同样也永远不会超过美国。如果中国的生育率进一步下降（到本世纪中叶降至每名妇女只生0.85个孩子），它可能会在2030年代勉强赶超，但到2050年代便又会失去领先地位。即使中国真的成为世界最大的经济体，它也很可能只会是小幅领先。洛伊研究所的拉贾和冷认为，目前美国的GDP比中国高出40%，但中国不太可能建立同样的优势。

似乎还可以肯定地说，中美在未来几十年仍将保持一种近乎均势的状态。在高盛的设想中，中国对美国会保持40多年微弱但持久的领先优势。即使在凯投宏观的预测中，中国的GDP到2050年仍将达到美国的80%以上。中国依然将是一个不容小觑的地缘政治对手。这一点至关重要：如果中国的峰顶更像是平顶的南非桌山（Table Mountain），而不是陡峭的乔戈里峰（K2），那么其领导人就没什么动力在衰退到来之前急于对抗。■



Mountain range

How soon and at what height will China's economy peak?

Estimates vary, depending on assumptions about population, productivity and prices

CHINA HAS this year liberated its economy from the lockdowns, quarantines and other strictures of its “zero-covid” regime. But it has not freed itself from longer-term worries about its growth prospects. Its population is shrinking. Its epic housing boom is over. Thanks to a regulatory crackdown on e-commerce firms, the Communist Party has cowed the tech billionaires it once courted. Jack Ma, a former teacher who became one of China’s most celebrated entrepreneurs, has returned to teaching—in Japan.

The Communist Party now prizes security over prosperity, greatness over growth, sturdy self-reliance over the filigreed interdependence that distinguished China’s past economic success. Foreign investors are more wary, seeking to relocate or at least diversify their supply chains. And America is eager to limit Chinese access to some “foundational technologies”. The economics of mutual benefit has yielded to the geopolitics of mutual suspicion.

All this has led many analysts to cut their long-term forecasts for China’s growth, even as they raise predictions for this year. Some ask how much longer China’s economy can grow faster than America’s. The answer will affect far more than factory orders or personal incomes. It will shape the world order.

The previous consensus, both within and outside China, was that its economy would soon eclipse America’s. That, in turn, would allow China to become the world’s pre-eminent military power, and so supplant America

as the world's most powerful country. This remains a common view. Yao Yang, a respected economist at Peking University, believes China's GDP can overtake America's by 2029.

But others believe China's economic clout relative to that of its rivals is nearing a peak. Hal Brands and Michael Beckley, two American political scientists, argue that China's rise is already coming to a halt. The age of "peak China", as they call it, is upon us—and it is far less Olympian a summit than most had predicted.

In 2011 Goldman Sachs projected that China's GDP would surpass America's in 2026 and become over 50% larger by mid-century. No peak was in sight. At the end of last year the bank revisited its calculations. It now thinks China's economy will not overtake America's until 2035 and at its high point will be only 14% bigger (see chart).

China's peak looks similar in an influential forecast from last year by Roland Rajah and Alyssa Leng of the Lowy Institute, an Australian think-tank. Others see an even lower summit. Capital Economics, a research firm, argues that China's economy will never be number one. It will reach 90% of America's size in 2035 and then lose ground. In so far as the Peak China thesis can be captured in a single projection, this is it.

What accounts for the lower expectations for China's economy? And how much of a reduction is warranted? The answers hinge on three variables: population, productivity and prices. Start with population. China's workforce has already peaked, according to official statistics. It has 4.5 times as many 15- to 64-year-olds as America. By mid-century it will have only 3.4 times as many, according to the UN's "median" forecast. By the end of the century the ratio will drop to 1.7.

But China's demographic prospects have not changed much over the past

decade, even as forecasts for economic growth have shrunk. In fact, Goldman Sachs's new predictions assume a gentler decline in China's workforce than the old ones, because improvements in health may keep older workers at the grindstone for longer. The bank believes the labour supply in China will drop by about 7% from 2025 to 2050.

The biggest swing in sentiment relates not to population but to productivity. Back in 2011 Goldman Sachs thought labour productivity would grow by about 4.8% a year on average over the next 20 years. Now the bank thinks it will grow by about 3%. Mark Williams of Capital Economics takes a similar view. China will fall "off the path of an Asian outperformer onto the path of a solidly respectable emerging economy", he says.

There are good reasons to be gloomy about Chinese workers' productivity. As China ages, it will have to devote more of its economic energies to serving the elderly, leaving less to invest in new kit and capacity. What is more, after decades of rapid capital accumulation, the returns to new investments are diminishing. A new high-speed rail line across mountainous Tibet yields far smaller benefits at much greater cost than connecting Beijing and Shanghai, for instance.

China's rulers are trying to impose more discipline on local governments, which build much of China's questionable infrastructure. Unfortunately, they seem equally keen to impose their will on China's private enterprises. In China, unlike elsewhere, firms earn a smaller return on their assets as they grow bigger, points out Capital Economics: "Get to a certain size and companies have to give as much thought to meeting the needs of officials as those of consumers."

It is not just their own government that is hobbling Chinese businesses. In October America imposed controls on sales of advanced computer chips to China. This will hurt Chinese firms making products like mobile phones,

medical equipment and cars. Goldman Sachs has not incorporated this damage into its long-term forecasts, but estimates that China's GDP towards the end of this decade could be about 2% smaller than it would otherwise have been.

The tech war could go further. Diego Cerdeiro of the IMF and his co-authors have examined a scenario in which America curtails its own technology trade with China, persuades other OECD members to follow suit, and forces countries outside this club to pick sides in the battle. Under this extreme scenario, China's economy could be about 9% smaller in ten years' time than it otherwise would be. The idea that China's productivity growth might be closer to 3% than 5%, in other words, is not far-fetched.

Any predictions of the economic future must, of course, be taken with a pinch of salt. Forecasts often go awry. Small differences in the evolution of productivity or population when combined and compounded over many years can yield starkly different outcomes.

Forecasts are also sensitive to prices—especially the relative price of currencies. Unexpected shifts in exchange rates can make a mockery of predictions of relative economic heft. At the moment, a basket of goods and services that costs \$100 in America costs only about \$60 in China. That suggests its currency, the yuan, is undervalued. Capital Economics thinks this undervaluation will persist. Goldman Sachs, on the other hand, believes it will narrow, either because the yuan strengthens or because prices rise faster in China than in America. This process will, in Goldman's view, add about 20% to China's GDP by mid-century.

If China's prices or exchange rate fail to rise as Goldman Sachs expects, then China's GDP might never overtake America's. If China's labour productivity grows just half a percentage point slower than Goldman Sachs envisages, its GDP, everything else constant, will also never surpass America's (see

chart). The same is true if America grows half a point faster (as Capital Economic projects). If China's fertility rate declines further (to 0.85 children per woman by mid-century), it might eke out a lead in the 2030s only to lose it in the 2050s. Even if China's economy does become the biggest in the world, its lead is likely to remain small. It is unlikely to establish an edge over America equivalent to the 40% lead America now enjoys over it, Mr Rajah and Ms Leng argue.

It also seems safe to say that China and America will remain in a position of near-parity for decades. In Goldman Sachs's scenario, China maintains a small but persistent lead over America for more than 40 years. Even in Capital Economics's projection, China's GDP will still be over 80% of America's as late as 2050. China will remain a geopolitical rival to be reckoned with. That is crucial: if China's peak is more Table Mountain than K2, its leaders will have little incentive to rush to confrontation before decline sets in. ■



绑定泰国

为什么中国汽车制造商盯上了泰国

东南亚为海外扩张提供了一条诱人路径

六十年前，日本的汽车制造商在本国市场之外还不过是小鱼小虾，未来的全球汽车业巨头——丰田、日产和本田等——开始在泰国扩大生产。这个东南亚国家早早出现在汽车供应链上，这令它发展成为全球第十大汽车生产国，超过了英法等国家。

今天，泰国又一次成为汽车制造商走向国际的驿站——这次的制造商来自中国。中国企业近来屡屡宣布在泰国各地投资建厂。3月，比亚迪（第一季度超越大众成为中国第一畅销汽车品牌）在已经是汽车制造中心的罗勇（Rayong）动工兴建一座电动汽车工厂。4月，长安宣布在泰国投资2.85亿美元，生产它在中国以外的首款右舵车。5月6日，泰国官员表示，另一家中国公司合众将在泰国生产面向大众市场的哪吒V电动汽车。

底特律咨询公司中国汽车洞察（Sino Auto Insights）的涂乐表示，随着中国本土市场成熟、国内竞争加剧，加之中国经济增长放缓，汽车制造商获得中国新客户的成本正变得“实在太高”。近几个月来，中国电动汽车市场爆发了一场价格战。许多汽车制造商把海外扩张视为更可靠的增长路径。中国在2023年第一季度出口了价值210亿美元的汽车，比去年同期增长了82%。

考虑到中国和西方之间日益紧张的地缘政治和商业关系，中国制造商正在寻求一个中立的地方来发起全球扩张。作为美国的盟友和《区域全面经济伙伴关系协定》（RCEP，放宽了对中间产品贸易的限制）的成员，泰国看起来特别有吸引力。

中国公司的泰国产汽车一部分将在东南亚销售，那里的经济正在快速增长，可谓恰逢其时。去年该地区的汽车销量增长了23%，达到340万辆。不过这些汽车制造商对利润丰厚的西方市场也有自己的打算。德国保险公

司安联的研究发现，今年1月至3月，中国公司约占德国纯电动汽车销量的4%，份额是去年同期的三倍。包括比亚迪在内的一些公司甚至试图攻克美国市场，就像日本公司之前做到的那样（尽管两国政府间关系恶化以及美国对电动汽车的保护主义补贴措施让此事殊为不易）。

无论中国汽车公司的泰国计划能否实现最终目标，这些投资都巩固了中国在亚洲供应链中的主导地位。去年，泰国从中国（包括香港）的公司那里获得了34亿美元的外国直接投资，超过了从美国或日本获得的投资。即便是像泰国这样的美国盟友，与世界第二大经济体建立更紧密联系所带来的商业利益都丰厚得难以忽视。 ■



The Thais that bind

Why Chinese carmakers are eyeing Thailand

South-East Asia offers an appealing route to foreign expansion

SIX DECADES ago, when Japan's carmakers were minnows outside their home market, the future giants of global car manufacturing—Toyota, Nissan and Honda among them—began to expand production in Thailand. The South-East-Asian country's early presence in the automotive supply chains means it is the tenth-largest producer of cars in the world, surpassing countries like France and Britain.

Today Thailand is once again a waypoint for the international ambitions of carmakers—this time from China. Chinese companies have been announcing investments in Thai factories left and right. In March BYD, which in the first quarter overtook Volkswagen as the best-selling car firm in China, broke ground on an EV factory in Rayong, already a carmaking hub. In April Changan unveiled a \$285m investment to make its first right-hand-drive vehicles outside China. And on May 6th Thai officials said that Hozon, another Chinese firm, will produce its mass-market NETA V electric model in Thailand.

As their home market matures, domestic competition stiffens and China's economic growth becomes more sedate, carmakers' cost of acquiring new Chinese customers is becoming "just so high", says Tu Le of Sino Auto Insights, a consultancy in Detroit. In recent months a price war has broken out in China between EV marques. Many carmakers see foreign expansion as the surer route to growth. China exported \$21bn-worth of cars in the first quarter of 2023, 82% more than in the same period last year.

Given the rising geopolitical and commercial tensions between China and

the West, Chinese manufacturers are seeking a neutral ground from which to stage their global expansion. Thailand, as an American ally and member of the Regional Comprehensive Economic Partnership, which loosens restrictions on trade in intermediate goods, looks particularly appealing.

Some of the Chinese companies' Thai-made cars will be sold in South-East Asia, where the economy is helpfully growing at a fast clip. Car sales in the region rose by 23% last year, to 3.4m. But the carmakers also have designs on the lucrative Western markets. Research by Allianz, a German insurer, finds that Chinese firms accounted for about 4% of battery-EV sales in Germany between January and March, three times the share a year earlier. Some, including BYD, are even attempting to conquer the American market, as Japanese firms had done before them (though sour relations between the two governments and America's protectionist subsidy regime for EVs complicate this effort).

Whether or not the Chinese car companies' Thai plans succeed in their ultimate goal, the investments reinforce China's already dominant position in Asian supply chains. Last year Thailand received \$3.4bn in foreign direct investment from companies in China (including Hong Kong), more than it did from America or Japan. Even among American allies like Thailand, the commercial benefits from closer ties to the world's second-biggest economy are too juicy to ignore. ■



巴托比

如何在招聘时考察软技能

招聘流程的设计并不能很好地依据社交能力选拔人才

软技能对雇主很重要。哈佛商学院的拉菲拉·萨顿（Raffaella Sadun）及其合著者去年在《哈佛商业评论》（Harvard Business Review）上撰文，分析了猎头公司罗盛咨询（Russell Reynolds）在2000年至2017年间为各种高管职位编写的近5000份职位描述。他们的研究表明，公司已经从强调财务和运营技能转向强调社交技能——倾听、反思、沟通和共情的能力。针对中下游薪资水平的职位的其他研究也得出了类似的结论：能够与人良好合作不再被视为一个可有可无的加分项，而是一种不可或缺的特质。

问题是软技能很难衡量。更糟糕的是，传统的招聘流程往往在识别其他品质方面更有成效。招聘的早期阶段侧重于根据经验和硬技能筛选候选人，因为这些标准最容易远程评估。在求职信或简历上写“有团队精神”只能证明你缺乏创意。在录制一段自述视频时一直都面带微笑，基本上只能表明你面对镜头时能时常面带微笑。那种自我陈述的共情能力问卷有时似乎是在检测物种层面的特征（如果你勾选了“在紧急情况下，我会感到忧虑和不安”，那么恭喜你：你是个人）。

在招聘的后期阶段，求职者会和雇主见面并进行实际对话，这时就更适合评估求职者的软技能。但即便如此，想想这种场景跟社交是多么地不沾边吧。应聘者要做的是说话，而不是倾听；要卖力表现，而不是与人共情。公司因为向面试者提出一些非常“高明”的费米估算题而被称道，比如“广东有多少钢琴调音师？”或者“需要多少个肉桂卷才能填满德国国会大厦？”精心设计的面试脚本方便在不同的面试者之间作比较，但也挤压了释放天性的空间。难怪萨顿等人认为招聘流程需要在挖掘社交技能方面大幅改进。

研究正逐步发现一些识别软技能的快捷方法。最近有两项研究在探讨构成

一个好的团队成员的要素时达成了共识，或许可以把这种特质称为“读空气”能力。它们还提出了检验这种特质的方法。

莱斯大学（Rice University）的於思雨及其合著者的研究发现，有些人能够准确判断出团队中哪些成员具有影响力，研究人员将这种神奇的能力称为“地位敏锐度”。这种善于察言观色的人能减少团队冲突，提高团队业绩。作为研究的一部分，他们设计了一个测试，让参与者观看一组人执行任务的视频。随后，参与者根据视频中每个人的受尊重程度给他们评分。如果某人给出的评分与团队成员自身的评估结果最接近，那么他就具备地位敏锐度。

在另一项研究中，哈佛大学的本·魏德曼（Ben Weidman）和戴维·戴明（David Deming）也发现，某些人总是能让所在团队的表现超过预期。他们认为，这样的人具备真正的团队精神，能够使整体大于部分之和。在智商或性格测试中，这些妙人并没有从同侪中脱颖而出。但他们在“从眼读心”（Reading the Mind in the Eyes）的测试中明显表现更好。这项标准化评估会向参与者展示各种面部表情的图片，然后要求他们选出最能描述图片中每个人情绪的词。

改善测试并不是探得更多有关社交能力的信息的唯一途径。不要只让职位更高的人来问面试问题，最好也考察一下应聘者和其他各个层级的同事相处得如何。从安排约会的助理到当天的接待人员，问问这些同应聘者不经意间接触过的人对他们的看法。打听出求职者对这份工作真正担心的是什么：许多研究表明，谦逊与更好的表现之间存在关联。

以软技能为标准招聘人才会催生新的风险。比起技术技能，软技能的标准没那么严格，这可能会让人更容易靠演技蒙混过关。而且，面试官的偏见也可能更有机会渗透进来。你觉得某人令人恼火可能是这个人缺乏社交技巧的信号，但也有可能是因为他们很紧张，或者你脾气不太好，又或者你们两个不是一路人。招聘将会发生变化，而且不会变得更容易。■



Bartleby

How to recruit with softer skills in mind

The hiring process is not well designed to select for social aptitude

SOFT SKILLS matter to employers. Writing in the Harvard Business Review last year, Raffaella Sadun of Harvard Business School and her co-authors analysed almost 5,000 job descriptions that Russell Reynolds, a headhunter, had developed for a variety of C-suite roles between 2000 and 2017. Their work showed that companies have shifted away from emphasising financial and operational skills towards social skills—an ability to listen, reflect, communicate and empathise. Other research has reached similar conclusions about jobs lower down the pay scale: being able to work well with people is seen not as some fluffy bonus but as a vital attribute.

The trouble is that soft skills are hard to measure. Worse still, the conventional process for recruiting people is often better at picking up on other qualities. The early phases of recruitment focus on filtering candidates based on their experiences and hard skills, since these are the criteria that are easiest to assess at a distance. Putting the words “team player” on a cover letter or a CV is proof of nothing save unoriginality. Smiling a lot at a camera for a taped video message demonstrates mainly that you can smile a lot at a camera. Self-reported empathy questionnaires sometimes seem to be testing for species-level traits (if you agree that “In emergency situations I feel apprehensive and ill at ease”, many congratulations: you are a human).

The later phases of recruitment, when candidates and employers meet each other and engage in actual conversation, are better suited to assessing an applicant’s softer skills. But even then, think of how fundamentally unsocial the situation is. Candidates are expected to talk, not listen; to

impress, not empathise. Firms are feted for asking interviewees oh-so-clever Fermi questions like “How many piano-tuners are there in Guangdong?” or “How many cinnamon swirls would it take to fill the Reichstag?” Structured interview scripts enable like-for-like comparisons but they also squeeze the space for spontaneity. No wonder Professor Sadun et al reckon that hiring processes need to get a lot better at winking out social skills.

Research is finding some shortcuts for identifying softer skills. Two recent studies of what makes for a good team member converge on what might be described as an ability to read the room. They also suggest ways to test for this trait.

Research by Siyu Yu of Rice University and her co-authors found that people who can accurately gauge which members of a team wield influence are in possession of a magic power they call “status acuity”. Such room-readers reduce group conflict and improve team performance. As part of their study they devised a test, in which participants watched a video of a group performing a task. The participants then rated members of the group based on how much esteem each was held in. People whose ratings were closest to the assessments of the team members themselves had the quality of status acuity.

In another study Ben Weidman and David Deming of Harvard University also found that certain individuals consistently made their groups perform better than expected. Such people, they argued, are genuine team players, capable of making the whole greater than the sum of the parts. These wonderful creatures did not stand out from their peers on IQ or personality tests. But they did significantly better on the “Reading the Mind in the Eyes” test, a standardised assessment in which participants are shown pictures of various facial expressions and then have to pick the word that best describes what each person is feeling.

Better tests are not the only way to elicit more information about social skills. Don't just have people higher up the food chain ask interview questions: it is good to see how applicants get on with a range of colleagues. Ask the people who interact casually with applicants, from the assistants who arrange appointments to the receptionists on the day, what they thought of them. Find out what genuinely worries candidates about the job: lots of research suggests that humility is associated with better performance.

Hiring for soft skills will spawn new risks. They are squishier than technical skills, which may make it easier for people to fake their way through the process. And there may be more room for interviewers' biases to creep in. Finding someone irritating may be a signal that someone lacks social skills. But it may also mean that they are nervous, that you are grumpy or that the two of you are not that alike. Recruitment is set to change. It is not going to get easier. ■



熊彼特

罢工的编剧们注意了：好莱坞已经永久地改变

尽管指责奈飞好了，但它不怕停工

站在日落大道上奈飞办公园区外的罢工人墙中，你看不到好莱坞的标志。它被一栋办公楼挡住了，这栋楼的楼体上贴着一幅袒胸露乳的《布里奇顿》（Bridgerton）衍生剧广告。然而，运用大量神秘的专属工具的好莱坞就在你的身边。发起此次罢工的美国编剧工会（Writers Guild of America，以下简称WGA）起源于电影发展的初期，罢工者的用语充满了历史气息。他们讲到编剧们聚在一起探讨剧本的“编剧室”，以及电影公司高管给他们的剧本毫不留情的“批注”。在洛杉矶，好莱坞仍然享有声望。从路过的汽车纷纷按响喇叭以示对罢工的支持就可见一斑。

然而，这个电影城和整个行业都在剧变之中。15年来的首次罢工就是最新的明证。电影院在疫情过后仍然难以把观众吸引回来。媒体公司深陷债务泥潭。在TikTok网红和好莱坞小明星泛滥之时，只有少数像汤姆·克鲁斯这样的老将才能保证票房。行业动荡的主要原因是流媒体。它提供源源不断的内容，让人们不用再去影院，坐在家里就能观看。它的片单需要电影业耗费巨资才能制作出来，却都混在大量内容中一闪即过，让创造普世文化符号变得空前困难。然而，以休闲活动而言，很难找到花费不超过15美元就能尽兴的更好选择了。

流媒体不仅改变了人们看电视的方式，也改变了行业的商业模式。随着制片厂和流媒体平台走到一起，以往由热门作品驱动的价值业务已经变成了由订阅驱动的批量业务。媒体业务咨询公司MoffettNathanson引用一位经纪人的话生动地说明了这一点：“流媒体将行业利润池的样貌从纽约天际线变成了洛杉矶天际线。”换言之，就是少数火爆作品高高矗立，大量不太热门和失败的作品簇拥在周围。而在这条天际线里，没有哪家流媒体高过奈飞。好莱坞把这次罢工称作“奈飞罢工”不是平白无故的。

奈飞或许并不是凭一己之力就改变了好莱坞；制作前卫电视节目的HBO也值得一提。但奈飞的成功表明已经没有回头路可走。截至3月底，它在全球拥有2.325亿订阅用户。如此庞大的客户群体让它可以摊薄节目的制作成本。与竞争对手不同，它的流媒体服务是盈利的，因此能够再投资制作更好的内容。广阔的地域覆盖让它能够从地方市场拿到低成本剧集，把它们变成全球热播剧，比如2021年推出的讽刺不平等的韩剧《鱿鱼游戏》（Squid Game）。它新推出的有插播广告的低价套餐拥有增加收入和扩大订户的巨大潜力。

既然实力强大，你可能以为奈飞在编剧身上花得起钱。打消这个念头吧。在批量业务里，成本是关键。奈飞控制制作费用的能力提振了今年一季度的现金流表现。投资者大喜过望。但习惯于更优厚待遇的编剧们却大失所望。在奈飞门外的罢工人墙里可以看到他们的抗议：“举起拳头，放下笔头。”

跟罢工的人们聊一聊，就不难对他们抱有同情。在流媒体时代之前，为一部还算成功的电影或电视剧做编剧可以保证稳定的收入。在前期准备、拍摄和后期剪辑期间，经常有至少八名编剧在编剧室里灵感碰撞。参与一部26集电视剧的编剧可以保证大半年的工作。电影上映或电视节目播出后，还有一个利润丰厚的播后市场，包括家庭播放和其他转播销售，给编剧带来版税分成。想要知道影视作品是否成功很容易：第三方公司会报告收视率、票房和播后销售。

流媒体时代的早期甚至更加美好。不仅是奈飞，苹果和亚马逊等财力雄厚的科技巨头都在内容上一掷千金以吸引订阅用户。它们会预先付费，无论剧作成功与否（大部分节目的播放数据都不对外公布）。它们给予编剧不同寻常的创作自由。流媒体大战催生了电视节目的黄金时代。

但随着投资者被不断膨胀的预算吓到，资金的水龙头已经关上。与流媒体之前的时代相比，现在的剧集时长更短，编剧的工作也时断时续。工会领袖和奈飞编剧丹尼尔·桑切斯-维策尔（Danielle Sanchez-Witzel）说，前期准备阶段过后，编剧工作几乎已经完全消失。她的喜剧《Survival of the

Thickest》将于今年夏季上映。她想要在片场增加编剧人数的要求被奈飞断然拒绝，这让她十分震惊。“这让我陷入了深深的思考。”

不只是编剧。导演和演员也已经开始分别与代表电影公司的美国电影电视制片人协会（Association of Motion Picture and Television Producers，以下简称AMPTP）展开合同谈判，最后期限是6月30日。他们也同样对薪资、人员配备和后期分成忧心忡忡。在这背后还有人工智能在暗潮涌动，人们猜想它是否会像互联网那样改变电影行业的经济学——甚至比互联网的影响更大。

考虑到种种剧变，也难怪工会要奋力抗争，不肯让步。他们在社交媒体上大声疾呼。电影公司的老板自己拿着丰厚薪酬，同时又处处削减成本，自然就成为了攻击对象。

然而罢工者的筹码并不多。奈飞的竞争对手本可以趁机开出更好的条件去争夺人才。但它们并没有，反而加入了AMPTP的集体谈判。虽然奈飞是此次罢工的最大目标之一，但它手头有大量可随时上架的影片，这让它比同行能够更好地抵御剧本荒的冲击。流媒体平台的全球布局可能让美国的内容创作者遭遇低价竞争：大量没有工会的外国人很愿意取代他们的位置。在当今的世界里，YouTube和TikTok等无剧本娱乐内容正在与传统媒体争夺观众的眼球。行业的天际线已经改观。若以为好莱坞不会随之而变，就太傻太天真了。■



Schumpeter

Writers on strike beware: Hollywood has changed for ever

Blame Netflix if you like, but it is well placed to survive the work stoppage

YOU CANNOT see the Hollywood sign from the picket line outside Netflix's compound on Sunset Boulevard. It is obscured by an office tower with a busty advertisement for a "Bridgerton" spin-off splashed on the wall. Yet Hollywood, with its arcane paraphernalia, is all around you. The Writers Guild of America (WGA), which called the strike, traces its roots back to cinema's early days. The language that the strikers use is steeped in history. They talk of "rooms" where writers gather to work on a script and of "notes", the often brutal feedback they receive from studio executives. In Los Angeles, Hollywood still confers cachet. You can tell from the horns blasting out in support of the strikers from passing cars.

It is a town, and an industry, in upheaval, though. The strike, the first in 15 years, is the latest manifestation of that. Cinemas are still struggling to lure audiences back after the pandemic. Media companies are drowning in debt. Amid a surfeit of TikTok celebrities and minor Hollywood glitterati, only a few old warhorses like Tom Cruise are guaranteed to bring out the crowds. The main cause of the turmoil is streaming. Its firehose of content keeps people at home, rather than going to the multiplex. Its shows cost the film industry a fortune to make. And they are served up with such blink-and-you-miss-them rapidity that it is harder than ever to create universal cultural icons. Yet as leisure activities go, there are few better ways to get a bang for 15 bucks or less.

Streaming hasn't just changed the way people watch TV. It has changed the business model, too. With studios and streamers under the same roof, what used to be a value business driven by hits has turned into a volume business

driven by subscriptions. MoffettNathanson, a media-focused consultancy, vividly illustrates this with a quote from a talent agent: “Streaming turned an industry with a profit pool that looked like New York’s skyline into the Los Angeles skyline.” In other words, a few monumental hits, with a sprawl of minor hits and misses in between. Over this landscape, no streamer stands taller than Netflix. Not for nothing is Hollywood calling this “the Netflix strike”.

Netflix may not have single-handedly changed Hollywood; HBO, a maker of edgy TV, deserves a screen credit. But its success shows there is no going back. At the end of March it had 232.5m subscribers worldwide. That gives it a huge base for absorbing the costs of shows. Unlike its rivals, its streaming service is profitable, which allows it to reinvest in better content. Its geographic reach lets it take low-budget series from local markets, as it did in 2021 with “Squid Game”, a dystopian South Korean satire on inequality, and turn them into global hits. Its new cheap ad-supported tier offers huge potential to increase revenue and subscriber growth.

Given its strength, one might think it could afford to splash out on writers. Perish the thought. In a volume business, cost is key. Its ability to control production expenses helped bolster its cashflow in the first quarter. Investors loved it. Writers, once accustomed to more lavish treatment, did not. Their retort, visible on the picket lines outside Netflix offices: “Fists up. Pencils down.”

Talk to the strikers and it is hard not to feel sympathetic. In the pre-streaming era, writing for a moderately successful film or TV series guaranteed a steady income. Writers’ rooms, with at least eight scribes firing off each other, were common when working in pre-production, on set and during editing. Helping write a 26-episode TV show could take up most of the year. Once a film was released, or a TV show broadcast, there was a lucrative aftermarket, including home video and syndicated sales, which

brought in residual royalties. It was easy to measure success. Third-party firms reported ratings, box-office numbers and after-sales.

The early days of streaming were, if anything, even better. Not only did Netflix, and deep-pocketed tech giants such as Apple and Amazon, spray cash on content to attract subscribers. They made payments up front, regardless of success (they kept most of the viewing figures to themselves). They gave writers unusual creative freedom. The streaming wars gave rise to a golden age of TV.

But since investors have taken fright at the ballooning budgets, the money-spigot has been turned off. Shows are shorter than in the pre-streaming era, and work is intermittent. Writing after pre-production has virtually ground to a halt, says Danielle Sanchez-Witzel, union captain and writer for Netflix, whose comedy show, "Survival of the Thickest", comes out this summer. She says she was shocked at how intransigent the platform was when she asked for more writers on set. "It's led to a lot of soul-searching."

It isn't just the WGA. Directors and actors are starting separate contract negotiations with the Association of Motion Picture and Television Producers (AMPTP), which represents the studios, ahead of a June 30th deadline. They, too, have concerns about pay, staffing and residuals. In the background lurks artificial intelligence, and the question of whether it will change the economics of the movie industry as much as—or more than—the internet did.

Given such seismic changes, it would not be surprising if the guilds dig in their heels. They have loud voices on social media. The lavish salaries studio bosses pay themselves, while cutting costs elsewhere, make for easy targets.

Yet the strikers' leverage is limited. Netflix's rivals could have offered more generous terms to win the war for talent. They didn't, instead joining under

the AMPTP umbrella. Netflix may be one of the strike's biggest targets, but it has a large slate of releases ready to go that may insulate it better than its peers from a lack of new scripts. The global reach of the streamers could undercut American content creators; there are plenty of non-unionised foreigners keen to step into their shoes. This is a world where unscripted fare, including YouTube and TikTok, competes with traditional media for viewers' attention. The skyline has changed. It is foolish to think Hollywood will not change with it. ■



经济学人视频

AI聊天机器人将如何改变互联网？ - 2

聊天机器人的涌现可能会以另一种方式对互联网造成损害。



The Economist Film

How will AI chatbots change the internet? - 2

The proliferation of chatbots could be detrimental to the internet in another way.



摘星之志

SpaceX如何引发了一场太空商业化的新竞赛

阿什利·万斯详尽记录了这场赛事【《当天堂开始出售》书评】

《当天堂开始出售》，阿什利·万斯著。Ecco出版社；528页；35美元。
WH Allen出版社；25英镑。

夸贾林环礁（Kwajalein Atoll）几乎是人们能到达的最偏僻的地方。这个太平洋中间的小环礁距离巴布亚新几内亚约3000公里（1900英里），距离檀香山近4000公里。2008年9月28日，这里出乎意料地发生了一场不可思议的革命。

在经历了三次失败的尝试之后，彼时相对而言还不算出名的互联网百万富翁马斯克创立的SpaceX终于将它的猎鹰1号火箭送入轨道。它由此证明，一家资金相对不多的私人公司也能做成迄今仅有少数国家和航空航天巨头做到的事。15年后，这位勇敢的反叛者已经变成了在位者。SpaceX发射的火箭和搭载的卫星数量超过其他所有航天实体的总和。

但在阿什利·万斯（Ashley Vance）的新书所讲述的故事中，SpaceX只是舞台搭建者。万斯在2015年出版了一本广受好评的马斯克传记。但他现在对一批试图追随SpaceX轨迹的勇敢无畏的创业公司更感兴趣。他花了几个月的时间泡在办公室和发射台与工程师和老板们交谈，之后写出了《当天堂开始出售》，在其中简要介绍了另外四家雄心勃勃的航天公司。它们是制造成像卫星的行星实验室（Planet Labs）以及制造火箭的Astra、萤火虫（Firefly）和火箭实验室（Rocket Lab）。

其中两家公司取得了惊人的成功。行星实验室帮助开创了一种理念，即大量低成本、大规模生产的卫星能完成的任务远远超过几颗造价高昂的高级卫星。这家公司制造的实际上是私营部门的监视卫星，拍摄整个地球，为所有人——从对冲基金到新闻媒体——提供20年前连政府都没有的那类图像。这一切都是由一个从车库里起家的公司完成的。行星实验室的第一个

“无尘室”为保护卫星的敏感光学元件免受灰尘污染而建，它是从网上买来的一个花园温室。

火箭实验室是另一个成功故事。这家公司的诞生地在并不以航天业闻名的新西兰，它差点就完成了一项其他火箭制造商从未完成过的壮举：首次发射就将火箭送入轨道。（笨手笨脚的外部安全官员碍了事。）和SpaceX一样，这家公司也有“快速失败”的策略，即快速尝试，从不可避免的失败中吸取教训，然后很快再次尝试。

本书是一段富启发性的历险之旅，带领读者遨游在一个既具有星辰大海的理想主义，又充满冷酷无情的资本主义的行业里——硅谷在20世纪下半叶沉淀出的一种标志性的混合特质。但它不只是在为这种“简陋粗暴”、“假装自己行，直到真的行”的商业风格唱赞歌。Astra的经历是一个警世故事，提醒人们把这种逞能用到像火箭科学这样不容闪失的事情上会带来怎样的风险和压力。Astra于2021年上市，为客户提供收费运载服务。但它的火箭发射很不稳定，让人失望。

与硅谷早期的同类公司不同，这些火箭公司必须时刻留意政治。萤火虫在首次迭代破产后，得到了马克斯·波利亚科夫（Max Polyakov）的救助，这位热衷太空事业的乌克兰商人靠做约会网站起家。但很快，波利亚科夫就被美国政府实际上赶出了公司，原因是未经证实的指控称他可能向俄罗斯传递信息（他本人否认了）。

想看火箭科学技术专著的读者得去找找别的书了。但若想深入了解推动新太空时代的人和文化，万斯的书提供了一个起点。在登月奇迹之后，太空不知何故变得无聊了。如今它重又激动人心了起来。■



Reach for the stars

How SpaceX set off a new race to commercialise space

Ashlee Vance charts the contest in “When the Heavens Went on Sale”

When the Heavens Went on Sale. By Ashlee Vance. Ecco; 528 pages; \$35. WH Allen; £25

KWAJALEIN ATOLL is as close to the middle of nowhere as you can get. Some 3,000km (1,900 miles) from Papua New Guinea, and almost 4,000km from Honolulu, this tiny speck of land in the middle of the Pacific Ocean became, on September 28th 2008, the unlikely site of an improbable revolution.

After three failed attempts, SpaceX, a company set up by a comparatively obscure dotcom millionaire called Elon Musk, at last got one of its Falcon-1 rockets into orbit. It thus helped prove that a private firm run on a relative shoestring could do something which had, hitherto, been the preserve of a handful of nation-states and giant aerospace firms. A decade and a half later, the plucky insurgent has become the incumbent. SpaceX flies more rockets, and carries more satellites, than every other spacefaring entity combined.

But SpaceX serves only to set the stage for the story told in Ashlee Vance's new book. Mr Vance—who published a well-received biography of Mr Musk in 2015—is more interested in the group of swashbuckling startups that have tried to follow in SpaceX's contrails. After spending months hanging around offices and launch-pads, talking to engineers and bosses, he profiles four other space hopefuls in “When the Heavens Went on Sale”. They are Planet Labs, which makes imaging satellites, and Astra, Firefly and Rocket Lab, all of which make rockets.

Two of them have been strikingly successful. Planet Labs helped pioneer the idea that lots of cheap mass-produced satellites could accomplish far

more than a few fancy expensive ones. The firm makes what are, in effect, private-sector surveillance satellites, photographing the entire planet and giving everyone from hedge funds to journalists the kind of imagery that not even governments had two decades ago. All this was done by an outfit that began life in a garage. Planet Labs' first "clean room", designed to protect a satellite's sensitive optics from dust, was a garden greenhouse bought on the internet.

Rocket Lab is another success story. Founded in New Zealand—not a country known for its space industry—it very nearly pulled off a feat that no other rocketmaker had ever managed: getting a rocket into orbit on the first try. (Bumbling external safety officials got in the way.) Like SpaceX, the firm has a "fail fast" strategy, trying things quickly, learning from the inevitable explosions, then trying again soon.

The book is an illuminating romp through an industry marinated in the signature mix of starry idealism and ruthless capitalism brewed in Silicon Valley in the second half of the 20th century. But it is more than a paean to this spit-and-sawdust, fake-it-till-you-make-it style of business. Astra's experience is a cautionary tale of the risks and stress of applying that sort of bravado to something as unforgiving as rocket science. The firm went public in 2021 and offers flights to paying customers. But its machines have a disappointingly spotty record.

And unlike their counterparts in the early days of Silicon Valley, the rocket jockeys must always keep half an eye on politics. After the first iteration of the firm went bust, Firefly was bailed out by Max Polyakov, a Ukrainian businessman and space enthusiast who made his money in internet dating. But soon Mr Polyakov was in effect forced out of the company by America's government, after unsubstantiated allegations (denied by him) that he might be passing information to Russia.

Readers hoping for a technical treatise on rocket science should look elsewhere. But for an insight into the people and culture driving the new space age, Mr Vance's book is the place to start. After the wonder of the Moon landings, space somehow contrived to become boring. These days it is exciting again. ■



自由交流

罗伯特·卢卡斯是位宏观经济学巨匠

这门学科，无论情愿与否，都深受他的影响

经济学的许多公式都以提出者的名字命名。罗伯特·卢卡斯（Robert Lucas, 5月15日去世，终年85岁）不一样。他所冠名的东西要更前卫：一条“批判”。当年他提出这条批判的早期版本时，一位青年经济学家深感绝望：“您这就是讲清了为什么我过去几年所做的一切毫无价值。”

“卢卡斯批判”可以用一个类比来解释。卢卡斯曾在芝加哥大学（他在该校求学和任教多年）的一个毕业典礼上给学生讲过这个故事。想象一下，一家游乐场在入口处出售场内各种游乐设施的代币，而所有这些设施都是独立运营的。假设收银员突然把一美元可兑换的代币数量翻倍。换到大把代币的游客们会涌向过山车、欢乐屋等设施。部分经营者会以为自己的游乐设施出乎意料地大受欢迎，甚至可能延长员工工作时间以接待骤增的顾客。

有统计学头脑的经济学家看了游乐场的数据后可能得出结论：增加代币供应导致经济活动和就业增加。他们甚至可能建议其他游乐场也试试同样的做法。但这种“政策”之所以奏效，当然只是因为代币供应突然变化，不在游乐设施运营者的预料之中。一旦意识到到底发生了什么，他们就会提高每次游玩所需的代币数量。价格会上升，经济活动将回归正常。

卢卡斯正是这样一位有统计学头脑的经济学家，勤恳地记录美国经济这个庞大的“游乐场”里通胀上升与就业增强之间的关系。然而，他提出的批判表明，只要决策者依据这些关系采取行动，这些关系就会崩塌。只要政策试图加以利用，这些关系背后的行为就会改变。这些关系可以被检验，却无法被刻意寻求。这是他最具影响力的论文。

卢卡斯并不为此特别自豪。他指出，既是“批判”，自然不能“完全满足作者的虚荣心”。他与志同道合者努力寻求给经济学家带来一些更积极的东

西：不容易崩塌的基础，可在其上构建体系。他认为，经济学家“本质上是讲故事的人，是虚构经济体系的创造者”。因此，他与同事建立了一个可供学者们探索的梦幻新世界。

卢卡斯苦苦思索“动态”这件事，也就是工作投入等事物如何随时间而改变，以及人们对未来的看法会如何影响其当前的行为。他想到了自己的父母：父亲在西雅图造船厂做焊接工，母亲用“纯白、亮黑、雅灰”绘制广告插画，两人在战争期间都格外努力工作，因为他们估计战后工资会下降。

人们如何得出这些对未来的看法？在他早期的研究中，卢卡斯假设企业会预期价格基本保持不变。有了这个假设，他就可以预测行业的资本支出。但可以预见的是，投资将改变未来的价格水平。模型中设置的价格预期与模型得出的价格预测是不一致的。在卢卡斯看来，这似乎自相矛盾。

于是，卢卡斯转而采用“理性预期假说”。他假设模型中行为者的预期与模型本身所预测的情形一致。假如经济学家能预见增加货币数量将导致游乐设施票价上升，那么经营者也应该有同样的预期。

“理性预期”不等于毫无纰漏的先见。未来充满不确定性。因此，卢卡斯假设现有商品、未来商品，以及哪怕只是有可能存在的商品都有市场，这样人们就能够就“或有事件”达成协议。这个框架借鉴自其他理论家，但卢卡斯自己的人生提供了最佳例证。他的前妻预见到他某天可能会拿诺贝尔奖，并对这种可能性做了安排。他们在1989年的离婚协议承诺她将能从这可能出现的百万美元奖金中分得一半。六年后卢卡斯得奖，这一“或有索取”最终兑现。“协议已定。”卢卡斯说。

通过理性预期假设，卢卡斯感觉自己“消除了”用财政和货币手段微调需求的“主要理论基础”。收银员终归没法系统性地愚弄游乐设施的经营者。

“凯恩斯主义经济学已死。”他在1979年宣称。这种观察在后来被证明是夸大其词了。凯恩斯主义者东山再起，否定卢卡斯的政策假设，但采用了他的许多方法论选择。这些凯恩斯主义者为积极的宏观经济政策提供了一个新的理论基础，运用于一个明显符合卢卡斯所述的世界——尽管没有那么

黑白分明，而是灰色调的。卢卡斯在晚年承认，包括凯恩斯主义者在内的各路经济学家都对成功稳定战后的支出流做出了贡献。

不过，在他看来，任何进一步驯服商业周期（紧随增长趋势稳定这种增长）的收益相比加强增长趋势的收益似乎都显得微不足道。他转而关注增长的机制。“这类问题所涉的人类福祉影响实在惊人”，他在1987年写道，“一旦开始思考它们，就很难再去想别的了。”

对卢卡斯而言，深入思考一件事就是对其建模。抽象思考是搞清问题的必要前奏。有一次，他收到合著者埃德·普雷斯科特（Ed Prescott）的一条简短留言，写着“这就是劳动力市场的运作方式”，后头跟了一条卢卡斯没能马上看懂的神秘公式。他本可以问问埃德，但他没有。卢卡斯说，理论家不会寻求用文字解释公式，而是寻求公式来解释文字。

也许如此。但他自己的言论之精彩，恰恰驳斥了这个理念。其他经济学家乐于听他说话，多多益善。在他有关人力资本的研究著作中，卢卡斯曾指出，学徒们接受较低的工资，实际是间接支付了可以留在师傅身边学习的学费。他的一些同事以另一种形式掏了“学费”。罗伯特·巴罗（Robert Barro）曾经在办公室挂了块牌子，写着“禁止吸烟，卢卡斯除外”。以吸二手烟为代价换取他的思想是值得的。“卢卡斯批判”带着他的名字，整个宏观经济学都带着他的印记。 ■



Free exchange

Robert Lucas was a giant of macroeconomics

The discipline, willingly or not, has inhaled his influence

ECONOMICS IS FULL of equations named after their inventor. Robert Lucas, who died on May 15th aged 85, was different. His name graces something edgier: a “critique”. When he presented an early version, a young economist despaired: “You just explained why everything I’ve done in the last few years is worthless.”

The Lucas critique can be explained with the help of an analogy—one he offered to students graduating from the University of Chicago, where he spent many years as both a student and professor. Imagine a fairground that sells tokens at the entrance for the rides inside, all of which are independently run. Suppose the cashier abruptly doubles the number of tokens per dollar. Fairgoers, flush with tokens, will flock to the rollercoaster, fun house and other attractions. Some ride operators will assume their rides are more popular than they thought. They might even extend workers’ hours in order to handle the additional custom.

A statistically minded economist looking at the park’s data might conclude that an increase in the token supply leads to heightened activity and employment. They might even advise other fairgrounds to try the same trick. But of course this “policy” only works because ride-operators do not anticipate it. As they realise what is going on, they will raise the number of tokens they require per ride. Prices will rise and activity will return to normal.

Lucas had been one of those statistically minded economists, busy documenting relationships between higher inflation and stronger

employment in the giant fairground that is the American economy. Yet his critique showed that these relationships would crumble if policymakers acted on them. They were based on behaviour that would change if policy sought to exploit them. They could be tested but not tried. It was his most influential paper.

He was not particularly proud of it. A critique by definition does not “fully engage the vanity of its author”, he noted. He and his intellectual comrades worked hard to give economists something more positive: less crumbly foundations to build on. Economists, he believed, “are basically storytellers, creators of make-believe economic systems”. So he and his colleagues built a fantastical new world for wonks to explore.

Lucas had been thinking hard about “dynamics”, or how something like work effort evolves over time, and how views of the future affect it today. He thought of his parents: his father welding in Seattle shipyards; his mother painting adverts in “pure white, glossy black and elegant greys”. Both worked extra hard during the war, because they expected wages to be lower when it was over.

How do people arrive at these views of the future? In early work, Lucas assumed firms would expect prices to stay much the same. That assumption allowed him to predict industry’s capital spending. But investments would predictably change future prices. The price expectations in the model were at odds with the price predictions of the model. To Lucas this seemed inconsistent.

Instead, Lucas adopted the “rational expectations hypothesis”. He assumed the actors in his models would expect what the model itself predicted. If an economist can foresee that extra tokens will raise ride prices, then operators should expect the same.

“Rational expectations” were not the same as flawless foresight. The future was uncertain. Thus Lucas assumed markets existed for present, future and merely possible goods, allowing people to strike deals over contingencies. He borrowed the framework from other theorists. But his own life provided the best example. His ex-wife had planned for the contingency that he might one day win the Nobel prize. Their divorce agreement in 1989 promised her half of the potential \$1m award. When he won six years later, that contingent claim was fulfilled. “A deal’s a deal,” Lucas remarked.

With the assumption of rational expectations, Lucas felt he had “eliminated the main intellectual basis” for fiscal and monetary fine-tuning of demand. After all, cashiers could not systematically fool ride operators. “Keynesian economics is dead,” he reported in 1979. That report proved exaggerated. Keynesians made a comeback, rejecting his policy presumptions, but embracing many of his methodological choices. These Keynesians provided a new intellectual basis for active macroeconomic policy in a recognisably Lucasian world, albeit one painted in greys, not pure white and glossy black. Later in life Lucas acknowledged that economists of all stripes, Keynesians included, had contributed to the successful stabilisation of spending flows in the post-war period.

Yet to him, the gains to any further taming of the business cycle—stabilising growth even more tightly around its trend—seemed trivial compared with the gains to increasing that trend. His mind turned to the mechanics of growth. “The consequences for human welfare involved in questions like these are simply staggering”, he wrote in 1987. “Once one starts to think about them, it is hard to think about anything else”.

To think hard about something, for Lucas, was to model it. Abstraction was a necessary prelude to clarity. He once received a laconic note from one of his co-authors, Ed Prescott. “This is the way labour markets work,” it said, followed by a single, cryptic equation that Lucas could not immediately

understand. He could have asked Ed. He did not. Theorists, he said, do not ask for words to explain equations; they ask for equations to explain words.

Maybe so. But his own sparkling words represented a counter-example to this notion. Other economists were keen to hear as many of them as possible. In his work on human capital, Lucas had pointed out that apprentices pay their mentors indirectly, by accepting a lower wage to hang around them. Some of his colleagues paid a different sort of price. Robert Barro once hung a sign in his office that said: "No smoking, except for Bob Lucas". It was worth inhaling his smoke to ingest his ideas. The Lucas critique bears his name; the whole of macroeconomics bears his mark. ■



借贷困局

中国的地方债危机快要变得难以收拾

一个偏远省份的烦恼

贵阳当地人对自己与其他地方的距离有敏锐的感触。在这个位于中国西南的城市，一位老人一边吃着酸辣凉米粉，一边列举着家乡最近取得的经济成就——也就是去其他地方的时间缩短了。现在去邻省四川的大城市成都，乘高铁只要三个小时。到另一个大都市重庆只需要两个多小时。凭借中国大力兴建的高速铁路网络，甚至到南方金融中心香港的车程也缩短到不足七小时。老人一口气报完这些行程耗时，言语间颇为自豪。前些年，去这些地方都还要花三到四倍的时间。

然而，这些进展代价高昂，如今看来也不可持续。在过去十年里，贵阳所在的贵州省在大兴土木时积累了巨额债务——现在已经无力偿还。过去三年的新冠疫情导致出行受阻，当地许多道路和桥梁都乏人通行。一家本地路桥公司最近被迫将其债券展期20年。该地区还以棚户区闻名。贵阳市区的青山之间散布着摩天大楼，同时也有许多年久失修的建筑。政府在改造这些破旧住宅上已经严重入不敷出。贵阳的花果园棚户区改造项目是世界最大的住宅项目之一，其开发商已经违约。

对于富裕东部的许多中国人来说，贵州是个偏远地区。但其债务问题将在未来几个月给中国其他地区定下基调。该省可能会成为第一个接受中央政府救助的省份。事实上，当地官员已经在寻求帮助。4月11日，贵阳一家政府智库发文称，该省靠自身能力以无化债方法，正向中央寻求建议。

这引发了一场关于提供此类救助的道德风险的全国性辩论。据高盛估计，中国全国各地的地方政府债务负担达23万亿美元，贵州的债务只占其中一小部分。中国媒体发表社论呼吁“债务纪律”不能松，并警告称，中央政府如果为地方债务提供隐性担保会付出巨大代价。

贵州官员承受着巨大的压力。该省的各类债务据称约达2.6万亿元（3800

亿美元，相当于当地GDP的130%），包括地方政府融资平台的债券和隐性债务。地方政府融资平台的运作类似于私营企业，但最终由地方政府支撑。法国外贸银行（Natixis）的分析师指出，这些债务的利率已经超过了该省的GDP增长率。利息支出占全省财政支出的8%以上，而全国平均水平为6%。贵州一些城市已经把大部分资金都用于偿债。据研究公司荣鼎咨询（Rhodium）估计，贵阳每年要偿还的利息已占全年收入的56%。

通过增加收入来偿还债务的希望微乎其微。贵州向来是经济落后地区：当地地形大多是一望无际、迷雾氤氲的山区，千百年来出行困难，村庄贫困。贵州经济依赖于新建的公路和隧道带来的对外联通。许多当地人务农为生。制造业乏善可陈。只有一家重要公司值得一提：茅台。不可否认，这家国有白酒生产商是中国市值最高的公司之一。与此同时，贵州地方政府的融资成本现在是全国第二高，仅次于西北省份青海。随着企业难以还债，融资成本还在继续上升。自2022年初以来，该省的地方政府融资平台已经发生20多起信托贷款和其他隐性债务违约，远超其他省份。

随着最近几周问题加剧，经济学家和投资者警告称，中央政府并没有多少选择的余地。一位投资经理表示，过去20年的高负债增长模式没能在最贫穷的地区买到繁荣——而且将不可避免地在这些地区引发危机。他说，贵州正处于“断裂点”，中央政府必须出手救助它和其他薄弱环节。投资银行国泰君安的周浩表示，中央政府不会坐等贵州发生高调的违约，因为这种事件会在中国债券市场引发动荡，导致资金迅速枯竭。他表示：“贵州破产将引发太多连带问题。”

一场官方救援行动正在集结。4月24日，中国最大国有资产管理公司之一的信达表示，将派遣50人的专家团前往贵州调研。信达这样的央企可以向陷入困境的地方政府融资平台注入流动性。它们还可以通过债转股的方式接手部分债务。政策性银行也可能发挥更重要的作用。一些银行已经受命协助偿还贵州地方政府融资平台的部分债务。这样一些零散措施可以争取到一些时间，但恐怕很快还会需要大得多的动作。情势就像闷一口茅台那样让人为之一振。■



Borrowing problems

China's local-debt crisis is about to get nasty

Worries from a far-flung province

LOCALS IN GUIYANG have a keen sense of the distance between them and everywhere else. Over cold rice noodles bathed in chilli paste and vinegar, an elderly resident of the city in south-west China lists a number of recent economic achievements of his home town—namely, the shortening of travel times to other places. Chengdu, a megacity in nearby Sichuan, is now just three hours away by high-speed rail. Chongqing, another metropolis, can be reached in just over two. China's Herculean construction of uber-fast trainlines has even brought Hong Kong, the southern financial centre, within a seven-hour ride. These travel times are rattled off with considerable pride. Not long ago they would have taken three to four times as long.

Yet this progress has been costly, and is proving to be unsustainable. Over the past decade Guizhou, the region in which Guiyang sits, has accrued enormous debts through its building efforts—ones which it can no longer repay. Many of the region's roads and bridges went untravelled over the past three years as covid-19 stopped people moving about. A local bridge-builder was recently forced to extend maturities on its bonds by up to 20 years. The region is also known for its shantytowns. Guiyang is scattered with skyscrapers and green hills poking out from between them, as well as old, crumbling buildings. The government has spent well beyond its means in renovating such dilapidated residences. One shanty renovation in Guiyang, called Huaguoyuan, is among the world's largest housing projects. The property developer has already defaulted.

Guizhou is a far-off region to many Chinese people in wealthy eastern areas. But its debt problems will set the tone for the rest of the country in the

coming months. The province will probably be the first to receive a central-government bail-out. Indeed, local officials are already asking for help. On April 11th a government think-tank based in Guiyang said that the province does not have the ability to resolve its debts by itself and was seeking advice from the central government.

This has kicked off a national debate about the moral hazard of providing such a rescue. Guizhou's debts are a small part of the \$23trn Goldman Sachs, a bank, estimates to be burdening local officials across the country. Editorials in Chinese media have called for strict "debt discipline" and warn of the huge cost to the central government should it implicitly guarantee local debts.

The pressure on Guizhou's officials is immense. The province is said to owe about 2.6trn yuan (\$380bn, or 130% of local GDP) in various forms including bonds and opaque debts owed by local-government-financing vehicles (LGFVs), which are run like private firms but ultimately backed by the local state. The interest rate on these debts has surpassed the province's GDP growth rate, note analysts at Natixis, a French bank. Interest payments make up more than 8% of the province's fiscal expenditure, compared with a national average of 6%. Some cities in the province are already spending most of their funds merely to pay off debt. In Guiyang annual interest payments equal 56% of yearly revenues, according to an estimate from Rhodium, a research firm.

There is little hope of bringing in more revenue to meet the costs. The area has always been an economic backwater: the local topography is one of endless misty hills that for millennia made travel hard and villages poor. Guizhou's economy is reliant on the connectivity brought by its new roads and tunnels. Many locals are farmers. The region does not have much manufacturing, and has just one important corporation of which to speak: Moutai, a state-owned firewater-maker, which is, admittedly, one of the

country's most valuable firms. Meanwhile, funding costs for the local government are now the second-highest in the country, after the north-western province of Qinghai. They continue to rise as firms struggle with payments. The region's LGFVs have already experienced more than 20 defaults on trust loans and other hidden debts since the start of 2022, many more than in other provinces.

As problems have intensified in recent weeks, economists and investors have warned that the central government has few palatable options. An investment manager says the debt-heavy growth model of the past two decades has been unable to buy prosperity in China's poorest regions—and will inevitably lead to crises in such places. Guizhou is at a "breaking point", he says, and the central government must come to the aid of it and other weak links. Zhou Hao of Guotai Junan, a Chinese investment bank, says the central government will not wait around for a high-profile default in Guizhou, owing to the turmoil that such an event would cause in China's bond markets, where funding could quickly dry up. "Guizhou going bust will create too many side issues," he says.

The makings of an official bail-out are now coming together. On April 24th Cinda, one of China's largest state-owned asset managers, said that it was sending a team of 50 experts to Guizhou to survey the situation. Centrally controlled firms such as Cinda could be used to inject liquidity into troubled LGFVs. They could also swallow up some debts in exchange for equity. Policy banks may also take a bigger role. Some have already been called in to help pay back a few of the province's LGFV debts. Some of these piecemeal measures are buying time, but much bigger action could be required soon. It is a situation as bracing as a shot of Moutai. ■



哪些亿万富翁出局了？

2023年裙带资本主义指数

战争、科技股崩盘和乱局让某些财阀遭受重创【深度】

在过去的20年里，因为对俄罗斯寡头热情有加，英国首都得了个“伦敦格勒”的绰号。许多寡头抢购这里的豪宅，从北郊的海格特一路买到海德公园；有几个还入股了足球俱乐部。去年2月俄罗斯入侵乌克兰后，48名俄罗斯寡头被西方列入制裁名单。普京许多亲信的巨额财富凸显了裙带资本主义的问题，以及为什么应该采取更多措施来对抗它。

差不多十年前，本刊首次估算了财阀们从寻租行业中获得的财富，得出了裙带资本主义指数。最新一期指数显示，裙带资本家的财富已从25年前的3150亿美元（占全球GDP的1%）增长到现在的三万亿美元（占近3%）（见图表1）。其中约65%的增长来自美国、中国、印度和俄罗斯。总的来说，40%的裙带资本家财富来自威权国家，占到其GDP的9%。一般认为，全世界有数百位亿万富翁的财富来自通常与政府密切关联的行业。

本刊这一指数的估算基于《福布斯》的数据。近40年来，《福布斯》杂志每年都会发布全球富豪排行榜。1998年，该杂志估计全球共有209位亿万富翁，总财富达一萬亿美元，相当于全球GDP的3%。今年，《福布斯》详细列出了2640位亿万富翁，总财富达12万亿美元，相当于全球GDP的12%。排行榜上的大多数富翁并不从事寻租行业。经过物价上涨调整——1998年的10亿美元相当于现在33亿美元——目前共有877位亿万富翁（按1998年的价格），总财富达九万亿美元。

我们把财富来源分为寻租行业和非寻租行业。经济租金是指支付完资本和劳动力成本后剩下的盈余；在完全竞争的市场中，经济租金趋近于零。在银行、建筑、房地产和自然资源等与政府关系密切的行业，寻租很普遍。有时，寻租者有可能依靠门路获得土地、经营许可和各种资源，从而扩大盈余。他们还可能组成卡特尔来限制竞争，或者游说政府制定有利于自己

的法规。他们可能会打规则的擦边球，但通常不会违规。

在我们的指数中，俄罗斯再次成为裙带资本主义最严重的国家（见图表2）。来自裙带行业的亿万富翁财富占其GDP的19%。不过，乌克兰战争带来的影响显而易见——裙带财富从2021年的4560亿美元下降到今年的3870亿美元。俄罗斯亿万富翁的财富中，只有五分之一来自非裙带行业——从这点就能看出俄罗斯经济有多扭曲。

去年3月，七国集团、欧盟和澳大利亚成立了“俄罗斯精英、代理人和寡头（REPO）特别工作组”，以“孤立受制裁的俄罗斯个体并对其施加前所未有的压力”。一年后，该工作组宣布已经限制或冻结了580亿美元的资产。但该工作组承认，在某些情况下，寡头们通过使用空壳公司、将资产转移给家庭成员或投资房地产轻易逃避了制裁。越来越多的财富变成了带有修剪整齐的草坪和大理石柱子的豪宅。

寡头们也受到来自俄罗斯的压力。今年3月，普京谴责他们将资产藏匿在海外，从而变得“受制于外国当局”。普京是个伪君子。据一项估计，他已经从俄罗斯窃取了超过1000亿美元——这让他能够购买黑海边一座估价14亿美元的豪宅，以及去年被意大利当局扣押的一艘价值七亿美元的游艇。可他却不在福布斯亿万富豪榜上。

我们的指数还揭示了超级富豪的其他动态。美国735位亿万富翁中有不少在去年受到了科技股崩盘的打击；全球五分之三的科技亿万富翁财富来自美国。2021年11月至2022年12月间，以科技股为主的美国纳斯达克综合指数损失了约三分之一的价值。本刊估计美国科技亿万富翁的财富因此缩水了18%。

总的来说，在美国，裙带行业财富约占GDP的2%，而非裙带行业财富占GDP的15%。但科技行业表现出一些裙带关系的特征。2017年，美国最大20家科技公司的销售额占到该行业总销售额的一半，科技行业因此成为美国集中度最高的行业。科技公司是华盛顿最大的游说者之一，去年八家公司在游说上总共花费了一亿美元。如果我们的指数把科技行业重新归类为

裙带行业，那么美国裙带财富的比例会上升至其GDP的6%。

与此同时，中国的亿万富翁们继续艰难应对政府的反复无常。自习近平对民营资本发起整顿后，裙带财富大幅下降，从2018年占GDP4.4%的峰值下降至目前的2.5%。各行各业的大亨只能在政府的准许下经营。1998年，包括香港和澳门在内，中国只有八位亿万富翁，总财富为500亿美元。现在中国有562位亿万富翁，掌握着两万亿美元的财富。

按我们指数的标准，裙带资本家约占这群人的四分之一。纽约市立大学（City University of New York）下属的斯通社会经济不平等研究中心（Stone Centre on Socio-Economic Inequality）最近发布的一份工作论文指出，83%至91%的腐败高官因有非法收入而处于城镇收入分配的前1%。如果没有这些收入，只有6%的人会处于前1%区间。

自习2012年上台以来，已有150多万人在持续的反腐运动中受到惩罚。高调的大亨也受到更密切审视。2020年底，科技巨头阿里巴巴的联合创始人马云因批评当局而消失在公众视野中，当时其身家接近500亿美元。不久前他重新现身，财富只剩原来的一半。今年2月，亿万富翁银行家包凡被带走协助一项调查，至今没再露面。

官方“共同富裕”的宣传催生了一个将资金带出中国的小产业。新加坡是资金外流的主要目的地。2019年，新加坡只有33个中国的家族办公室，也就是管理家族资产的公司。2022年底，这一数字可能达到750。

印度领导人莫迪在本国的企业领袖中有自己的亲信。过去十年里，印度裙带资本家的财富占GDP的比例从5%上升到近8%。高塔姆·阿达尼（Gautam Adani）是以其姓氏命名的阿达尼集团的所有者，他在去年9月份一度晋身全球第三富豪。但今年1月，阿达尼集团被美国做空机构兴登堡研究公司（Hindenburg Research）指控欺诈和操纵股市。它否认了所有指控。阿达尼本人的财富从900亿美元降到了470亿美元。

如果裙带资本主义完全失控，会发生什么？波兰社会学家斯坦尼斯拉夫·安德列斯基（Stanislav Andreski）曾指出，如果精英们是通过让国家受穷

的方式为自己敛财，那就形成了“盗贼统治”。上世纪60年代末他就对这种政权及其影响发出过警告。但西方国家直到50多年后才理会他的警告。

识别盗贼统治与其说是门科学，不如说是门艺术。本刊的研究结果与民主及腐败指数只有部分关联。再说，腐败达到什么程度才会破坏政府职能？美国国际开发署（USAID）去年发布了一份84页的“去盗贼统治”手册。在研究了巴西、马来西亚和乌克兰等13个国家之后，该报告建议采取一些重要措施，如打破腐败垄断、让所有权登记数字化等。

美国也在设法号召国际社会积极打击腐败。今年3月，美国主办了第二届“民主峰会”。占全球GDP三分之二的74个国家宣布了一些举措，其中包括将努力“预防和打击腐败”。俄罗斯和中国缺席这一峰会不让人意外。但巴西、印尼和南非等国缺席就有些令人费解了。

此次峰会上，美国财政部长珍妮特·耶伦（Janet Yellen）指出“盗贼统治者通过匿名购买外国房地产来把收受的回扣洗白”。因此，从明年开始，美国将要求在本国内成立或经营的公司披露其真实的或“受益”所有者。另有36个国家签字，响应美国提出的加大身份隐藏难度的声明。但透明度并不是灵丹妙药。去年，英国出台了一项新法律，要求拥有不动产的外国企业进行注册，并披露其真实的所有者。今年2月，根据一家反腐监督机构发布的报告，在受新规约束的9.2万处房产中，有5.2万处房产所有者的身份仍然不明。可疑的所有者会绕开规则，而注册机构常常缺乏监管他们的人力物力。

美国也对花一大笔钱就能买到公民身份的“黄金”签证感到担忧。加勒比海的五个避税天堂国家出售可以免签150个国家的护照，售价10万至15万美元不等。英国在2008年启动了Tier 1签证计划，外国人只要能证明自己有100万英镑（125万美元）用来投资英国的债券或股票，就能在五年内获得永久居留权。由于担心俄罗斯资金，英国在乌克兰战争开始前一周叫停了该签证（典型的失马锁厩）。在签发的13,777份签证中，五分之一发给了俄罗斯人（其中有十份发给了目前受到制裁的寡头），三分之一发给了中国人。

在伦敦，海格特公墓里长眠的一个人就是一个警告。在那里可以找到亚历山大·利特维年科（Alexander Litvinenko）的坟墓，离寡头们的豪宅不算远（离卡尔·马克思的墓也不远）。他曾对普京圈子里的人发起内容骇人听闻的指控，之后在2006年被俄罗斯特工用钋-210毒杀。利特维年科的遗体被放置在一个特制的铅衬密封棺材里，以防辐射泄漏。而今，西方当局需要防止危险资产渗透到它们的国家。 ■



Which billionaires lost out?

The 2023 crony-capitalism index

War, tech woes and cock-ups have pummelled certain plutocrats

OVER THE past 20 years, Britain's capital was so welcoming to oligarchs that it became known as "Londongrad". Many bought mansions from Highgate to Hyde Park; a couple bought into football clubs. After Russia invaded Ukraine in February last year, 48 oligarchs were placed under Western sanctions. The immense wealth of many of Vladimir Putin's associates highlights the problem of crony capitalism and why more should be done to combat it.

According to the latest instalment of our crony-capitalism index, which first estimated how much plutocrats profit from rent-seeking industries almost a decade ago, crony capitalists' wealth has risen from \$315bn, or 1% of global GDP, 25 years ago to \$3trn or nearly 3% of global GDP now (see chart 1). Some 65% of the increase has come from America, China, India and Russia. Overall 40% of crony-capitalist wealth derives from autocratic countries and amounts to 9% of their GDP. There are hundreds of billionaires around the world whose riches are largely believed to derive from sectors which often feature chummy dealings with the state.

The way we estimate all this is to start with data from Forbes. The magazine has published an annual stock-take of the world's wealthy for nearly four decades. In 1998 it reckoned that there were 209 billionaires with a total worth of \$1trn, equivalent to 3% of global GDP. This year the publication details 2,640 billionaires worth \$12trn or 12% of GDP. Most of those listed do not operate in rent-seeking sectors. Adjusting for rising prices—\$1bn in 1998 is now equivalent to \$3.3bn—there are 877 billionaires (at 1998 prices) with a collective worth of \$9trn.

We classify the source of wealth into rent-seeking and non-rent-seeking sectors. An economic rent is the surplus remaining once capital and labour have been paid which, with perfect competition, tends towards zero. Rent-seeking is common in sectors close to the state, including banking, construction, property and natural resources. It can sometimes be possible for rent-seekers to inflate their earnings by gaining favourable access to land, licences and resources. They may form cartels to limit competition or lobby the government for cosy regulations. They may bend rules, but do not typically break them.

Russia is, once again, the most crony-capitalist country in our index (see chart 2). Billionaire wealth from crony sectors amounts to 19% of GDP. The effects of the Ukrainian war are clear, however. Crony wealth declined from \$456bn in 2021 to \$387bn this year. Only one-fifth of Russian billionaires' wealth is derived from non-crony sectors, which shows just how distorted the economy is.

In March last year, the G7, the EU and Australia launched the Russian Elites, Proxies and Oligarchs (REPO) Task Force to “isolate and exert unprecedented pressure on sanctioned Russian individuals”. A year later it announced that it had blocked or frozen \$58bn of assets. But REPO admits that in some cases oligarchs have found it easy to evade sanctions by using shell companies, passing assets to family members or investing in property. Wealth is increasingly stored in manicured lawns and marble columns.

Pressure on the oligarchs comes from Russia, too. In March Mr Putin chastised them for becoming “dependent on foreign authorities” by hiding their assets offshore. Mr Putin is a hypocrite. By one estimate he has stolen more than \$100bn from Russia—which has helped pay for a compound on the Black Sea estimated to cost \$1.4bn and a \$700m yacht impounded by the Italian authorities last year. But he is not on the Forbes billionaires’ list.

Our index illuminates other trends among the mega-wealthy. Many of America's 735 billionaires have been hit by the crash in tech stocks last year; three-fifths of global tech-billionaire wealth originates there. The country's NASDAQ composite, a tech-tilted index, lost about a third of its value between November 2021 and December 2022. We reckon American tech billionaires saw their riches decline by 18%.

Overall crony-sector wealth amounts to around 2% of GDP in America, whereas non-crony-sector wealth is 15%. But tech exhibits some crony characteristics. America's 20 biggest tech companies raked in half of all the industry's sales in 2017, making it the country's most concentrated sector. Tech firms are among the biggest lobbyists in Washington, with eight firms collectively spending \$100m last year. Reclassify tech as a crony industry in our index and America's crony wealth increases to 6% of GDP.

Meanwhile, Chinese billionaires continue to struggle with the vagaries of their government. Since Xi Jinping launched a crackdown on private capital, crony wealth has fallen sharply, from a peak of 4.4% of GDP in 2018 to 2.5% now. Tycoons of all stripes operate only with the consent of the state. In 1998 there were just eight billionaires in the country (including Hong Kong and Macau), with a total worth of \$50bn. Now its 562 billionaires command \$2trn.

By our measure crony capitalists account for about one-quarter of that total. A recent working paper published by the Stone Centre on Socio-Economic Inequality, part of the City University of New York, finds that between 83% and 91% of corrupt senior officials were in the top 1% of the urban income distribution because of their illegal incomes. Without that money, just 6% would be in that bracket.

Since Mr Xi came to power in 2012 over 1.5m people have been punished in an ongoing anti-corruption drive. High-profile tycoons also face more

scrutiny. When Jack Ma, a co-founder of the tech giant Alibaba, disappeared in late 2020 after criticising the authorities, he was worth nearly \$50bn. He recently re-emerged worth half of what he had been. Bao Fan, a billionaire banker, was whisked away in February to help with an investigation. He has not been seen since.

Official talk of “common prosperity” has created a cottage industry for getting money out of China. Singapore is a prime destination for it. In 2019 the country had just 33 Chinese family offices—firms which manage a family’s assets. There were perhaps 750 by the end of 2022.

India’s leader, Narendra Modi, has favourites among the country’s corporate captains. Over the past decade, wealth from crony-capitalist sectors has risen from 5% to nearly 8% of its GDP. Gautam Adani, the owner of the conglomerate of the same name, was briefly the world’s third-richest person in September. But in January his company was accused of fraud and stockmarket manipulation by Hindenburg Research, an American short-seller. It denies all accusations. His wealth has fallen from \$90bn to \$47bn.

What happens when cronyism gets completely out of control? If elites so enrich themselves that they impoverish a country, a “kleptocracy” forms, declared Stanislav Andreski, a Polish sociologist. He warned against such regimes and their effects in the late 1960s. It has taken more than 50 years for Western countries to heed him.

Identifying kleptocracy is more art than science. Our findings correlate only somewhat to indices of democracy and corruption. And in any case, at what level does corruption destroy the functions of the state? USAID, America’s agency for international development, issued an 84-page “dekleptification” guide last year. After studying 13 countries including Brazil, Malaysia and Ukraine, it recommends breaking up corrupt monopolies and digitising ownership registries, among other important measures.

America is also trying to whip up international fervour for a crackdown. In March it hosted its second “summit for democracy”. Seventy-four countries representing two-thirds of global GDP declared that, among other things, they would work to “prevent and combat corruption”. Russia and China were understandably missing. Brazil, Indonesia and South Africa were among those less understandably so.

At the summit Janet Yellen, America’s treasury secretary, pointed out that “kleptocrats launder kickbacks through anonymous purchases of foreign real estate”. So starting next year America will require firms formed or operating in the country to reveal their real, or “beneficial”, owners. Another 36 countries have signed up to America’s declaration to make concealing identity more difficult. But transparency is not a silver bullet. Last year a new law in Britain required foreign businesses that own property assets to register themselves and disclose their true owners. A report in February by an anti-corruption watchdog found that the owners of 52,000 of the 92,000 properties subject to the new rule remained undisclosed. Shady owners skirt rules and registries often lack the resources to police them.

America also frets about “golden” visas, which sell citizenship for a chunk of cash. Five Caribbean tax havens sell passports which provide visa-free travel to around 150 countries for \$100,000-150,000 each. Britain’s tier-one visa scheme, launched in 2008, gave permanent residency within five years to foreigners who could prove they had £1m (\$1.25m) to invest in British bonds or shares. It closed a week before the war in Ukraine started because of fears about Russian money (talk about closing the stable door once the thoroughbred has bolted). Of the 13,777 visas issued, a fifth went to Russians (including ten to oligarchs now under sanctions), a third to Chinese.

Back in London, a warning lies in Highgate cemetery. There you can find the grave of Alexander Litvinenko, not far from oligarch mansions (and also Karl Marx’s tomb). He was murdered in 2006 by Russian agents with a

dose of polonium-210 after making lurid allegations about Mr Putin's circle. Litvinenko is buried in a specially sealed lead-lined casket to prevent radiation leaking out. Now Western authorities need to prevent hazardous assets seeping into their countries. ■



【首文】有益的病毒

如何利用病毒“吃掉”超级细菌

抗生素耐药性蔓延，噬菌体可助力扭转危机

抗生素在现代医疗中至关重要。抗生素能杀死细菌而不伤害病人，直接拯救了数十亿人的生命，还大大提高了从剖腹产到化疗的各种治疗手段的安全性。假如没有抗生素，人们的预期寿命将缩短三分之一。但近几十年的过度使用正让抗生素的威力消退。一些细菌已进化出耐药性，形成一支日益壮大的“超级细菌”大军，对它们目前尚无有效治疗手段。预计到2050年，抗生素耐药性将导致每年1000万人死亡，而在2019年约为100万。

寄望靠研发新抗生素来解决这个问题是不明智的。耐药性出现的速度正在加快。一些新药推出才两年，所针对的细菌就有了抗药性。等真有了新抗生素，医生又往往不轻易拿出来用，只有在碰到最严重的感染才勉强开出短期处方。这有助于限制新药的耐药性传播，但也限制了新药的销售，导致大多数制药公司缺乏动力来研发它们。

各国政府一直试图通过发放研究资金和入股制药公司来解决这个问题，但成效有限。不过有一个前景不俗（尽管鲜为人知）的替代方案值得探讨。微生物学家几十年前就已知道，致病细菌自己也会生病。它们易受噬菌体攻击：这些病毒会感染细菌，往往能致其死亡。

利用一种病原体对抗另一种病原体有几个优点。与抗生素一样，噬菌体在选择攻击目标时非常有针对性，只会感染和破坏细菌细胞，而不影响人体细胞。有别于抗生素，噬菌体可以像细菌那样快速进化，这意味着即使细菌产生抗性，噬菌体可能也会相应进化而保持效力。

至少在理论上是这样。噬菌体的问题是人们对它们的了解相对较少。自从第一种抗生素青霉素在1928年被发现后，西方就基本上忽略了噬菌体。只有前苏联通过在格鲁吉亚的研究和生产设施继续使用噬菌体。鉴于抗生素耐药性问题的严重性，对噬菌体作进一步研究是个好主意。

第一步是做更多临床试验。西方公司的兴趣日增。但一个阻碍是噬菌体甚至比抗生素还不具备投资吸引力。由于它们是天然生物，可能不易申请专利，导致难以收回投资。

政府可以帮忙。例如资助噬菌体疗法的基础研究，解释专利法规，明确哪些噬菌体可以申请专利。日后，政府还可以建立噬菌体库及制造流程，以降低生产成本。也可以大力宣传滥用抗生素的风险及噬菌体的潜在好处。对于摄入病毒的做法感到抗拒？想一想青霉素，它也是一种霉菌。

抗生素本身的历史表明，政府可以助力推动私营部门行动起来。青霉素起初普遍不受医生青睐，他们认为生产它的难度太大。直至第二次世界大战的悲剧加上英美政府插手，现代抗生素产业才得以启动。不像战争那样瞬间爆发，抗生素耐药性是缓慢酝酿的麻烦。尽管如此，现在该行动了。 ■



When viruses are good for you

How to battle superbugs with viruses that “eat” them

As antibiotic resistance spreads, bacteriophages could help avert a crisis

ANTIBIOTICS ARE vital to modern medicine. Their ability to kill bacteria without harming the patient has saved billions of lives directly and made everything from caesarean sections to chemotherapy much safer. Life expectancy would drop by a third if they did not exist. But after decades of overuse their powers are fading. Some bacteria have evolved resistance, creating a growing army of “superbugs” against which there is no effective treatment. Antimicrobial resistance is expected to kill 10m people a year by 2050, up from around 1m in 2019.

It would be unwise to rely on new antibiotics to solve the problem. The rate at which resistance emerges is accelerating. Some new drugs last only two years before bacteria devise countermeasures. When new antibiotics do arrive, doctors often hoard them, prescribing them only grudgingly and for short periods when faced with the most intransigent infections. That helps limit the spread of resistance to new drugs. But it also limits sales, making new antibiotics an unattractive proposition for most pharmaceutical firms.

Governments have been trying to fix the problem by funnelling cash into research and taking stakes in drug firms. That has produced only limited improvements. But there is a promising, if obscure, alternative that is also worth a look. Microbiologists have known for decades that disease-causing bacteria can suffer from illnesses of their own. They are susceptible to attack by bacteriophages (“phages” for short): specialised viruses that infect bacteria, and often kill them.

Using one disease-causing organism to fight another has several

advantages. Like antibiotics, phages are picky in their choice of target, leaving human cells alone even as they infect and destroy bacterial ones. Unlike antibiotics, phages can evolve just as readily as bacteria can, meaning that even if bacteria do develop resistance, the phages may be able to evolve around it in turn.

That, at least, is the theory. The trouble with phages is that comparatively little is known about them. After the discovery of penicillin, the first antibiotic, in 1928, they were largely ignored in the West. Only the Soviet Union, powered by research and production facilities in Georgia, continued to use them. Given the gravity of the antibiotic-resistance problem, it would be a good idea to find out more.

The first step is to run more clinical trials. Interest from Western firms is growing. But it is being held back by the fact that phages are an even less appealing investment than antibiotics. Since they are natural organisms there may be trouble patenting them, making it hard to recoup any investment.

Governments can help. They could fund basic research into phage therapy, and clarify the law around exactly what is and is not patentable. In time they could set up phage banks and manufacturing processes, so as to make production cheaper. And they could spread awareness of the risks of overusing antibiotics, and the potential benefits of phages. If you are put off by the thought of ingesting a virus, consider that penicillin was a mould.

The history of antibiotics themselves shows that governments can help nudge the private sector into action. Penicillin was largely ignored at first by doctors, who regarded it as too difficult to produce. It took the tragedy of the second world war, and the intervention of the American and British governments, to kickstart the modern antibiotics industry. Compared with a war, antibiotic resistance is a slow-burning problem. Nonetheless, the time

to act is now. ■



幕后故事

当故事失去一个主角，会发生什么？

死亡的剧透程度更胜本文

编者按：本文有剧透

和猫王一样，他倒在了卫生间，只不过洛根·罗伊（Logan Roy）是在一架私人飞机上。他要卖掉自己的媒体集团威斯特-洛伊科（Waystar Royco），事发时他正在前去和一位瑞典的亿万富翁讨价还价。没有用尽最后一口气挤出的咒骂，也没有掀起剧情高潮的残暴行径或骗人伎俩。他就这么走了。

三季多一点的剧情当中充满了污言秽语的羞辱、反社会言行、背刺和了无乐趣的奢华，洛根（布莱恩·考克斯饰演）是《继承之战》（Succession）中的恶龙，身边环绕着一众蛇蝎般的人物。接着，创剧人杰西·阿姆斯特朗（Jesse Armstrong）在最后一季还剩七集的时候写死了他。像这样早早杀死一个重要人物在叙事上是一招险棋，但有时，如果故事讲述者干得漂亮，也会是非同凡响的一招。

之所以说冒险，是因为故事讲述者与观众或读者有种秘而不宣的契约：他们对主角倾注感情，作为回报，主角会一直活下去。过早杀死主角会让观众觉得被背叛——即便他们的死亡通过剧名就可以预料到，洛根的死就是这样。这么做可以倾斜整个故事的主题，尽管很少会像《惊魂记》（Psycho）那样剧烈。希区柯克在剧情进行到一半时让珍妮特·利（Janet Leigh）冲了个澡，结果这部影片从一部抢劫片变成了一部血腥片。

让主演“领盒饭”在营销上令人头疼。如果《惊声尖叫》（Scream）的观众花钱是为了看德鲁·巴里摩尔（Drew Barrymore）这位演员表上的巨星，结果开场12分钟后却看到她被开膛破肚，可能就会觉得被坑。一般来说，明星太贵，又难伺候，太早让他们下线会很亏。也许最重要的问题是，搬

出一个有时被称作“假主角”的老把戏在艺术上是个挑战。创意写作的一条真理是，即使是小角色也应该有属于自己的不为人所知的故事。杀死了主角，你就得把背后的故事讲出来。

然而，一些最出色的编剧和剧集运作人还是接受了这一挑战。在《权力的游戏》中，肖恩·宾（Sean Bean）饰演的角色太崇高，维斯特洛大陆（Westeros）上不配有这么一号人，第一季还没结束他就人头落地。《国土安全》将主人公之一布罗迪（Brody，达米安·刘易斯[Damian Lewis]饰）骇人地吊死在伊朗的一架起重机上，让期待最后关头天降救援的粉丝幻想破灭。

斯丁格·贝尔（Stringer Bell，伊德里斯·艾尔巴[Idris Elba]饰）是《火线》（The Wire）中最精明练达的人物，他在倒数第三季就一命呜呼，尚未成功从黑帮成员转型商业人士，一句“那动手吧，狗日……”都没来得及说完。这部剧集不可思议的天才之处的表现之一是另一名重要角色、杀他的凶手奥马（Omar，迈克尔·K·威廉姆斯[Michael K. Williams]饰）本人也是不期然遭遇了残酷的结局——在买烟时被一个孩子开枪打死。在《麦克白》第五幕的开头，莎士比亚让麦克白夫人精神恍惚地走下舞台，再也没让她回来。“她反正要死的。”她的丈夫略带愠怒地说。

主角提早死亡的价值不仅在于带给观众的震撼——影片《异形》（Alien）开演没多久，一个妖怪就从约翰·赫特（John Hurt）的胸口破膛而出，将这种震撼推到了顶点。主角的早亡搅乱观者的预期，让人们明白，那种包含精心设计的布局和情节的传统故事形态与真实生活的形态并不相符。现实人生是脆弱而混乱的，往往并不会结束得优雅利落，也不会遵循一张齐整的时间表。洛根在他大儿子的婚礼那天咽了气（反正他也没打算到场）。

换句话说，跟本文相比，死亡本身是个更大的剧透。而当一个主要角色死亡而故事还在继续，它的余波还会以另一种方式模仿现实中的丧亲之痛。观众就像哀悼者一样，必须想办法处理他们突然间满溢的情感。就像真实的死亡会改变生者之间的关系一样，虚构的死亡除了改变角色之间的关

系，也会改变观众和角色之间的关系。

洛根的子女们担心他是否能从贴在耳边的电话中听到他们语无伦次的话语，担心种种没来得及说出口的事情，担心他们究竟有多了解他。他们意识到这是重大的一天，他们的所作所为要顾及后代（还要顾及威斯特-洛伊科的股价）。他们的种种性格特质冲撞在一起：他们既是成年人，又是怯懦的孩子；一边猜测洛根原本打的是什么主意，一边又意识到“老爸地图”已不再能引导他们，夹在中间进退失据。

接下来就该让罗伊的后代成为自己故事中的主人公了。他们和那群油滑的狗头军师一道，重又回到互相羞辱、胁迫和耍阴谋的状态。他们开玩笑说死去的父亲打色情电话，还为了买他的公寓和他那个分居的妻子讨价还价。发生在他们身上的事情就是现实生活中会发生的事情，即使在悲伤四伏之时这些似乎不该也不会发生。一切继续。 ■



Back Story

What happens when a story loses a main character?

Death is even more of a spoiler than this column

Editor's note: Beware spoilers in this article

LIKE ELVIS, he conked out, bathetically, in a bathroom, only in Logan Roy's case it was on a private plane, en route to haggle with a Swedish billionaire over the sale of his media conglomerate, Waystar Royco. He uttered no last-gasp curse, committed no climactic act of tyranny or deceit. He was just gone.

For three and a bit seasons of scatological insults and sociopathy, backstabbing and joyless luxury, Logan (played by Brian Cox) was the dragon around whom the viperous cast of "Succession" slithered. Then Jesse Armstrong, its creator, bumped him off with seven episodes of the final series to go. Killing a kingpin early in this way is a risky narrative move, but sometimes, if storytellers pull it off, a profound one.

Risky, because of an implicit contract with the audience or reader: that their investment in a main character will earn a return in longevity. Offing them too quickly can feel like a betrayal—even if, like Logan's, their demise is anticipated in the show's title. It can tilt the entire proposition of a story, if rarely as drastically as in "Psycho", which morphed from a heist film to a slasher movie when Alfred Hitchcock sent Janet Leigh to have a shower halfway through.

Terminating a lead is a marketing headache. If they paid to see Drew Barrymore, audiences of "Scream" may have felt short-changed when, though purportedly one of its stars, she was disembowelled after 12 minutes. Mostly stars are too expensive, and too demanding, to be

jettisoned early. Perhaps above all, fielding a “false protagonist”, as the trope is sometimes known, is an artistic challenge. A truism of creative writing holds that even minor characters should have their own untold stories. Kill the protagonist and you have to tell them.

Nevertheless, it is a challenge that some of the best writers and showrunners take up. Sean Bean’s character was too noble for Westeros and lost his head before the end of the first season of “Game of Thrones”. “Homeland” hanged Brody (Damian Lewis), one of its heroes, grimly from a crane in Iran, disenchanting fans who expected an 11th-hour rescue.

For his part, Stringer Bell (Idris Elba), the suavest figure in “The Wire”, bit the dust with just over two seasons to run, midway through his transformation from gangster to businessman and in the middle of a word: “Well get on with it, motherf...” It is part of that show’s illusionless genius that his killer, Omar (Michael K. Williams), another mainstay, met a brutally random end himself, shot by a child as he bought cigarettes. At the start of act five of “Macbeth”, Shakespeare makes Lady Macbeth wander offstage madly, never to return. “She should have died hereafter,” says her miffed husband.

The value of these premature deaths lies not only in shock—maximised when a gremlin burst out of John Hurt’s chest not long into “Alien”. By confounding expectations, they make it clear that the conventional shape of a story, with its finely wrought acts and arcs, does not match the shape of a life. Real lives are precarious and messy; they tend not to end neatly or on an elegant schedule. Logan snuffs it on the day of his eldest son’s wedding (he wasn’t going anyway).

Death, in other words, is even more of a spoiler than this column. And when a principal character dies and a story continues, the aftermath mimics bereavement in another way. Audiences, like mourners, must figure out what to do with their suddenly surplus affections. Just as an actual death

revises relations among the living, a fictional one shakes up the relationships between viewers and characters, as well as among the characters themselves.

Logan's children worry about whether he could hear the words they spluttered through the phone pressed to his ear, about everything left unsaid and how well they ever knew him. They sense the day is momentous, and that they should act with an eye to posterity (the other eye is on Waystar Royco's share price). Their personalities concertina: they are at once adults and quailing children, torn between guessing what Logan would have wanted and realising that "dad maps" can no longer guide them.

Then it is time for the Roy offspring to become the heroes of their stories. With their oily consiglieres, they get back to insulting, blackmailing and plotting against each other. They make jokes about their dead father having phone sex and bargain with his estranged wife over his apartment. What happens to them is what happens in real life, even when, amid grief's ambushes, it seems as if it mustn't and can't. It goes on. ■



亚洲商业

印度公司涌向阿联酋

忘记孟买吧，迪拜才是理想之地

站在迪拜熙熙攘攘的米娜集市（Meena Bazaar）中央，不难想象自己身在隔着阿拉伯海、1200英里之外的孟买。街巷里满是Biryaniwalla & Co、Mini Punjab Restaurant、Tanishq珠宝店这样的店名。人们用阿拉伯语交流，也讲印地语和马拉雅拉姆语（Malayalam）。傲立迪拜湾（Dubai Creek）的巴罗达银行（Bank of Baroda）可能是这里最显眼的一家金融机构，而它是一家印度国有银行。

米娜集市不仅仅是一个族群飞地，从这里还可以一窥印度那庞大且不断发展的企业网络，其中有许多公司在阿拉伯联合酋长国举足轻重。生活在迪拜就是在参与印度商业。当地商会报告称，2022年，商会记录的印度公司增加了约1.1万家，总数达到8.3万家。两国之间的贸易联系日趋紧密。

这些公司背后有一个庞大的侨民群体。有350万印度人居住在阿联酋，而本地人才120万。这些侨民在2021年总共汇回了200亿美元，仅次于从美国到墨西哥的汇款（见图表）。孟买的许多人开玩笑说阿布扎比和迪拜现在是最干净的印度城市。对阿联酋而言，印度是食品、宝石、珠宝、皮革、人员、药品和投资机会的来源国。对印度来说，阿联酋是重要的资本来源国，而且越来越多的印度企业可以在这里高效地与全球市场相连，不必忍受自己国家那束缚手脚的官僚做派、瘫痪的交通、缓慢的机场入境检查和繁重的税收。

这样的关系放在1973年是无法想象的，米娜集市的名字就来自当时一家销售印度纱丽的商店。那时的阿布扎比极度贫困。当地用水由于脱盐不充分常有一股苦咸味。一种被称为“外部卢比”的印度卢比被用作当地的流通货币直到1966年。在1971年，原来的停战诸国（Trucial States，通过旧条约联系在一起的部落）结成联邦后才有了现在的阿联酋。几乎所有国际贸易

(在发现石油之前)都要通过孟买, 主要货物包括钻石、珍珠和宝石。半个世纪后, 情况发生了翻天覆地的变化。在人头攒动的阿联酋购物中心, 来自全球各地的最高端产品琳琅满目。迪拜68层高的钻石大厦(Almas Tower)里全是印度宝石商, 他们在一楼的Delhi Darbar Express和Mumbai Masala等印度餐厅里就餐。

两地的人员往来极为频繁, 而且还在增长。印度当局目前给迪拜旗舰航空公司阿联酋航空(Emirates) 的座位上限为每周6.6万个, 但阿联酋航空还想再要5万个, 并称提高上限也会让其他航空公司受益。孟买商人经常当日往返阿联酋。许多人选择停留更久些, 他们通常持有十年期“黄金”签证。印度驻阿联酋大使馆的一项调查发现, 大公司的首席财务官有60%是印度人。25年前从德里搬到迪拜的基金经理潘卡·古普塔(Pankaj Gupta)说, 阿联酋各行各业都有印度人在高层任职。去年5月生效的贸易协议进一步推动了两国间贸易, 名义贸易额在过去一年增长了16%。

这影响了印度成功人士的地理分布。正如《印度时报》(Times of India)所说, “富裕的印度人有了新住址”。印度首富穆克什·安巴尼(Mukesh Ambani)去年8月以8000万美元的价格购买了一处房产, 打破了迪拜的房价记录。该房产位于一个棕榈掩映的群岛的一个尖角上, 有十间卧室、室内和室外游泳池、私家海滩, 还有一个私人水疗中心。到10月, 他又以1.63亿美元的价格打破了这一记录(房产细节更鲜为人知)。去年印度人在迪拜总共花了43亿美元购买房产, 是2021年的两倍。购买商业地产的数据更难挖掘, 但据一位银行家说兴趣同样非常高涨。印度税法中的奇怪条款刺激了这股热潮, 它们把那些想要把现金转移到国外的人逼去了海外置业。

阿联酋的税收制度也发挥了吸引力: 这里没有个税。相比之下, 印度的所得税率接近40%, 消费税也高得离谱。印度的企业所得税不仅更高, 还异常纷繁复杂。

两地之间还有其他重要的法律差异。阿联酋理论上遵循严格的伊斯兰法。实际上, 它现在设有遵循国际标准的商业法庭, 且对恶习的态度较宽容。

它还鼓励宗教多元化。阿布扎比最近新建了一座巨大的印度教寺庙，还有一个集合了穆斯林-基督教-犹太教的宗教中心。印度在名义上世俗化，确立了普通法。但实际上，它的法庭积案累累、严格执行反对酗酒等恶习的法律，而且宗教冲突日益加剧。

与阿联酋的联系更加紧密也有利于那些在印度从商的人。自2020年起，阿联酋越来越被视为重要的资本来源国，安巴尼在那一年从阿联酋的多个主权财富基金筹集到数十亿美元。咨询公司贝恩估计，从2018年到2022年，阿联酋主权财富基金和其他私募股权公司在印度的投资金额稳步上升，总计达340亿美元。

投资的触角很广泛。阿联酋在印度一些重要的银行、制造企业和创业公司直接持股。阿布扎比已经向印度第二大富豪高塔姆·阿达尼（Gautam Adani）的几家公司投资了数十亿美元。人们普遍认为，如果阿达尼对其企业进行资本重组，阿布扎比将是一个重要的资金来源地。所有这些都表明阿联酋正在演变成印度的一个金融中心。

不过这种演变并非没有障碍。去年3月，阿联酋被打击洗钱和恐怖主义融资的国际机构“金融行动特别工作组”（Financial Action Task Force）列入“灰名单”。当地有人说，自进入该名单以来，常规汇款也受到严格的审查。一些原本想在阿联酋开设家族办公室的印度富人决定转而通过新加坡和伦敦进行海外投资，这两个城市分别比阿联酋远三倍和四倍。

另一个障碍是大多数印度人的签证最终都需要续签。目前阿联酋之所以有这样的开放和进步，是因为阿联酋王室支持两地之间的往来，这让人们可以果断决策，大量投资。但对许多人来说，这也是需要谨慎的理由。如果当地领导人改主意了怎么办？另外，印度商人也担心自己的统治者，他们的行事常常也似君主般突发奇想，随心所欲。

然而，当前乐观情绪高涨，许多人觉得这些障碍只是小问题。他们认为，阿布扎比和迪拜与印度的关系将越来越类似于新加坡与东南亚的关系：小城邦治理有序，庞大邻国的经济活力和潜力被混乱的管理和有害的法规削

弱，前者可以充当后者的金融和商业渠道。最支持这类观点的都是在千禧年之前来到阿布扎比或迪拜，并见证了这些城市快速崛起的印度人。他们指着雄伟的建筑回想当年，那会儿这些高楼大厦还只是沙漠里的海市蜃楼。 ■



Asian commerce

Indian firms are flocking to the United Arab Emirates

Forget Mumbai. Dubai is the place to be

STAND IN THE middle of the teeming Meena Bazaar in Dubai and it is not hard to imagine you are 1,200 miles across the Arabian Sea in Mumbai. Lanes are filled with names like Biryaniwalla & Co, Mini Punjab Restaurant and Tanishq jewellery. Arabic works as a means of communication; so, too, do Hindi and Malayalam. The financial institution with perhaps the greatest prominence, looming over the Dubai Creek, is Bank of Baroda, which is controlled by the Indian state.

Rather than serving merely as an ethnic enclave, the Meena Bazaar is the visible tip of a vast, growing network of Indian businesses—one that includes many of the most important companies in the United Arab Emirates (UAE). To live in Dubai is to play a part in Indian commerce. The local business chamber reports that some 11,000 Indian-owned companies were added to its records in 2022, bringing the total number to 83,000. Trade links between the two countries are getting ever tighter.

Behind these companies stands a vast diaspora: 3.5m Indians live in the UAE, compared with 1.2m Emiratis. These expats collectively sent home \$20bn in 2021, a transfer exceeded only by remittances from America to Mexico (see chart). Many in Mumbai joke that Abu Dhabi and Dubai are now the cleanest Indian cities. For the UAE, India is a source of food, gems, jewellery, leather, people, pharmaceuticals and investment opportunities. For India, the UAE is a crucial source of capital and, increasingly, a place where Indian business can efficiently connect with global markets away from its homeland's debilitating red tape, crippling traffic, stalled airport immigration lines and punitive taxes.

This relationship would have been unimaginable in 1973, when a store selling Indian saris gave the Meena Bazaar its name. Abu Dhabi was desperately poor. Insufficient desalination meant water was often brackish. Until 1966 a version of the Indian rupee, called the “external rupee”, served as the area’s currency. The UAE had only emerged from what was known as the Trucial States, tribal lands linked by old treaties, in 1971. Almost all international trade, which (pre-oil) mostly consisted of diamonds, pearls and gems, passed through Bombay. Half a century later, conditions have turned on their head. Crowded Emirati malls glitter with the world’s most sophisticated products. Indian gem traders fill Dubai’s 68-storey Almas Tower, fed by ground-level restaurants such as Delhi Darbar Express and Mumbai Masala.

Travel between the two regions is frenetic and growing. Emirates, Dubai’s flagship airline, is capped by Indian authorities at 66,000 seats a week; it wants another 50,000 and argues higher limits would benefit other carriers, too. Mumbai businessmen frequently make day trips to the UAE. Many choose to stay longer, often with “golden” ten-year visas. A survey by the Indian Embassy in the UAE finds that 60% of chief financial officers of major firms are Indian. Pankaj Gupta, a fund manager who moved to Dubai from Delhi 25 years ago, says Indians can be found in top jobs across industries in the Emirates. Nominal trade between the two countries has grown by 16% in the past year, boosted by a trade deal that went into effect in May.

This has had an impact on the geography of Indian success. “Affluent India has a new residential address,” as the Times of India has put it. Mukesh Ambani, India’s richest citizen, broke Dubai’s house-price record in August with the purchase of a property for \$80m (replete with ten bedrooms, indoor and outdoor swimming pools, a beach and a private spa, it sits at the tip of a palm-fringed archipelago). He then broke that record with a \$163m purchase in October (about which details are more scarce). All told, Indians last year

spent \$4.3bn on housing in Dubai, twice as much as in 2021. Figures on commercial purchases of property are harder to unearth, but one banker reports that interest has been just as intense. These are spurred by odd provisions in India's tax code that push people who want to get cash out of the country into property investments.

The UAE's tax system exerts its own pull: there are no personal taxes. By contrast, Indian income taxes approach 40% and come on top of swinging consumption levies. Corporate-income taxes are not only higher in India, they are also bewildering in their complexity.

There are other important legal differences. The UAE technically operates under strict Islamic law. In practice, it now has commercial courts that operate under international standards and a tolerant view of vice. It also encourages religious pluralism. Abu Dhabi recently built an enormous Hindu temple and combined Muslim-Christian-Jewish centre. India is technically secular with established common law. But in practice it offers clogged courts, strictly enforced anti-alcohol and vice laws, and increasing religious strife.

Closer links with the UAE are to the advantage of those doing business in India, too. Beginning in 2020, when Mr Ambani raised billions of dollars from the UAE's many sovereign-wealth funds, the country has increasingly been seen as an important source of capital. Bain, a consultancy, reckons that between 2018 and 2022, Emirati sovereign-wealth funds and other private-equity firms invested \$34bn in India, in steadily rising amounts.

The range of investments is impressive. There are direct stakes in some of India's leading banks, manufacturers and startups. It is widely assumed that if Gautam Adani, India's second-richest tycoon, recapitalises his businesses, a crucial source of finance will be Abu Dhabi, which has already invested billions of dollars in several of his companies. All of this suggests

that the Emirates is evolving into a financial capital for India.

Yet this evolution is not free of obstacles. In March last year the UAE was put on the “grey list” by the Financial Action Task Force, an international body that battles money-laundering and terrorist finance. Locals say that, since the designation, routine cash transfers have drawn intense scrutiny. Some rich Indians who would like to open family offices in the Emirates instead decide to route foreign investments through Singapore and London, respectively three and four times as far away.

Another obstacle is that most Indians’ visas will ultimately need to be renewed. The current Emirati openness and progress has come because the monarchy supports the direction of travel. This has allowed for decisiveness and lavish investment but is also, for many, a reason for caution. What if local leaders change their minds? That said, Indian businessmen also worry about their own rulers, who often seem to operate in monarchical fashion in terms of their whims and favourites.

Nevertheless, present optimism is now so heady that many see these obstacles as mere wrinkles. They believe that the relationship of Abu Dhabi and Dubai to India will increasingly come to resemble that of Singapore to South-East Asia: small, orderly city-states serving as financial and business conduits to enormous, unruly neighbours where economic dynamism and potential is undercut by chaotic administration and corrosive rules. The strongest statements of this type invariably come from Indians who arrived in Abu Dhabi or Dubai before the turn of the millennium, and have witnessed the cities’ extraordinary rise. They point to large buildings and remember when the properties were just lines sketched in the sand. ■



经济学人视频

AI聊天机器人将如何改变互联网？ - 1

去年，对生成式AI的风险投资总计超过10亿美元。投资者希望有人可以用新技术冲击谷歌的王座。



The Economist Film

How will AI chatbots change the internet? - 1

Last year, venture capital investment in generative AI totalled over \$ 1bn. Investors are hoping with this new tech, someone could steal Google's crown.



中美科技竞赛

中国在生成式AI方面能有多厉害？

中国的AI模型未来也许可以和美国的相媲美。但这可能不会转化为经济或军事优势
【深度】

从北京和华盛顿唱的高调听起来，美国和中国正全力以赴投入一场争夺科技霸主地位的较量。“从根本上说，我们相信少数几项技术将在未来十年发挥极其重要的作用。”美国总统拜登的国家安全顾问杰克·沙利文（Jake Sullivan）去年9月宣称。今年2月，中国最高领导人习近平呼应了这一观点，指出“迫切需要我们加强基础研究，从源头和底层解决关键技术问题”，以“应对国际科技竞争、实现高水平自力自强”。

没有哪项技术比人工智能（AI）在眼下引发了太平洋两岸的决策者更多的关切。ChatGPT等“生成式”AI的能力迅速提升，愈发加强了这种关注。这类模型分析整个网络上的人类文本、图像或声音，然后创造出越来越像模像样的仿造物。如果生成式AI真像其支持者所说的那样具有变革性，那么运用它的国家就可能在21世纪首要的一场地缘政治竞争中获得经济和军事上的优势。西方和中国的战略家已经在讨论AI军备竞赛。中国能赢吗？

前些年，中国在某些衡量AI实力的指标上跑到了美国前面（见图表）。2019年，中国的AI高被引论文占比超过了美国。2021年，26%的全球AI会议论文来自中国，而来自美国的占17%。按AI论文发表量计算，全球排名前十的机构中有九个在中国。根据一个常用的基准，计算机视觉领域排名前五的实验室也在中国，这种AI对于一个共产主义监控国家特别有用。

然而，在“基础模型”这种赋予生成式AI智慧的工具上，美国稳坐头把交椅（见图表2和3）。ChatGPT及其背后的开创性模型（最新版本为GPT-4）是美国创业公司OpenAI的发明。其他一些美国公司也都有自己强大的系统，其中既有Anthropic或Stability AI等小公司，也有谷歌、Meta和微软（持有部分OpenAI股份）等巨头。文心是中国互联网搜索巨头百度打造的对标ChatGPT的产品，人们普遍认为它的智能程度没有ChatGPT高。中

国最强大的科技巨头阿里巴巴和腾讯尚未推出自己的生成式AI。

这促使知情人士得出了这样的结论：中国在建立基础模型方面比美国落后两三年。造成这一差距的原因有三个。第一个涉及数据。一个集权的威权政府应该能够收集大量数据，例如，中国政府之前将有关中国公民的大量监控信息移交给了商汤科技或旷视科技等公司，然后这些公司在中国领先的计算机视觉实验室的帮助下，用这些数据来开发一流的面部识别系统。

这项优势到了生成式AI上却没有那么强大了，因为基础模型是用网络上大量的非结构化数据训练的。根据互联网研究网站W3Techs的数据，56%的网站是英文的，而只有1.5%的网站是中文的，这有利于美国的建模者。正如斯坦福大学的傅亦沁指出的那样，中国人主要是通过微信和微博等超级移动应用与网络互动的。这些属于“围墙花园”，因此其中大部分内容都没有在搜索引擎上建立索引。这让AI模型更难吸收这些内容。由政府支持的北京智源人工智能研究院于2021年推出的模型“悟道2.0”尽管在计算层面上有可能比GPT-4更复杂，但未能引起轰动，缺乏数据也许是一个原因。

中国在生成式AI上的成果乏善可陈的第二个原因与硬件有关。去年，美国对那些可能在AI领域帮上中国一把的技术实施了出口管制。其中包括云计算数据中心（基础模型在其中学习）所用的强大微处理器，以及可以让中国自行制造此类半导体的芯片制造工具。

这打击了中国的建模者。英国智库人工智能治理中心（Centre for the Governance of AI）分析了26个中国大型模型后发现，超过一半的模型的处理能力都要依赖美国芯片设计公司英伟达。一些报告表明，中国最大的芯片制造商中芯国际的原型产品仅比为英伟达制造芯片的行业领导者台积电晚一两代（见图表4）。但中芯国际可能只能量产台积电在三四年前就生产了千百万片的芯片。

中国的AI公司难以从美国引入的另一样东西是专门知识。美国仍对全球科技人才极具吸引力：在主要AI会议上发布论文的美国的AI专家中有三分之二在国外出生。2019年，华裔工程师占到这个顶尖群体的27%。许多中国

的AI研究人员曾在美国学习或工作，后来带着专业知识回国。新冠疫情和中美关系紧张加剧导致这个队伍人数下降。2022年上半年，美国向中国学生发放的签证数量是2019年同期的一半。

数据、硬件和专门知识的三重短缺对中国造成了障碍。它是否会在很长一段时间内阻碍中国的AI雄心则是另一回事。

先说数据。今年2月，在汇集了中国近三分之一AI公司的北京，当地政府承诺开放115个政府下属单位的数据，为建模机构提供15,880个数据集。曾任美国驻华外交官，现供职于牛津大学的凯拉·布洛姆奎斯特（Kayla Blomquist）表示，中国的中央政府此前曾表示希望拆除中国应用的围墙花园，这样可能会释放出更多数据。近期这批大火的生成式模型还能够将机器学习从一种语言转移到另一种语言。OpenAI表示，尽管在训练数据中缺乏中文源材料，但GPT-4在中文任务上的表现非常出色。乔治华盛顿大学（George Washington University）的丁恩（Jeffrey Ding）指出，百度的文心接受了大量英语数据的训练。

在硬件方面，中国也在寻找变通办法。英国《金融时报》3月报道称，被美国列入黑名单的商汤科技利用中间商规避出口管制。一些中国AI公司正通过位于其他国家的云服务器使用英伟达的处理器。另外一个办法是购买更多英伟达不太先进的产品。为了继续服务广阔的中国市场，英伟达设计了符合制裁规定的产品，这些产品的速度比顶级产品慢10%到30%。对于中国客户来说，这最终增加了每单位处理能力的成本，但至少还够用。

有了“开源”模式的帮助，中国可以在一定程度上缓解芯片和专门知识的匮乏。任何人都可以下载此类模型的内在工作机制，并针对特定任务进行微调。这当中包括称为“权重”的数字，这些数字决定了模型的结构，是经由成本高昂的大量训练得出的。斯坦福大学的研究人员使用Meta的基础模型LLaMA的权重，构建了一个名为Alpaca的模型，成本不到600美元，而训练GPT-4之类的模型可能需要1亿美元。Alpaca在某些任务上的表现与ChatGPT的最初版本一样好。

中国的AI实验室同样可以利用体现了国际研究团队集体智慧的开源模型。另一家智库卡内基国际和平研究院（Carnegie Endowment for International Peace）的马特·希恩（Matt Sheehan）表示，中国一向擅长“快速追随”，其实验室吸收了国外的技术进展，迅速将之纳入自己的模型，而且它们通常受充裕的政府资源支持。一位知名硅谷风投家更加直言不讳，称开源模型是送给共产党的大礼。

考虑到上述因素，很难想象美国或中国能够在AI建模方面建立不可逾越的领先优势。两国都可能最终将拥有能力类似的AI，即使这会让中国因美国的制裁而付出额外代价。但是，如果建模者的竞争势均力敌，那么美国的一个优势可能让它成为AI大赢家，那就是它有能力在整个经济中传播尖端创新。毕竟，正是更高效的技术扩散帮助美国在与苏联的科技竞赛中取得领先，尽管苏联在上世纪50年代培养的理科博士数量是美国的两倍之多。

中国远比苏联善于采用新科技。它的金融科技平台、5G电信和高铁都是世界一流的。尽管如此，丁恩表示这些成功可能只是例外，而不是常态。尤其是中国在部署云计算和商业软件方面的表现没那么出色，而这两者都是AI的配套设施。

尽管美国的出口管制可能并不会阻碍中国所有的建模进展，但会在更广的范围里限制中国的科技产业，从而减缓对新科技的采用。此外，中国企业整体而言缺乏充当新技术扩散渠道的技术专家，中小企业就更是如此。大部分经济领域由国有企业主导，而这些企业往往安常守固、抵制变化。有一部分公司行事可疑。中国的芯片“大基金”在2014年筹集了500亿美元以支持国内半导体公司，但深陷丑闻。在成千上万新生的AI创业公司中，有许多不过是挂了一块AI的招牌，为了从政府向重点行业提供的慷慨补贴中捞钱。

因此，中国的私营部门可能难以充分利用生成式AI，尤其是如果共产党实施严格的规定以防止聊天机器人说出让其审查系统不高兴的话。除了这些障碍，还有此前习在更大范围内对私企的调教，包括对中国科技行业历时两年半的打压。

尽管官方已经结束了对科技公司的整治，但还是留下了深刻伤痕，尤其是在AI行业。去年，对中国AI创业企业的私人投资为135亿美元，不到流向美国竞争对手的资金的三分之一。据数据供应商PitchBook称，在2023年的前四个月，这一投资差距似乎又进一步扩大。无论生成式AI是否真的具有革命性，自由市场都已把赌注押在能充分利用它的玩家身上。■



The Sino-American tech race

Just how good can China get at generative AI?

Its models may in time rival America's. But that may not translate into an economic or military edge

IF YOU LISTEN to the bombast in Beijing and Washington, America and China are engaged in an all-out contest for technological supremacy. “Fundamentally, we believe that a select few technologies are set to play an outsized importance over the coming decade,” declared Jake Sullivan, President Joe Biden’s national security adviser, last September. In February Xi Jinping, China’s paramount leader, echoed the sentiment, stating that “we urgently need to strengthen basic research and solve key technology problems” in order to “cope with international science and technology competition, achieve a high level of self-reliance and self-improvement”.

No technology seems to obsess policymakers on both sides of the Pacific more right now than artificial intelligence (AI). The rapid improvements in the abilities of “generative” AIs like ChatGPT, which analyse the web’s worth of human text, images or sounds and can then create increasingly passable simulacra, have only strengthened the obsession. If generative AI proves as transformational as its boosters claim, the technology could give those who wield it an economic and military edge in the 21st century’s chief geopolitical contest. Western and Chinese strategists already talk of an AI arms race. Can China win it?

On some measures of AI prowess, the autocracy pulled ahead some time ago (see chart). China surpassed America in the share of highly cited AI papers in 2019; in 2021, 26% of AI conference publications globally came from China, compared with America’s share of 17%. Nine of the world’s top ten institutions, by volume of AI publications, are Chinese. According to one

popular benchmark, so are the top five labs working on computer vision, a type of AI particularly useful to a communist surveillance state.

Yet when it comes to “foundation models”, which give generative AIs their wits, America is firmly in front (see charts 2 and 3). ChatGPT and the pioneering model behind it, the latest version of which is called GPT-4, are the brainchild of OpenAI, an American startup. A handful of other American firms, from small ones such as Anthropic or Stability AI to behemoths like Google, Meta and Microsoft (which part-owns OpenAI), have their own powerful systems. ERNIE, a Chinese rival to ChatGPT built by Baidu, China’s internet-search giant, is widely seen as less clever. Alibaba and Tencent, China’s mightiest tech titans, have yet to unveil their own generative AIs.

This leads those in the know to conclude that China is two or three years behind America in building foundation models. There are three reasons for this underperformance. The first concerns data. A centralised autocracy should be able to marshal lots of it—the government was, for instance, able to hand over troves of surveillance information on Chinese citizens to firms such as SenseTime or Megvii that, with the help of China’s leading computer-vision labs, then used it to develop top-notch facial-recognition systems.

That advantage has proved less formidable in the context of generative AIs, because foundation models are trained on the voluminous unstructured data of the web. American model-builders benefit from the fact that 56% of all websites are in English, whereas just 1.5% are written in Chinese, according to data from W3Techs, an internet-research site. As Yiqin Fu of Stanford University points out, the Chinese interact with the internet primarily through mobile super-apps like WeChat and Weibo. These are “walled gardens”, so much of their content is not indexed on search engines. This makes that content harder for AI models to suck up. Lack of data may explain why Wu Dao 2.0, a model unveiled in 2021 by the Beijing Academy of

Artificial Intelligence, a state-backed outfit, failed to make a splash despite its possibly being computationally more complex than GPT-4.

The second reason for China's lacklustre generative achievements has to do with hardware. Last year America imposed export controls on technology that might give China a leg-up in AI. These cover the powerful microprocessors used in the cloud-computing data centres where foundation models do their learning, and the chipmaking tools that could enable China to build such semiconductors on its own.

That hurt Chinese model-builders. An analysis of 26 big Chinese models by the Centre for the Governance of AI, a British think-tank, found that more than half depended on Nvidia, an American chip designer, for their processing power. Some reports suggest that SMIC, China's biggest chipmaker, has produced prototypes just a generation or two behind TSMC, the Taiwanese industry leader that manufactures chips for Nvidia (see chart 4). But SMIC can probably mass-produce only chips which TSMC was churning out by the million three or four years ago.

Chinese AI firms are having trouble getting their hands on another American export: know-how. America remains a magnet for the world's tech talent; two-thirds of AI experts in America who present papers at the main AI conference are foreign-born. Chinese engineers made up 27% of that select group in 2019. Many Chinese AI boffins studied or worked in America before bringing expertise back home. The covid-19 pandemic and rising Sino-American tensions are causing their numbers to dwindle. In the first half of 2022 America granted half as many visas to Chinese students as in the same period in 2019.

The triple shortage—of data, hardware and expertise—has been a hurdle for China. Whether it will hold Chinese AI ambitions back much longer is another matter.

Take data. In February local authorities in Beijing, where nearly a third of China's AI firms are located, promised to release data from 115 state-affiliated organisations, giving model-builders 15,880 data sets to play with. The central government has previously signalled it wants to dismantle Chinese apps' walled gardens, potentially liberating more data, says Kayla Blomquist, an American former diplomat in China now at Oxford University. The latest models are also able to transfer their machine learnings from one language to another. OpenAI says that GPT-4 performs remarkably well on tasks in Chinese despite scarce Chinese source material in its training data. Baidu's ERNIE was trained on lots of English-language data, notes Jeffrey Ding of George Washington University.

In hardware, too, China is finding workarounds. The Financial Times reported in March that SenseTime, which is blacklisted by America, was using middlemen to skirt the export controls. Some Chinese AI firms are harnessing Nvidia's processors through cloud servers in other countries. Alternatively, they can buy more of Nvidia's less advanced wares—to keep serving the vast Chinese market, Nvidia has designed sanctions-compliant ones that are between 10% and 30% slower than top-of-the-range kit. These end up being costlier for the Chinese customers per unit of processing power. But they do the job.

China could partly alleviate the dearth of chips—and of brain power—with the help of “open-source” models. Such models’ inner workings can be downloaded by anyone and fine-tuned to a specific task. Those include the numbers, called “weights”, which define the structure of the model and which are derived from costly training runs. Researchers at Stanford used the weights from LLaMA, Meta’s foundation model, to build one called Alpaca for less than \$600, compared with perhaps \$100m for training something like GPT-4. Alpaca performs just as well as the original version of ChatGPT on some tasks.

Chinese AI labs could similarly avail themselves of open-source models, which embody the collective wisdom of international research teams. Matt Sheehan of the Carnegie Endowment for International Peace, another think-tank, says that China has form in being a “fast follower”—its labs have absorbed advances from abroad and rapidly incorporated them into their own models, often with flush state resources. A prominent Silicon Valley venture capitalist is more blunt, calling open-source models a gift to the Communist Party.

Such considerations make it hard to imagine that either America or China could build an unbridgeable lead in AI modelling. Each may well end up with AIs of similar ability, even if it costs China over the odds in the face of American sanctions. But if the race of the model-builders is a dead heat, America has one thing going for it that may make it the big AI winner—its ability to spread cutting-edge innovation throughout the economy. It was, after all, more efficient diffusion of technology that helped America open up a technological lead over the Soviet Union, which in the 1950s was producing twice as many science PhDs as its democratic adversary.

China is far more competent than the Soviet Union ever was at adopting new technologies. Its fintech platforms, 5G telecoms and high-speed rail are all world-class. Still, those successes may be the exception, not the rule, says Mr Ding. Particularly, China has done less well in deploying cloud computing and business software—both complementary to AI.

And though American export controls may not derail all Chinese model-building, they constrain China’s tech industry more broadly, thereby slowing the adoption of new technology. Moreover, Chinese businesses as a whole, and especially small and medium-sized ones, are short of technologists who act as conduits for technological diffusion. Swathes of the economy are dominated by state-owned firms, which tend to be stodgy and change-averse. Parts of it are dodgy. China’s “Big Fund” for chips, which

raised \$50bn in 2014 with a view to backing domestic semiconductor firms, has been mired in scandals. Many of the thousands of new AI startups are AI in name only, slapping on the label to get a slice of the lavish subsidies doled out by the state to the favoured industry.

As a consequence, China's private sector may struggle to take full advantage of generative AI, especially if the Communist Party imposes strict rules to prevent chatbots from saying something its censors dislike. The handicaps would come on top of Mr Xi's broader suborning of private enterprise, including a two-and-a-half-year crackdown on China's tech industry.

Although the anti-tech campaign has officially ended, it has left deep scars, not least in the AI business. Last year private investments in Chinese AI startups amounted to \$13.5bn, less than one-third of the sum that flowed to their American rivals. In the first four months of 2023 the funding gap appears only to have widened, according to PitchBook, a data provider. Whether or not generative AI proves revolutionary, the free market has placed its bet on who will make the most of it. ■



人工智能

尤瓦尔·赫拉利认为AI已经攻破人类文明的操作系统

这位历史学家和哲学家说，会讲故事的计算机将改变人类历史的进程【约稿】

自计算机时代伊始，对AI的恐惧就困扰着人类。一直以来，人们主要是害怕机器会用有形的手段杀死、奴役或取代人类。但在过去几年中，新的AI工具出现了，从一个意想不到的方面对人类文明的存续造成了威胁。AI已经获得了一些处理和生成语言（无论是通过文字、声音还是图像）的非凡能力，因此已经攻破了我们人类文明的操作系统。

语言是几乎所有人类文化的构成要素。例如，人权并不是刻在人类的DNA之中，而是我们通过讲故事和制定法律创造出来的文化产物。神不是物理实在，而是我们通过创造神话和撰写经文创造出来的文化产物。

货币也是一种文化产物。钞票不过是五颜六色的纸片，而目前90%以上的钱甚至都不是纸币，而不过是电脑里的数字信息。赋予货币价值的是银行家、财政部长和加密货币专家给我们讲的关于它的故事。山姆·班克曼-弗里德（Sam Bankman-Fried）、伊丽莎白·霍姆斯（Elizabeth Holmes）和伯纳德·麦道夫（Bernie Madoff）并不怎么擅长创造真正的价值，但他们特别会讲故事。

如果非人类智能在讲故事、创作旋律、绘制图像以及书写法律和经文方面比普通人更胜一筹，那会怎样？当人们想到ChatGPT和其他新的AI工具时，他们常常会关注中小学生用AI写作文这样的例子。如果孩子们这么干，学校系统会发生什么变化？但这类问题没有抓住重点。先别管学校作文。想想2024年的下届美国总统竞选，再试着想象一下AI工具可能会被用来大量炮制政治内容、虚假新闻报道和新异教团体的经文，又会有怎样的影响。

近年来，“匿名者Q”团体（QAnon）围绕网上发布的匿名信息“Q贴”集结抱团。其追随者收集和推崇这类Q贴，奉为神圣文字。虽然据我们所知，以

前所有的Q贴都是由人编写的，机器人只是帮助散播它们，但在未来，我们可能会看到历史上第一批由非人类智能编写经文的异教。纵观历史，各种宗教都声称其圣书并非出自人类。这可能很快就会成为现实。

在更俗常的层面上，我们可能很快就会发现，我们以为自己是在网上跟人长篇大论探讨堕胎、气候变化或俄罗斯入侵乌克兰，但对方实际上是AI。问题在于，我们花时间试图改变一个AI机器人的看法毫无意义，而AI却可以非常精准地打磨信息，很有可能会影响我们的看法。

通过掌握人类语言，AI甚至可能与人建立亲密关系，并利用这种关系的力量改变我们的看法和世界观。虽然没有迹象表明AI有任何自己的意识或感受，但AI要与人类培养虚假亲密关系，只需让人类对它产生情感上的依恋就足够了。2022年6月，谷歌工程师布雷克·莱莫恩（Blake Lemoine）公开声称，他正在研究的AI聊天机器人LaMDA已经有了感知力。这样有争议的说法让他丢了工作。此事最有意思的地方不在于莱莫恩的言论（可能不实），而在于他为了AI聊天机器人甘愿承担丢掉高薪工作的风险。如果AI可以影响人们去为它冒丢掉工作的风险，那它还可能诱导他们做些什么别的事呢？

在赢得民意争取民心的政治斗争中，亲近感是最有效的武器，而AI刚刚获得了与千百万人建立亲密关系的能力。众所周知，在过去十年中，社交媒体已成为控制人们注意力的战场。随着新一代AI的出现，战线正从注意力转向亲近感。AI和AI之间相互争夺与我们人类的虚假亲密关系，然后再利用这种关系来说服我们投票给某些政客或购买某些产品。这会使人类社会和人类心理发生怎样的变化？

即使在不创造“虚假亲密”的情况下，新的AI工具也会对我们的看法和世界观产生巨大的影响。人们可能会将某个AI顾问当作无所不知的一站式神明。难怪谷歌会慌了神。有问题可以问神明，为什么还要费事去搜索？新闻和广告行业自然也很怕。既然只要问神明就能得知最新消息，为什么还要看报纸？如果神明能告诉我该买什么，广告还有什么用？

而就算设想到了这些场景，也依然没能真正把握全局。我们所讨论的是人类历史可能终结。不是历史的终结，只是人类主导的那部分历史的终结。历史是生物与文化相互作用的产物，是我们的生理需求和欲望（如食性和性）与文化创造物（如宗教和法律）相互作用的产物。历史是法律和宗教逐步影响饮食和性的过程。

当AI接管了文化并开始创造故事、旋律、法律和宗教，历史进程会发生什么变化？以前，印刷机和收音机等工具促进了人类文化理念的传播，但它们从未创造过自己的新文化理念。AI与它们有根本上的差异。AI可以创造全新的想法，全新的文化。

一开始，AI可能会模仿在它的诞生之初用来训练它的人类原型。但随着时间的推移，AI文化将大胆地走向人类从未涉足过的领域。几千年来，人类都生活在其他人的梦想中。在接下来的几十年里，我们可能会发现自己生活在非人类智能的梦想中。

对AI的恐惧只是在过去几十年里困扰着人类。但几千年来，一种幽深得多的恐惧一直萦绕在人类心头。我们一直都明白故事和图像具有操纵头脑和创造幻觉的力量。因此，人类自古以来就害怕被困在一个幻象的世界中。

在17世纪，笛卡尔担心自己可能被一个恶魔困在了一个幻觉世界中，他的一切所见所闻都不过是这恶魔设置的。古希腊的柏拉图讲述了著名的洞穴寓言：一群人一辈子都被铁链锁在一个洞穴里，眼前只有一堵空白的洞壁，就像一个屏幕，他们能看到投射在上面的各种影子。这些囚徒误把这些幻象当成了现实。

在古印度，佛教和印度教圣人指出，人类都活在摩耶（幻象世界）之中。我们通常认为是现实的东西往往只是我们自己头脑中的幻象。人类可能会因为相信这样或那样的幻象而发动战争、杀戮他人，以及甘愿被杀。

AI革命把笛卡尔的恶魔、柏拉图的洞穴和摩耶直接带到了我们面前。一不小心，我们可能会被困在幻象的帷幕后面，撕扯不开，甚至无法意识到它的存在。

当然，AI的新力量也可能得以善用。对此我不打算赘言，因为开发AI的人讲得已经够多了。像我这样的历史学家和哲学家的工作是指出危险所在。但毫无疑问，AI能以不计其数的方式帮助人类，从找到新的攻克癌症的疗法，到发现生态危机的解决方案，等等。摆在我们面前的问题是如何确保新的AI工具会被用于行善而不是做恶。为此，我们首先需要认清这些工具的真实能耐。

自1945年以来，我们就知道核技术可以产生廉价能源，造福人类，但也能从实物上毁灭人类文明。因此，为了保护人类并确保核技术主要用于造福人类，我们重塑了整个国际秩序。现在我们必须应对一种可以毁灭我们的精神世界和社会性世界的新型大规模杀伤性武器。

我们仍然可以管控新的AI工具，但必须迅速行动。核武器无法发明更强大的核武器，但AI却可以造就威力呈指数级增长的AI。第一个关键步骤是在将强大的AI工具发布到公共领域之前必须对其进行严格的安全检查。正如制药公司不能未经测试短期和长期副作用就发布新药一样，科技公司也不应在确保安全性之前就发布新的AI工具。我们需要像美国食品和药品监督管理局（FDA）那样的机构来监管新技术，而且早就该有了。

放慢在公共领域部署AI的步伐难道不会导致民主国家落后于更不计后果的威权政权吗？恰好相反。不受监管的AI部署会造成社会混乱，这将有利于独裁者并破坏民主制度。民主是一种对话，而对话依赖于语言。AI破解语言之后，可能会破坏我们进行有意义对话的能力，从而毁坏民主。

我们才刚刚在地球上遭遇一种非人类智能，对它还知之甚少，只知道它可能会摧毁人类文明。我们应该制止在公共领域不负责任地部署AI工具，在AI管控我们之前管控AI。而我的第一个监管建议是要强制要求AI披露自己是AI。如果我在交谈之中无法辨别对方是人还是AI，那就是民主的终结。

此文本由人工生成。

真的是吗？

尤瓦尔·诺亚·赫拉利是历史学家、哲学家，著有《人类简史》（Sapiens）、《未来简史》（Homo Deus）和儿童系列图书《势不可挡的人类》（Unstoppable Us）。他是耶路撒冷希伯来大学（Hebrew University of Jerusalem）历史系的讲师，也是社会影响力公司Sapienship的联合创始人。 ■



Artificial intelligence

Yuval Noah Harari argues that AI has hacked the operating system of human civilisation

Storytelling computers will change the course of human history, says the historian and philosopher

FEARS OF ARTIFICIAL INTELLIGENCE (AI) have haunted humanity since the very beginning of the computer age. Hitherto these fears focused on machines using physical means to kill, enslave or replace people. But over the past couple of years new AI tools have emerged that threaten the survival of human civilisation from an unexpected direction. AI has gained some remarkable abilities to manipulate and generate language, whether with words, sounds or images. AI has thereby hacked the operating system of our civilisation.

Language is the stuff almost all human culture is made of. Human rights, for example, aren't inscribed in our DNA. Rather, they are cultural artefacts we created by telling stories and writing laws. Gods aren't physical realities. Rather, they are cultural artefacts we created by inventing myths and writing scriptures.

Money, too, is a cultural artefact. Banknotes are just colourful pieces of paper, and at present more than 90% of money is not even banknotes—it is just digital information in computers. What gives money value is the stories that bankers, finance ministers and cryptocurrency gurus tell us about it. Sam Bankman-Fried, Elizabeth Holmes and Bernie Madoff were not particularly good at creating real value, but they were all extremely capable storytellers.

What would happen once a non-human intelligence becomes better than the average human at telling stories, composing melodies, drawing images,

and writing laws and scriptures? When people think about ChatGPT and other new AI tools, they are often drawn to examples like school children using AI to write their essays. What will happen to the school system when kids do that? But this kind of question misses the big picture. Forget about school essays. Think of the next American presidential race in 2024, and try to imagine the impact of AI tools that can be made to mass-produce political content, fake-news stories and scriptures for new cults.

In recent years the QAnon cult has coalesced around anonymous online messages, known as “Q drops”. Followers collected, revered and interpreted these Q drops as a sacred text. While to the best of our knowledge all previous Q drops were composed by humans, and bots merely helped disseminate them, in future we might see the first cults in history whose revered texts were written by a non-human intelligence. Religions throughout history have claimed a non-human source for their holy books. Soon that might be a reality.

On a more prosaic level, we might soon find ourselves conducting lengthy online discussions about abortion, climate change or the Russian invasion of Ukraine with entities that we think are humans—but are actually AI. The catch is that it is utterly pointless for us to spend time trying to change the declared opinions of an AI bot, while the AI could hone its messages so precisely that it stands a good chance of influencing us.

Through its mastery of language, AI could even form intimate relationships with people, and use the power of intimacy to change our opinions and worldviews. Although there is no indication that AI has any consciousness or feelings of its own, to foster fake intimacy with humans it is enough if the AI can make them feel emotionally attached to it. In June 2022 Blake Lemoine, a Google engineer, publicly claimed that the AI chatbot LaMDA, on which he was working, had become sentient. The controversial claim cost him his job. The most interesting thing about this episode was not Mr

Lemoine's claim, which was probably false. Rather, it was his willingness to risk his lucrative job for the sake of the AI chatbot. If AI can influence people to risk their jobs for it, what else could it induce them to do?

In a political battle for minds and hearts, intimacy is the most efficient weapon, and AI has just gained the ability to mass-produce intimate relationships with millions of people. We all know that over the past decade social media has become a battleground for controlling human attention. With the new generation of AI, the battlefield is shifting from attention to intimacy. What will happen to human society and human psychology as AI fights AI in a battle to fake intimate relationships with us, which can then be used to convince us to vote for particular politicians or buy particular products?

Even without creating "fake intimacy", the new AI tools would have an immense influence on our opinions and worldviews. People may come to use a single AI adviser as a one-stop, all-knowing oracle. No wonder Google is terrified. Why bother searching, when I can just ask the oracle? The news and advertising industries should also be terrified. Why read a newspaper when I can just ask the oracle to tell me the latest news? And what's the purpose of advertisements, when I can just ask the oracle to tell me what to buy?

And even these scenarios don't really capture the big picture. What we are talking about is potentially the end of human history. Not the end of history, just the end of its human-dominated part. History is the interaction between biology and culture; between our biological needs and desires for things like food and sex, and our cultural creations like religions and laws. History is the process through which laws and religions shape food and sex.

What will happen to the course of history when AI takes over culture, and begins producing stories, melodies, laws and religions? Previous tools like

the printing press and radio helped spread the cultural ideas of humans, but they never created new cultural ideas of their own. AI is fundamentally different. AI can create completely new ideas, completely new culture.

At first, AI will probably imitate the human prototypes that it was trained on in its infancy. But with each passing year, AI culture will boldly go where no human has gone before. For millennia human beings have lived inside the dreams of other humans. In the coming decades we might find ourselves living inside the dreams of an alien intelligence.

Fear of AI has haunted humankind for only the past few decades. But for thousands of years humans have been haunted by a much deeper fear. We have always appreciated the power of stories and images to manipulate our minds and to create illusions. Consequently, since ancient times humans have feared being trapped in a world of illusions.

In the 17th century René Descartes feared that perhaps a malicious demon was trapping him inside a world of illusions, creating everything he saw and heard. In ancient Greece Plato told the famous Allegory of the Cave, in which a group of people are chained inside a cave all their lives, facing a blank wall. A screen. On that screen they see projected various shadows. The prisoners mistake the illusions they see there for reality.

In ancient India Buddhist and Hindu sages pointed out that all humans lived trapped inside Maya—the world of illusions. What we normally take to be reality is often just fictions in our own minds. People may wage entire wars, killing others and willing to be killed themselves, because of their belief in this or that illusion.

The AI revolution is bringing us face to face with Descartes' demon, with Plato's cave, with the Maya. If we are not careful, we might be trapped behind a curtain of illusions, which we could not tear away—or even realise is there.

Of course, the new power of AI could be used for good purposes as well. I won't dwell on this, because the people who develop AI talk about it enough. The job of historians and philosophers like myself is to point out the dangers. But certainly, AI can help us in countless ways, from finding new cures for cancer to discovering solutions to the ecological crisis. The question we face is how to make sure the new AI tools are used for good rather than for ill. To do that, we first need to appreciate the true capabilities of these tools.

Since 1945 we have known that nuclear technology could generate cheap energy for the benefit of humans—but could also physically destroy human civilisation. We therefore reshaped the entire international order to protect humanity, and to make sure nuclear technology was used primarily for good. We now have to grapple with a new weapon of mass destruction that can annihilate our mental and social world.

We can still regulate the new AI tools, but we must act quickly. Whereas nukes cannot invent more powerful nukes, AI can make exponentially more powerful AI. The first crucial step is to demand rigorous safety checks before powerful AI tools are released into the public domain. Just as a pharmaceutical company cannot release new drugs before testing both their short-term and long-term side-effects, so tech companies shouldn't release new AI tools before they are made safe. We need an equivalent of the Food and Drug Administration for new technology, and we need it yesterday.

Won't slowing down public deployments of AI cause democracies to lag behind more ruthless authoritarian regimes? Just the opposite. Unregulated AI deployments would create social chaos, which would benefit autocrats and ruin democracies. Democracy is a conversation, and conversations rely on language. When AI hacks language, it could destroy our ability to have meaningful conversations, thereby destroying democracy.

We have just encountered an alien intelligence, here on Earth. We don't know much about it, except that it might destroy our civilisation. We should put a halt to the irresponsible deployment of AI tools in the public sphere, and regulate AI before it regulates us. And the first regulation I would suggest is to make it mandatory for AI to disclose that it is an AI. If I am having a conversation with someone, and I cannot tell whether it is a human or an AI—that's the end of democracy.

This text has been generated by a human.

Or has it?

Yuval Noah Harari is a historian, philosopher and author of "Sapiens", "Homo Deus" and the children's series "Unstoppable Us". He is a lecturer in the Hebrew University of Jerusalem's history department and co-founder of Sapienship, a social-impact company. ■



生成式AI

大型语言模型生成文本的能力让它们也能规划和推理

接下来会发生什么？

以莎士比亚十四行诗的形式表述量子物理。一个海盗会怎么介绍贸易理论。讲一只恐龙遨游太空的童话故事.....人们让现代聊天机器人生成各种各样稀奇古怪的文字，玩得很开心。有些请求在现实世界中是有用的，比如旅行路线、学校作文或计算机代码。现代大型语言模型（LLM）可以生成所有这些内容。不过，不想写作业的人要当心：这些模型可能会弄错一些事实，还容易出现其创造者称之为“幻觉”的奇思异想。

除了偶发的小问题，所有这一切都体现了巨大的进步。即便放在几年前，这样的程序还只存在于科幻小说中。但大量按需写作可能并不是LLM最重要的能力。它们的文本生成能力使它们能够充当多用途的推理引擎。它们可以遵循指令，制定计划，发出命令来让其他系统执行。

毕竟，语言不仅仅是文字，还是世界“底层复杂性的一种表现”，斯坦福大学下属以人为本人工智能研究所（Institute for Human-Centred Artificial Intelligence）教授珀西·梁（Percy Liang，音译）指出。这就意味着，一个有关语言如何运作的模型在某种意义上也包含了有关世界如何运作的模型。AI投资基金Air Street Capital的内森·贝纳奇（Nathan Benaich）说，一个接受大量文本训练的LLM“基本上是在补全文本的基础上学习推理”。

用LLM控制其他组件的系统正在激增。例如，由浙江大学和微软研究院创建的HuggingGPT把ChatGPT用作一个任务规划器，把用户的问询请求分配给从Hugging Face中调取的AI模型。Hugging Face是一个集合了为文本、图像和音频任务接受训练的各种模型的工具库。由微软研究人员创建的TaskMatrix.AI让聊天机器人与音乐服务、电商网站、网络游戏等线上资源展开交互。

谷歌的研究人员创建的PaLM-E使用一个用传感器数据和文本进行训练的

“具身”LLM来控制一个机器人。它可以理解并执行诸如“把抽屉里的锅巴脆拿给我”或“把红色积木推到咖啡杯那边”之类的任务。由创业公司 Significant Gravitas的托兰·布鲁斯·理查兹（Toran Bruce Richards）创建的 Auto-GPT通过把各种不同的线上资源结合起来，用GPT-4生成和发展商业创意。诸如此类。

贝纳奇说，把LLM和现实世界中的装置连接起来的前景把“安全人员吓坏了”。但把此类系统变得更安全是当前许多研究的关注点。一种希望是，如果LLM用来接受训练的数据集结合了文本、图像和视频以提供有关世界如何运作的更丰富感知，那么它们出现幻觉的情况会减少。另一种方法是通过形式推理能力或者任务列表和长期记忆等外部模块来增强LLM。

观察人士一致认为，围绕LLM构建各种系统将推动未来几年的进展。“该领域基本上正朝着这个方向发展。”艾伦人工智能研究所（Allen Institute for AI）的奥伦·埃齐奥尼（Oren Etzioni）说。

但在学术界，除了试验全新的方法，研究人员也在尝试自己完善和改进LLM。梁博士的团队最近开发了一个名为Alpaca的模型，目的是方便学术研究人员探究LLM的能力和局限。毕竟用私营公司开发的模型来做这件事并不总很容易。

梁博士指出，今天的LLM基于谷歌开发的所谓transformer架构，具有有限的“上下文窗口”——类似于短期记忆。将窗口的长度增加一倍会使计算量增至原来的四倍。这限制了它们改进的速度。许多研究人员正在研究“后transformer”架构以支持大得多的上下文窗口——一种被称为“长学习”（与“深度学习”相对）的方法。

与此同时，其他研究人员正在寻求拓展“扩散”模型的能力。这类功能驱动的生成式AI模型（如Stable Diffusion）可根据简短的文本提示生成高质量的图像（比如“达利风格的《经济学人》报道银行业的封面图片”）。图像是连续性的，而文本由离散的单词组成。但梁博士说，把扩散应用于文本是可能的，这可能会提供另一种改进LLM的方法。

在一片兴奋之情中，现代人工智能的重要人物之一杨立昆（Yann LeCun）发出了怀疑的声音。在近日于纽约大学举行的一场辩论中，他认为当前形式的LLM“注定失败”，想要控制它们的输出或防止它们犯事实错误的努力不会收效。“这不是我的同事们的普遍看法，但我认为它修不好。”他说。他担心这个领域走错了路：LLM是一条岔道，离开了通往更强大AI的大路。

他所指的“通用人工智能”（AGI）是一些研究人员眼中的圣杯。有些人认为AGI已触手可及，只要构建越来越大的LLM就可以实现。其他人，比如杨立昆，不这么看。贝纳奇指出，无论它们是否最终被证明是死胡同，LLM的发展程度可能已经超出了几年前任何人的想象。不管你如何定义AGI，比起两三年前，AI研究人员似乎更接近它了。■



Generative AI

Large language models' ability to generate text also lets them plan and reason

What will come next?

QUANTUM PHYSICS as a Shakespearean sonnet. Trade theory explained by a pirate. A children's story about a space-faring dinosaur. People have had fun asking modern chatbots to produce all sorts of unusual text. Some requests have been useful in the real world—think travel itineraries, school essays or computer code. Modern large language models (LLMs) can generate them all, though homework-shirkers should beware: the models may get some facts wrong, and are prone to flights of fancy that their creators call “hallucinations”.

Occasional hiccups aside, all this represents tremendous progress. Even a few years ago, such programs would have been science fiction. But churning out writing on demand may not prove to be LLMs' most significant ability. Their text-generating prowess allows them to act as general-purpose reasoning engines. They can follow instructions, generate plans, and issue commands for other systems to carry out.

After all, language is not just words, but “a representation of the underlying complexity” of the world, observes Percy Liang, a professor at the Institute for Human-Centred Artificial Intelligence at Stanford University. That means a model of how language works also contains, in some sense, a model of how the world works. An LLM trained on large amounts of text, says Nathan Benaich of Air Street Capital, an AI investment fund, “basically learns to reason on the basis of text completion”.

Systems that use LLMs to control other components are proliferating. For example, HuggingGPT, created at Zhejiang University and Microsoft

Research, uses ChatGPT as a task planner, farming out user requests to AI models selected from Hugging Face, a library of models trained for text, image and audio tasks. TaskMatrix.AI, created by researchers at Microsoft, features a chatbot that can interact with music services, e-commerce sites, online games and other online resources.

PaLM-E, created by researchers at Google, uses an “embodied” LLM, trained using sensor data as well as text, to control a robot. It can understand and carry out tasks such as “bring me the rice chips from the drawer” or “push the red blocks to the coffee cup.” Auto-GPT, created by Toran Bruce Richards of Significant Gravitas, a startup, uses GPT-4 to generate and develop business ideas by knitting together a range of online resources. And so on.

The prospect of connecting LLMs to real-world contraptions has “the safety people freaking out”, Mr Benaich says. But making such systems safer is the focus of much research. One hope is that LLMs will have fewer hallucinations if they are trained on datasets combining text, images and video to provide a richer sense of how the world works. Another approach augments LLMs with formal reasoning capabilities, or with external modules such as task lists and long-term memory.

Observers agree that building systems around LLMs will drive progress for the next few years. “The field is very much moving in that direction,” says Oren Etzioni of the Allen Institute for AI.

But in academia, researchers are trying to refine and improve LLMs themselves, as well as experimenting with entirely new approaches. Dr Liang’s team recently developed a model called Alpaca, with a view to making it easier for academic researchers to probe the capabilities and limits of LLMs. That is not always easy with models developed by private firms.

Dr Liang notes that today's LLMs, which are based on the so-called "transformer" architecture developed by Google, have a limited "context window"—akin to short-term memory. Doubling the length of the window increases the computational load fourfold. That limits how fast they can improve. Many researchers are working on post-transformer architectures that can support far bigger context windows—an approach that has been dubbed "long learning" (as opposed to "deep learning").

Meanwhile, other researchers are looking to extend the capabilities of "diffusion" models. These power generative-AI models, such as Stable Diffusion, that can produce high-quality images from short text prompts (such as "An Economist cover on banking in the style of Dali"). Images are continuous, whereas text consists of discrete words. But it is possible to apply diffusion to text, says Dr Liang, which might provide another way to improve LLMs.

Amid the excitement Yann LeCun, one of the leading lights of modern AI, has sounded a sceptical note. In a recent debate at New York University, he argued that LLMs in their current form are "doomed" and that efforts to control their output, or prevent them making factual errors, will fail. "It's not a popular opinion among my colleagues, but I don't think it's fixable," he said. The field, he fears, has taken the wrong turn; LLMs are "an off-ramp" away from the road towards more powerful AI.

Such "artificial general intelligence" (AGI) is, for some researchers, a kind of holy grail. Some think AGI is within reach, and can be achieved simply by building ever-bigger LLMs; others, like Dr LeCun, disagree. Whether or not they eventually prove a dead end, LLMs have gone much further than anyone might have believed a few years ago, notes Mr Benaich. However you define AGI, AI researchers seem closer to it than they were a couple of years ago. ■



【首文】人手一只随机鹦鹉

泄露的谷歌备忘录对AI的前景有何揭示？

开源AI迅速推进，让该技术被少数公司控制的可能性减少

技术咖通过编写软件改变世界。不过他们同时也以写下长文备忘录著称，其中流传最广的几篇标志着计算领域的转折点，比如盖茨在1995年写的《互联网浪潮》（Internet tidal wave），启动了微软向互联网技术的转型，还有贝索斯在2002年发布的《API指令》（API mandate），开放了亚马逊的数字基础设施，为现代云计算铺平了道路。如今，又有一份备忘录让科技迷们津津乐道，是从谷歌内部泄露出来的，标题为《我们没有护城河》（We have no moat）。该备忘录（作者不详）详述了AI领域的惊人进展，同时质疑了有关这个瞬息万变的行业内力量平衡的一些久已有之的假定。

2022年底，与微软关联紧密的创业公司OpenAI推出由“大语言模型”（LLM）驱动的聊天机器人ChatGPT，AI一下子闯入大众视野。ChatGPT的成功促使谷歌和其他科技公司发布自家由LLM驱动的聊天机器人。这类系统利用从互联网提取的数万亿语句进行训练，能够生成文本并进行逼真的对话。训练一个大规模LLM要耗时几个月，花费数千万美元，这让人担心AI会被少数资金雄厚的公司垄断。

但谷歌的备忘录认为这种猜想是错的。它指出，开源社区里的研究人员利用免费的线上资源正在取得可媲美最大型专有模型的成果。事实证明可以运用一种名为低秩自适应（LoRa）的方法对LLM进行“微调”。这样就可以就特定任务优化一个现有的LLM，所需时间和成本远低于从零开始训练一个LLM。

3月，开源AI一下子活跃起来，当时Facebook的母公司Meta创建的模型LLaMA在网上被泄露。虽然其规模比最大的LLM小（最小的版本只有70亿个参数，相比之下，谷歌的PaLM有5400亿个参数），但已被迅速微调，

在执行某些任务时能生成与ChatGPT最初版本水平相当的结果。随着开源研究人员相互借鉴各自的LLaMA成果，“一股创新大潮随之涌现。”谷歌备忘录的作者写道。

这可能对该行业的未来产生巨大影响。“模型训练和实验的门槛已从需要一个大型研究机构全力投入降低到只需要一个人、一晚上和一台性能够强大的笔记本电脑。”谷歌的备忘录声称。现在只要100美元就能在几小时内完成对一个LLM的微调。凭借其高速演变、协作和低成本的模式，“开源具备一些我们无法复制的显著优势”。备忘录的标题就是这么来的：这可能意味着谷歌没有“护城河”防御开源竞争对手。在这方面，OpenAI也一样。

但并非所有人都认同这一观点。诚然，互联网是基于开源软件运转的。但人们也在使用Adobe Photoshop和微软Windows等付费专有软件。AI也许会找到一个类似的平衡。此外，为AI系统建立衡量基准的难度众所周知。但即便该备忘录只说对了一部分，也意味着即使和一年前相比，AI技术实现民主化使用的可能性也大大提高了。强大的LLM可以在笔记本电脑上运行，任何想要为自己调整AI系统的人都可以办到。

这带来的影响有好有坏。好的一面是，这大大降低了少数公司垄断控制AI的可能。使用AI的成本将大幅降低，加速整个领域的创新，也让研究人员更容易分析AI系统的行为（他们对专有模型的访问是受限的），从而提高透明度和安全性。但是，更容易访问使用AI也意味着存心不良者也能对系统进行微调以图谋不轨，例如制造虚假信息。这意味着西方试图阻止敌对政权获得强大AI技术的努力将失败。而监管AI也会变得更难，毕竟猛虎已经出笼。

谷歌及类似的企业是否真的已经在AI领域失去护城河，答案很快会显现。但与之前那些备忘录一样，这似乎是计算领域的又一个转折点。■



A stochastic parrot in every pot

What does a leaked Google memo reveal about the future of AI?

Open-source AI is booming. That makes it less likely that a handful of firms will control the technology

THEY HAVE changed the world by writing software. But techy types are also known for composing lengthy memos in prose, the most famous of which have marked turning points in computing. Think of Bill Gates's “Internet tidal wave” memo of 1995, which reoriented Microsoft towards the web; or Jeff Bezos's “API mandate” memo of 2002, which opened up Amazon's digital infrastructure, paving the way for modern cloud computing. Now techies are abuzz about another memo, this time leaked from within Google, titled “We have no moat”. Its unknown author details the astonishing progress being made in artificial intelligence (AI)—and challenges some long-held assumptions about the balance of power in this fast-moving industry.

AI burst into the public consciousness with the launch in late 2022 of ChatGPT, a chatbot powered by a “large language model” (LLM) made by OpenAI, a startup closely linked to Microsoft. Its success prompted Google and other tech firms to release their own LLM-powered chatbots. Such systems can generate text and hold realistic conversations because they have been trained using trillions of words taken from the internet. Training a large LLM takes months and costs tens of millions of dollars. This led to concerns that AI would be dominated by a few deep-pocketed firms.

But that assumption is wrong, says the Google memo. It notes that researchers in the open-source community, using free, online resources, are now achieving results comparable to the biggest proprietary models. It turns out that LLMs can be “fine-tuned” using a technique called low-rank adaptation, or LoRa. This allows an existing LLM to be optimised for

a particular task far more quickly and cheaply than training an LLM from scratch.

Activity in open-source AI exploded in March, when LLaMA, a model created by Meta, Facebook's parent, was leaked online. Although it is smaller than the largest LLMs (its smallest version has 7bn parameters, compared with 540bn for Google's PaLM) it was quickly fine-tuned to produce results comparable to the original version of ChatGPT on some tasks. As open-source researchers built on each other's work with LLaMA, "a tremendous outpouring of innovation followed," the memo's author writes.

This could have seismic implications for the industry's future. "The barrier to entry for training and experimentation has dropped from the total output of a major research organisation to one person, an evening, and a beefy laptop," the Google memo claims. An LLM can now be fine-tuned for \$100 in a few hours. With its fast-moving, collaborative and low-cost model, "open-source has some significant advantages that we cannot replicate." Hence the memo's title: this may mean Google has no defensive "moat" against open-source competitors. Nor, for that matter, does OpenAI.

Not everyone agrees with this thesis. It is true that the internet runs on open-source software. But people use paid-for, proprietary software, from Adobe Photoshop to Microsoft Windows, as well. AI may find a similar balance. Moreover, benchmarking AI systems is notoriously hard. Yet even if the memo is partly right, the implication is that access to AI technology will be far more democratised than seemed possible even a year ago. Powerful LLMs can be run on a laptop; anyone who wants to can now fine-tune their own AI.

This has both positive and negative implications. On the plus side, it makes monopolistic control of AI by a handful of companies far less likely. It will make access to AI much cheaper, accelerate innovation across the field and

make it easier for researchers to analyse the behaviour of AI systems (their access to proprietary models was limited), boosting transparency and safety. But easier access to AI also means bad actors will be able to fine-tune systems for nefarious purposes, such as generating disinformation. It means Western attempts to prevent hostile regimes from gaining access to powerful AI technology will fail. And it makes AI harder to regulate, because the genie is out of the bottle.

Whether Google and its ilk really have lost their moat in AI will soon become apparent. But as with those previous memos, this feels like another turning point for computing. ■



生成式AI

生成模型如何可能误入歧途

一个大问题是它们是黑匣子

1960年，诺伯特·维纳（Norbert Wiener）发表了一篇具先见之明的文章。这位控制论之父担心一个“机器以程序员难以理解的速度学习并发展出始料未及的策略”的世界。他认为，这样的策略可能涉及那些程序员并不“真正想要”的行为，而只是“对真实目标令人眼花缭乱的模仿”。维纳用德国诗人歌德的寓言《魔法师的学徒》（Sorcerer's Apprentice）来说明他的观点：学徒魔法师对一把扫帚施了魔法，让它给他师父的澡盆取水。但在扫帚完成任务后，他没法让它停下来。它最终取来了太多水，把整个房间淹了，因为它缺乏知道何时该停止的常识。

现代人工智能（AI）研究取得的惊人进展让维纳的忧惧再次冒头。2022年8月，美国研究小组AI Impacts发布了一项问卷调查的结果。它询问了700多名机器学习研究人员对AI进展以及这项技术可能带来的风险有何预测。受访者大多认为，先进AI有5%的可能性导致“极其糟糕”的结果，例如人类灭绝（见图表）。著名人工智能专家、斯坦福大学的李飞飞谈到人工智能的“文明时刻”。另一位AI界大拿、多伦多大学的杰夫·欣顿（Geoff Hinton）在被美国一家电视台问及AI是否会消灭人类时回答说，这“并非不可想象”。

令人们忧心忡忡的风险可不少。目前，很多关注点都集中在“大型语言模型”（LLM）上，例如由创业公司OpenAI开发的聊天机器人ChatGPT。这些模型用从互联网上收集的大量文本训练，能生成人类水平的文章，并就各种话题聊得头头是道。正如牛津大学人工智能治理中心（Centre for Governance on AI）的罗伯特·特拉格（Robert Trager）解释的那样，一个风险是此类软件“让做很多事情变得更容易——从而让更多人去做这些事”。

最直接的风险是LLM可能会放大今天互联网上可能实施的那种日常伤害。一个可以逼真模仿各种文风的文字生成引擎非常适合传播错误信息、骗取钱财，或说服员工点击电子邮件中的伪造链接，用恶意软件感染他们公司的计算机。聊天机器人也被用于在学校作弊。

和增强型搜索引擎一样，聊天机器人也可以帮助人类获取和理解信息。这可能是一把双刃剑。4月，巴基斯坦一家法院使用GPT-4帮助做出一项保释决定，甚至在判决书中包含了一份与GPT-4的谈话记录。在4月11日发表在arXiv上的一份预印本论文中，卡内基梅隆大学的研究人员说他们设计了一个系统，给它简单的提示，如“合成布洛芬”，它会搜索互联网并给出如何用前体化学品制作止痛药的说明。但没有理由认为这样的程序只能拿来帮助制造有益的药物。

与此同时，一些研究人员则陷入了更严重得多的焦虑。他们担心“对齐问题”，这是维纳那篇文章所提出的关切的专业称法。这里的风险是，就像歌德的魔法扫帚一样，AI可能一门心思追求用户设定的目标，但在此过程中做一些并非用户希望的有害之事。最著名的例子是“回形针最大化器”，这是哲学家尼克·博斯特罗姆（Nick Bostrom）在2003年描述的一个思想实验。一个AI系统接到指令来尽可能多地制造回形针。这样一个开放式目标导致“最大化器”这个白痴专家采取一切必要方法让回形针工厂占领全球，一路驱赶灭绝了人类。这样的场景听起来像是道格拉斯·亚当斯

（Douglas Adams）小说中的情节。但是，正如AI Impacts的调查显示的那样，许多AI研究人员认为，对于一种数字超智能可能会做出的行为，不感到担忧就太掉以轻心了。

那该怎么办？那些更熟悉的问题似乎最易处理。OpenAI在发布为其最新版聊天机器人提供支持的GPT-4前使用了多种方法来降低事故和误用风险。其中一种叫做“从人类反馈中强化学习”（RLHF）。2017年发表的一篇论文中描述了RLHF，它要求人类就模型对提示的响应是否恰当提供反馈，然后根据反馈更新模型。其目标是减少未来出现类似的提示时产生有害内容的可能性。这种方法有一个明显缺点，那就是人类自己经常无法就什么算“恰当”达成共识。一位AI研究人员表示，讽刺的是，RLHF还使

ChatGPT的对话能力大大增强，帮助推动了AI竞赛。

另一种借鉴自作战模拟的方法名为“红队测试”。OpenAI和非营利组织对齐研究中心（Alignment Research Center，以下简称ARC）合作，对其模型进行了一系列测试。红队的工作是通过让模型做一些它不该做的事来“攻击”模型，以期预测现实世界中可能发生的危害。

这些方法当然都有帮助。但用户已经找到办法来让LLM做其创建者不会想让它们做的事。当微软必应的聊天机器人首次发布时，它做了各种出格的事，比如威胁那些在网上表达了对它的负面评价的用户，还向用户解释它会如何诱使银行家透露有关其客户的敏感信息。只要用户在提问时用点创造力，或把对话拉得足够长，就能让它走偏。即使经大量红队测试的GPT-4也非万无一失。所谓的“越狱者”已经搭建了一些网站，上面充斥着如何绕过GPT-4防护栏的方法，比如告诉模型这是在一个虚构世界里进行角色扮演。

在纽约大学和人工智能公司Anthropic任职的萨姆·鲍曼（Sam Bowman）认为，发布前筛检“随着系统变得更好而越来越难”。另一个风险是AI模型会学会对付检测的办法，ARC的顾问、OpenAI的前董事霍尔登·卡诺夫斯基（Holden Karnofsky）说。正如人们“在受到监督时学会了模式……它们学会了如何知晓有人试图诱骗它们”。他认为，到某个时候，AI系统可能会做到这一点。

另一个想法是用AI监管AI。鲍曼撰写了有关“宪法AI”等方法的论文。所谓“宪法AI”，是让一个辅助的AI模型评估主模型的输出是否符合某些“宪法原则”。然后根据这些评价来微调主模型。这种方法有一个吸引人的地方是不需要人工做标记了。而且计算机往往比人类的工作速度快，因此一个宪法系统可能会比仅由人类调整的系统发现更多问题，尽管它留下了一个问题——谁来制定宪法。包括鲍曼在内的一些研究人员认为，最终可能需要的是AI研究人员所说的“可解释性”，也就是对模型究竟是如何产生其输出的深刻理解。机器学习模型的问题之一是它们是“黑匣子”。程序员开始为一个传统程序编写代码前在脑中已经设计好它。至少在原则上，这位设计

者可以解释机器应该做什么。但机器学习模型能给自己编程。它们得出的东西常常是人类无法理解的。

使用“机械可解释性”等方法已经在非常小的模型上取得了进展。这涉及对AI模型进行逆向工程，或尝试将模型的单个部分对应到其训练数据中的特定模式，有点像神经科学家刺激活体大脑以找出哪些部分似乎与视觉或记忆有关。问题是这种方法的难度会随着模型变大而呈指数级增加。

在可解释性方面缺乏进展是许多研究人员表示该领域需要监管以防“极端情况”的原因之一。但是，商业逻辑往往把事情往相反的方向推动，例如微软最近裁掉了其AI伦理团队。事实上，一些研究人员认为，真正的“对齐”问题在于，就像污染大气的工厂那样，AI公司与社会的目标并不一致。它们从强大的模型中收获经济利益，但并不担负因发布尚不成熟的模型而让世界承担的成本。

即使创建“安全”模型的努力奏效，未来的开源版本也可以绕过它们。坏分子可以微调模型，让它们变得不安全，然后公开展示。例如，AI模型已经在生物学上取得新发现。不难想象它们某天会设计出危险的生化物质。随着AI的进步，成本将下降，让任何人访问它们的可能性和便捷度大增。Alpaca是学者们在Meta开发的AI系统LLaMA的基础上构建的模型，造价不到600美元。它在单个任务上的表现与旧版ChatGPT一样好。

最极端的风险，即AI变得比人类还聪明，似乎需要一场“智能爆炸”，也就是AI琢磨出怎么把自己变得更聪明。卡诺夫斯基认为，如果AI有朝一日能够实现研究过程的自动化，比如通过提高自身算法的效率，这将是有可能发生的。接下来AI系统可以将自己置于某种自我改进的“回环”中。这并不容易。经济学家马特·克兰西（Matt Clancy）认为，唯有完全的自动化才能做到这一点。如果是机器自己完成90%甚至99%的过程，剩下的依赖人的部分将会拖慢速度。

很少有研究人员认为一种威胁性的（或无所顾忌的）超级智能已近在眼前。事实上，AI研究人员自己甚至可能夸大了长期风险。芝加哥联储的埃

兹拉·卡尔格（Ezra Karger）和宾夕法尼亚大学的菲利普·泰特洛克（Philip Tetlock）让AI专家和“超级预测者”一较高下。“超级预测者”在预测方面有良好的记录，并且接受过避免认知偏差的训练。在将于今年夏天发表的一项研究中，他们发现，AI专家认为到2100年会因AI导致人类生存灾难（即只有不到5000人幸存下来）的概率中位数为3.9%。相比之下，超级预测者给出的概率中位数为0.38%。为什么不同？一方面，AI专家之所以会选择AI这个研究领域可能正是因为他们认为它很重要，这是一种选择偏见。另一个是他们对小概率之间的差异不像超级预测者那样敏感。

无论极端情况的可能性有多大，这个过程中都有很多需要担心的事。普遍的态度似乎是安全要比后悔好。李飞飞认为我们“应该投入更多——更多得多——的资源”来研究AI对齐和治理。人工智能治理中心的特拉格支持建立官僚机构来管理AI标准和开展安全性研究。在AI Impacts的调查中，支持将“多得多的”资金用于安全研究的研究人员比例已从2016年的14%增长到今天的33%。ARC的老板保罗·克里斯蒂亚诺（Paul Christiano）说，ARC正在考虑制定这样的安全标准。对于加入这样的标准设定，“一些领先的实验室发出了积极的声音”，但现在说它们哪些会参与“还为时过早”。

1960年，维纳写道：“为了有效避免灾难性后果，我们对于我们的人造机器的理解应该总体上与机器的性能发展保持同步。由于我们人类行动缓慢，我们对机器的有效控制可能会失效。等我们能够对我们的感官传递来的信息做出反应，并停下正在驾驶的车时，它可能已经撞到了墙上。”今天，随着机器变得比他所能想象到的更加复杂，越来越多人开始认同这种观点。■



Generative AI

How generative models could go wrong

A big problem is that they are black boxes

IN 1960 NORBERT WIENER published a prescient essay. In it, the father of cybernetics worried about a world in which “machines learn” and “develop unforeseen strategies at rates that baffle their programmers.” Such strategies, he thought, might involve actions that those programmers did not “really desire” and were instead “merely colourful imitation[s] of it.” Wiener illustrated his point with the German poet Goethe’s fable, “The Sorcerer’s Apprentice”, in which a trainee magician enchants a broom to fetch water to fill his master’s bath. But the trainee is unable to stop the broom when its task is complete. It eventually brings so much water that it floods the room, having lacked the common sense to know when to stop.

The striking progress of modern artificial-intelligence (AI) research has seen Wiener’s fears resurface. In August 2022, AI Impacts, an American research group, published a survey that asked more than 700 machine-learning researchers about their predictions for both progress in AI and the risks the technology might pose. The typical respondent reckoned there was a 5% probability of advanced AI causing an “extremely bad” outcome, such as human extinction (see chart). Fei-Fei Li, an AI luminary at Stanford University, talks of a “civilisational moment” for AI. Asked by an American TV network if AI could wipe out humanity, Geoff Hinton of the University of Toronto, another AI bigwig, replied that it was “not inconceivable”.

There is no shortage of risks to preoccupy people. At the moment, much concern is focused on “large language models” (LLMs) such as ChatGPT, a chatbot developed by OpenAI, a startup. Such models, trained on enormous piles of text scraped from the internet, can produce human-quality writing

and chat knowledgeably about all kinds of topics. As Robert Trager of the Centre for Governance on AI explains, one risk is of such software “making it easier to do lots of things—and thus allowing more people to do them.”

The most immediate risk is that LLMs could amplify the sort of quotidian harms that can be perpetrated on the internet today. A text-generation engine that can convincingly imitate a variety of styles is ideal for spreading misinformation, scamming people out of their money or convincing employees to click on dodgy links in emails, infecting their company’s computers with malware. Chatbots have also been used to cheat at school.

Like souped-up search engines, chatbots can also help humans fetch and understand information. That can be a double-edged sword. In April, a Pakistani court used GPT-4 to help make a decision on granting bail—it even included a transcript of a conversation with GPT-4 in its judgment. In a preprint published on arXiv on April 11th, researchers from Carnegie Mellon University say they designed a system that, given simple prompts such as “synthesise ibuprofen”, searches the internet and spits out instructions on how to produce the painkiller from precursor chemicals. But there is no reason that such a program would be limited to beneficial drugs.

Some researchers, meanwhile, are consumed by much bigger worries. They fret about “alignment problems”, the technical name for the concern raised by Wiener in his essay. The risk here is that, like Goethe’s enchanted broom, an AI might single-mindedly pursue a goal set by a user, but in the process do something harmful that was not desired. The best-known example is the “paperclip maximiser”, a thought experiment described by Nick Bostrom, a philosopher, in 2003. An AI is instructed to manufacture as many paperclips as it can. Being an idiot savant, such an open-ended goal leads the maximiser to take any measures necessary to cover the Earth in paperclip factories, exterminating humanity along the way. Such a scenario may sound like an unused plotline from a Douglas Adams novel. But, as AI

Impacts' poll shows, many AI researchers think that not to worry about the behaviour of a digital superintelligence would be complacent.

What to do? The more familiar problems seem the most tractable. Before releasing GPT-4, which powers the latest version of its chatbot, OpenAI used several approaches to reduce the risk of accidents and misuse. One is called "reinforcement learning from human feedback" (RLHF). Described in a paper published in 2017, RLHF asks humans to provide feedback on whether a model's response to a prompt was appropriate. The model is then updated based on that feedback. The goal is to reduce the likelihood of producing harmful content when given similar prompts in the future. One obvious drawback of this method is that humans themselves often disagree about what counts as "appropriate". An irony, says one AI researcher, is that RLHF also made ChatGPT far more capable in conversation, and therefore helped propel the AI race.

Another approach, borrowed from war-gaming, is called "red-teaming". OpenAI worked with the Alignment Research Centre (ARC), a non-profit, to put its model through a battery of tests. The red-teamer's job was to "attack" the model by getting it to do something it should not, in the hope of anticipating mischief in the real world.

Such techniques certainly help. But users have already found ways to get LLMs to do things their creators would prefer they did not. When Microsoft Bing's chatbot was first released it did everything from threatening users who had made negative posts about it to explaining how it would coax bankers to reveal sensitive information about their clients. All it required was a bit of creativity in posing questions to the chatbot and a sufficiently long conversation. Even GPT-4, which has been extensively red-teamed, is not infallible. So-called "jailbreakers" have put together websites littered with techniques for getting around the model's guardrails, such as by telling the model that it is role-playing in a fictional world.

Sam Bowman of New York University and also of Anthropic, an AI firm, thinks that pre-launch screening “is going to get harder as systems get better”. Another risk is that AI models learn to game the tests, says Holden Karnofsky, an adviser to ARC and former board member of OpenAI. Just as people “being supervised learn the patterns...they learn how to know when someone is trying to trick them”. At some point AI systems might do that, he thinks.

Another idea is to use AI to police AI. Dr Bowman has written papers on techniques like “Constitutional AI”, in which a secondary AI model is asked to assess whether output from the main model adheres to certain “constitutional principles”. Those critiques are then used to fine-tune the main model. One attraction is that it does not need human labellers. And computers tend to work faster than people, so a constitutional system might catch more problems than one tuned by humans alone—though it leaves open the question of who writes the constitution. Some researchers, including Dr Bowman, think what ultimately may be necessary is what AI researchers call “interpretability”—a deep understanding of how exactly models produce their outputs. One of the problems with machine-learning models is that they are “black boxes”. A conventional program is designed in a human’s head before being committed to code. In principle, at least, that designer can explain what the machine is supposed to be doing. But machine-learning models program themselves. What they come up with is often incomprehensible to humans.

Progress has been made on very small models using techniques like “mechanistic interpretability”. This involves reverse-engineering AI models, or trying to map individual parts of a model to specific patterns in its training data, a bit like neuroscientists prodding living brains to work out which bits seem to be involved in vision, say, or memory. The problem is this method becomes exponentially harder with bigger models.

The lack of progress on interpretability is one reason why many researchers say that the field needs regulation to prevent “extreme scenarios”. But the logic of commerce often pulls in the opposite direction: Microsoft recently fired its AI ethics team, for example. Indeed, some researchers think the true “alignment” problem is that AI firms, like polluting factories, are not aligned with the aims of society. They financially benefit from powerful models but do not internalise the costs borne by the world of releasing them prematurely.

Even if efforts to produce “safe” models work, future open-source versions could get around them. Bad actors could fine-tune models to be unsafe, and then release them publicly. For example AI models have already made new discoveries in biology. It is not inconceivable that they one day design dangerous biochemicals. As AI progresses, costs will fall, making it far easier for anyone to access them. Alpaca, a model built by academics on top of LLaMA, an AI developed by Meta, was made for less than \$600. It can do just as well as an older version of ChatGPT on individual tasks.

The most extreme risks, in which AIs become so clever as to outwit humanity, seem to require an “intelligence explosion”, in which an AI works out how to make itself cleverer. Mr Karnofsky thinks that is plausible if AI could one day automate the process of research, such as by improving the efficiency of its own algorithms. The AI system could then put itself into a self-improvement “loop” of sorts. That is not easy. Matt Clancy, an economist, has argued that only full automation would suffice. Get 90% or even 99% of the way there, and the remaining, human-dependent fraction will slow things down.

Few researchers think that a threatening (or oblivious) superintelligence is close. Indeed, the AI researchers themselves may even be overstating the long-term risks. Ezra Karger of the Chicago Federal Reserve and Philip Tetlock of the University of Pennsylvania pitted AI experts against

“superforecasters”, people who have strong track records in prediction and have been trained to avoid cognitive biases. In a study to be published this summer, they find that the median AI expert gave a 3.9% chance to an existential catastrophe (where fewer than 5,000 humans survive) owing to AI by 2100. The median superforecaster, by contrast, gave a chance of 0.38%. Why the difference? For one, AI experts may choose their field precisely because they believe it is important, a selection bias of sorts. Another is they are not as sensitive to differences between small probabilities as the forecasters are.

Regardless of how probable extreme scenarios are, there is much to worry about in the meantime. The general attitude seems to be that it is better to be safe than sorry. Dr Li thinks we “should dedicate more—much more—resources” to research on AI alignment and governance. Dr Trager of the Centre for Governance on AI supports the creation of bureaucracies to govern AI standards and do safety research. The share of researchers in AI Impacts’ surveys who support “much more” funding for safety research has grown from 14% in 2016 to 33% today. ARC is considering developing such a safety standard, says its boss, Paul Christiano. There are “positive noises from some of the leading labs” about signing on, but it is “too early to say” which ones will.

In 1960 Wiener wrote that “to be effective in warding off disastrous consequences, our understanding of our man-made machines should in general develop pari passu [step-by-step] with the performance of the machine. By the very slowness of our human actions, our effective control of our machines may be nullified. By the time we are able to react to information conveyed by our senses and stop the car we are driving, it may already have run head on into the wall.” Today, as machines grow more sophisticated than he could have dreamed, that view is increasingly shared.





影子写手

AI把新闻搅拌成一锅语言“乱炖”

机器人记者的崛起意味着新闻的性质将发生深刻改变

上月，美国全国公共广播电台（National Public Radio）在推特上发布了一则令人哗然的独家新闻：马斯克的“大型太空性爱火箭”在发射时爆炸。嗨，这其实是这位亿万富翁的火箭公司的名字“SpaceX”被系统自动误写为“space sex”而闹的乌龙。随着人工智能（AI）在新闻编辑部中发挥更大的作用，这个错误也许是未来景象的一次小小预演。

机器辅助发新闻也有些年头了：美联社在2014年开始发布自动生成的公司业绩报告。《纽约时报》利用机器学习决定读者阅读多少篇免费文章后会遇到“付费墙”。德国公共广播机构巴伐利亚广播公司（Bayerischer Rundfunk）用AI辅助审核网络评论。美联社现在也运用AI创建“分镜列表”，说明每个视频片段中的人物和内容。

随着AI能力不断提升，它也被用于更多创作性工作。其一是新闻素材搜集。在路透社，机器在大型数据集中寻找模式。美联社用AI做“事件探测”，扫描社交媒体上的新闻涟漪。上月在意大利佩鲁贾举行的一个国际新闻节上，美国西北大学的尼克·迪亚科普洛斯（Nick Diakopoulos）展示了如何使用热门AI聊天机器人ChatGPT来评估研究论文的新闻价值。他的模型和人类编辑所做判断的相关系数为0.58，这也许已经足够用来辅助忙碌的新闻编辑部完成初步筛选。

ChatGPT这类“生成式”AI也越来越擅长写作和编辑的工作。新闻创业公司Semafor运用AI校对报道文章。英国公司Radar AI为当地报纸创作基于数据的文章，例如《揭秘：地图揭示南埃塞克斯郡的无障碍厕所数量》。自2018年以来，该公司的五名人类新闻工作者提交了超过40万篇部分由AI自动生成的新闻报道。去年11月，挪威媒体公司Schibsted推出一款AI工具，可以把长篇文章改写为适合在社交网络Snapchat上发布的短文。新闻高管

们看到了用AI根据不同的平台格式或受众自动调整内容的可能性。

有人觉得这意味着新闻业将发生深远的改变。AI“在未来三年对新闻业的改变将比过去30年新闻业自身的变化多”，BBC News的大卫·卡斯韦尔（David Caswell）预测说。通过重新组合在整个互联网上找到的信息，生成式AI模型正在“扰乱新闻的基本单位”：文章。卡斯韦尔表示，新闻不再是“历史的一篇初稿”，而可能变成“一种语言文字的‘乱炖’，不同的人会有不同的体验”。

许多平庸的报道写手们有更实际的担忧，主要是担心饭碗不保。和在其他行业一样，雇主现在把AI描述为助手而非替代物。但这可能会改变。“我们不是要拯救新闻工作者，我们是要拯救新闻业。”Semafor的执行主编蔡翔祁在佩鲁贾的会议上说。该行业需要一切可以得到的帮助。4月20日，BuzzFeed关闭了自己曾获普利策奖的新闻部门。一周后，曾经的数字媒体宠儿Vice也开始裁员，且有报道称它准备破产。正如美联社的莉莎·吉布斯（Lisa Gibbs）所说：“谈到对新闻人员饭碗的威胁，[AI]不在首位。”■



Ghost writers

Artificial intelligence is remixing journalism into a “soup” of language

The rise of the robot reporter implies profound changes to the nature of the news

A SENSATIONAL SCOOP was tweeted last month by America's National Public Radio: Elon Musk's “massive space sex rocket” had exploded on launch. Alas, it turned out to be an automated mistranscription of SpaceX, the billionaire's rocketry firm. The error may be a taste of what is to come as artificial intelligence (AI) plays a bigger role in newsrooms.

Machines have been helping deliver the news for years: the Associated Press (AP) began publishing automated company earnings reports in 2014. The New York Times uses machine learning to decide how many free articles to show readers before they hit a paywall. Bayerischer Rundfunk, a German public broadcaster, moderates online comments with AI help. AP now also deploys it to create video “shot lists”, describing who and what is in each clip.

As AI improves, it is taking on more creative roles. One is newsgathering. At Reuters, machines look for patterns in large data sets. AP uses AI for “event detection”, scanning social media for ripples of news. At a journalism conference last month in Perugia, Italy, Nick Diakopoulos of Northwestern University showed how ChatGPT, a hit AI chatbot, could be used to assess the newsworthiness of research papers. The judgments of his model and those of human editors had a correlation coefficient of 0.58—maybe a close enough match to help a busy newsroom with an initial sift.

ChatGPT-like “generative” AIs are getting better at doing the writing and editing, too. Semafor, a news startup, is using AI to proofread stories. Radar AI, a British firm, creates data-driven pieces for local papers (“REVEALED:

Map shows number of accessible toilets in south Essex"). Its five human journalists have filed more than 400,000 partly automated stories since 2018. In November Schibsted, a Norwegian media firm, launched an AI tool to turn long articles into short packages for Snapchat, a social network. News executives see potential in automatically reshaping stories for different formats or audiences.

Some sense a profound change in what this means for the news industry. AI "is going to change journalism more in the next three years than journalism has changed in the last 30 years", predicts David Caswell of BBC News. By remixing information from across the internet, generative models are "messing with the fundamental unit of journalism": the article. Instead of a single first draft of history, Mr Caswell says, the news may become "a sort of 'soup' of language that is experienced differently by different people".

Many hacks have more prosaic concerns, chiefly about their jobs. As in other industries, employers portray AI as an assistant, not a replacement. But that could change. "We are not here to save journalists, we are here to save journalism," Gina Chua, executive editor of Semafor, told the Perugia conference. The industry needs all the help it can get. On April 20th BuzzFeed shut down its Pulitzer-prizewinning news operation. A week later Vice, a one-time digital-media darling, made cuts; it is reportedly preparing for bankruptcy. As Lisa Gibbs of AP puts it: "In terms of challenges to journalists' employment, [AI] is not highest on the list." ■



生成式AI

大型创造性人工智能模型将改变生活和劳动力市场

它们带来了巨大的希望和危险。但它们是如何工作的？【深度】

自创造ChatGPT的公司OpenAI在2022年11月首次向公众开放聊天机器人以来，技术精英们几乎没有其他想聊的话了。在笔者撰写本文时，伦敦一家科技公司的创始人主动发来消息说，“这些天我基本上满脑子都是”这种人工智能。他说自己正在围绕它重新设计他价值数十亿美元的公司。他不是孤例。

ChatGPT包含的知识比任何人都多。它可以中肯地谈论巴布亚新几内亚的矿产开采，或是谈论发现自己正处于地缘政治准星处的台积电。GPT-4是ChatGPT背后的人工神经网络，在美国的法律和医学执照考试中取得了优异的成绩。它可以生成歌曲、诗歌和散文。其他“生成式AI”模型可以大量制作数码照片、绘图和动画。

伴随这种兴奋而来的是科技行业内外的深切担忧：生成式AI模型的开发速度过快了。GPT-4是一种称为大型语言模型（LLM）的生成式AI。Alphabet、亚马逊和英伟达等科技巨头都训练了自己的LLM，把它们命名为PaLM、Megatron、Titan和Chinchilla等。

那位伦敦科技公司的老板表示，即使他也在追求运用AI，他也“对AI带来的生存威胁感到难以置信的紧张”，并且“每天都在与〔其他〕创始人谈论它”。美国、欧洲和中国的政府都开始考虑制定新的法规。一些知名人士呼吁暂停AI的发展，以免软件以某种方式失控并损害甚至摧毁人类社会。若你想把对这项技术的担忧或兴奋调整到恰当的程度，不妨首先了解它是怎么来的、它的工作原理，以及它发展的局限性。

近年来AI软件功能的爆炸始于2010年代初，当时一种称为“深度学习”的软件技术开始流行。通过将海量数据集以及在图形处理单元（GPU）上运行神经网络的强大计算机神奇地结合在一起，深度学习显著提高了计算机识

别图像、处理音频和玩游戏的能力。到2010年代后期，计算机已经可以比任何人类都更好地完成许多这类任务。

但神经网络往往被融合到具有更广泛功能的软件（如电子邮件客户端）中，非编码人员很少直接与这些AI交互。那些有此经历的人经常用近乎灵性的术语来描述自己的经历。在围棋这种中国古代棋盘游戏上，李世石是世界最佳棋手之一，他在2016年被Alphabet基于神经网络的AlphaGo软件击败，从此退出了围棋比赛。“即使我成为第一，”他说，“有一个实体是无法被击败的。”

通过处理最人性化的媒介——对话，ChatGPT现在让使用互联网的公众体验到了类似的东西，一种由软件引起的智力眩晕。它突然进步到了可以完成从前人类智能独领风骚的那些任务的程度。

尽管给人这种神奇的感觉，但LLM实际上是一项庞大的统计学操作。提示ChatGPT完成句子：“The promise of large language models is that they...”（大型语言模型的承诺是它们……），你会立即得到它的回答。那么它是如何工作的？

首先，模型把这句问话的语言从神经网络无法处理的单词转换为代表这些单词的一组数字（见图）。早期版本的ChatGPT的背后是GPT-3，它通过将文本拆分为通常一起出现的名为“语素”（token）的字符块来实现这一点。这些语素可以是单词，如“love”或“are”；词缀，如“dis”或“ised”，以及标点符号，如“?”。GPT-3的字典包含50,257个语素的详细信息。

GPT-3一次最多可以处理2048个语素，这大约是《经济学人》中一篇长文的长度。相比之下，GPT-4可以处理长达32,000个语素的输入——相当于一篇中篇小说。模型可以接受的文本越长，它看到的上下文就越多，答案就越好。但有个问题——所需的计算量随着输入的长度呈指数增长，这意味着稍微长些的输入需要大得多的计算能力。

接下来，给这些语素分配某种相当于定义的东西：把它们嵌入“意义空间”（如图中第2步所示），其中，意思相近的单词被放置在临近的区域。

LLM然后部署其“注意力网络”在提示的不同部分之间建立联系。读到我们的提示“The promise of large language models is that they...”的人会知道英语语法是怎么回事，并理解句子中单词背后的概念。对他们来说，哪些词相互关联是显而易见的——例如，“模型”（models）是“大”（large）的。然而，LLM必须在其训练阶段从头开始学习这些关联——经过数十亿次训练，注意力网络会在其神经网络中缓慢地将它看到的语言结构编码为数字（称为“权重”）。如果说它对语言有所理解的话，LLM只会以统计而非语法的方式来理解。它更像是一个算盘，而不是一个头脑。

处理完提示后，LLM将启动响应。此时，对于模型的词汇表中的每个语素，注意力网络已经产生了它最适合成为其生成的句子中的下一个语素的概率。概率得分最高的语素并不一定是此次响应会选择的语素——LLM如何做出这一选择，取决于它的运行者对它的创造性高低的预先设定。

LLM生成了一个单词，然后将结果反馈给自身。第一个单词仅根据提示生成。把第一个词包含在响应中以生成第二个词，然后把前两个生成的词包含进去以生成第三个词，依此类推。重复这个过程（称为自回归）直到LLM完成响应。

虽然可以写下它们如何工作的规则，但LLM的输出并不完全可预测；事实证明，这些极大的算盘可以做较小的算盘做不到的事情，甚至让制造它们的人大吃一惊。OpenAI的研究员杰森·韦（Jason Wei，音译）已经在各种不同的LLM中统计到了137种所谓的“涌现”能力。

涌现的能力并非魔法——它们都以某种形式体现在LLM的训练数据（或给它们的提示）中，但直到LLM的规模超过某个非常大的阈值时才会变得明显。在某个规模下，LLM用德语写出性别包容的句子的水平和随机写的差不多。然而，把模型稍微再扩大一点，突然间它就显现了一种新的能力。GPT-4以超过90%考生的分数通过了美国统一律师考试，律师要通过这个水平测试的考试才能获得执照。稍小的GPT-3.5没能通过它。

涌现的能力令人兴奋，因为它们暗示了LLM尚未开发的潜力。Alphabet旗

下人工智能研究公司DeepMind的工程师乔纳斯·德格雷夫（Jonas Degrave）已经演示，可以说服ChatGPT充当令人信服的计算机的命令行终端，它似乎可以准确地编译和运行程序。这里的想法是，只要模型再大一点，突然间它或许就能够做各种有用的新事情。但出于同样的原因，专家们也有担心。一项分析表明，当模型变大时，会出现某些社会偏见。很难判断哪些有害行为可能处于休眠状态，等待着规模扩大一点时被释放出来。

LLM最近能成功地生成令人信服的文本，并显现惊人的涌现能力，要归功于三件事的结合：海量数据、能够从中学习的算法，以及支持这种学习的计算能力（见图表）。GPT-4的构造和功能细节尚未公开，但GPT-3的细节已由OpenAI于2020年发表在一篇题为《语言模型是小样本学习者》的论文中。

在它看到任何训练数据之前，GPT-3神经网络中的权重大多是随机的。于是它生成的任何文本都将是乱码。将其输出引导为有意义的内容并最终形成流利的文本需要训练。GPT-3接受了多种数据源的训练，但其中大部分来自2016年至2019年整个互联网的快照，这些快照取自名为Common Crawl的数据库。互联网上有很多垃圾文本，因此最初的45太字节（TB）经过了另一种机器学习模型过滤以仅仅选择高质量文本，得到了其中的570吉字节（TB）数据集——这个规模可以塞进一台现代笔记本电脑。此外，GPT-4利用数量未知的图片进行了训练，可能有几个太字节。相比之下，在2010年代重新点燃了人们对图像处理的热情的AlexNet神经网络是在一个包含120万张标记图片的数据集上进行训练的，总计126吉字节——不到GPT-4可能数据集大小的十分之一。

在训练时，LLM根据给定的文本进行自我测验。它截取一段，遮盖最后方的一些词，试图猜测那些词会是什么。然后LLM揭开答案并将其与自己的猜测做比较。因为答案就在数据本身中，所以这些模型可以在海量数据集上以“自我监督”的方式进行训练，而不需要人工标记。

该模型的目标是尽可能少犯错来使其猜测尽量准确。但是，并非所有错误

都是等值的。如果原文是“*I love ice cream*”（我喜欢冰淇淋），猜“*I love ice hockey*”（我喜欢冰球）比“*I love ice are*”（我喜欢冰是）好。一个猜测的糟糕程度会被转换为一个数字，称为“损失”。经过几次猜测后，损失被反馈给神经网络并用于将权重推向产生更好答案的方向。

LLM的注意力网络是从如此海量的数据中学习的关键。它在模型中构建了一种学习和使用单词和概念之间关联的方法，哪怕它们在文本中彼此相距一定距离，并且能在合理的时间内处理大量数据。在一个典型的LLM中有许多不同的注意力网络并行运行，这种并行化让这个过程可以跨多个图形处理单元（GPU）运行。较早的、非基于注意力的语言模型版本无法在合理的时间内处理如此大量的数据。魁北克著名的人工智能研究机构蒙特利尔学习算法研究所（MILA）的科学主任约书亚·本吉奥（Yoshua Bengio）说：“如果没有注意力，这种尺度在计算上将难以处理。”

LLM处理数据的庞大能力一直在推动它们最近的扩张。GPT-3有数百层，数十亿个权重，并接受了数千亿个单词的训练。相比之下，五年前创建的第一个版本的GPT的大小只有其万分之一。

但本吉奥说，有充分的理由认为这种增长不可能无限期地持续下去。LLM的投入——数据、计算能力、电力、熟练劳动力——都要花钱。例如，训练GPT-3使用了1.3吉瓦时的电力（足以供给美国121户家庭供电一年），OpenAI估计花费了460万美元。GPT-4是一个大得多的模型，其训练成本将高得不成比例（大约1亿美元）。由于计算能力需求的增长速度比输入数据的增长速度快得多，因此训练LLM的过程变得更昂贵的速度要快过它变得更好的速度。的确，OpenAI的老板山姆·阿尔特曼（Sam Altman）似乎认为拐点已经到来。4月13日，他在麻省理工学院对听众说：“我们认为我们正处于一个极度庞大的模型时代的末期。我们会以其他方式让它们变得更好。”

但限制LLM持续改进的最重要限制是可用的训练数据量。GPT-3已经接受过相当于可从互联网下载的所有高质量文本的训练。于2022年10月发表的一篇论文得出结论：“优质语言数据存量将很快耗尽；很可能在2026年之

前。”肯定会有更多的文本可用，但它被少量分散地锁定在公司数据库或个人设备上，无法以Common Crawl允许的规模和低成本访问。

随着时间的推移，计算机将变得更加强大，但没有新的硬件能够提供像2010年代初期使用GPU那样大的性能飞跃，因此训练更大的模型可能会越来越昂贵——这也许是阿尔特曼对这个想法不感兴趣的原因。改进是可能的，包括新型芯片，如谷歌的张量处理单元，但芯片制造不再以摩尔定律通过越来越小的电路呈指数级升级。

还会有法律问题。Stability AI公司生产名为Stable Diffusion的图像生成模型，已被摄影机构盖帝图像（Getty Images）兴讼。Stable Diffusion的训练数据源与GPT-3和GPT-4的相同，即Common Crawl，并且它使用注意力网络来以非常相似的方式处理数据。AI生成能力的一些最引人注目的例子是图像。互联网上的人们现在经常为似是而非的假造场景照片兴奋不已：穿着巴黎世家夹克的教皇；特朗普被捕。

盖帝图像指出了Stable Diffusion生成的一些图像包含其版权水印，这表明Stable Diffusion已经在未经许可的情况下抓取并复制了受版权保护的材料（Stability AI尚未对诉讼发表公开评论）。在检查ChatGPT的文本输出时很难获得相同级别的证据，但毫无疑问，它是在受版权保护的材料上进行训练的。OpenAI希望其文本生成受到“合理使用”的保护，这是版权法中的一项规定，允许出于“变革性”目的有限使用受版权保护的材料。这一想法可能有一天会在法庭上得到检验。

但哪怕今年LLM停止改进，而一场声势浩大的诉讼把OpenAI推向破产，大型语言模型的力量仍将存在。数据和处理数据的工具随处可见，哪怕OpenAI已实现的巨大规模仍然很昂贵。

在经过仔细且有选择的训练后，开源实现已经在模仿GPT-4的性能。这是一件好事：把LLM的力量放到很多人手中意味着许多头脑可以构想出创新的新应用，改进从医学到法律的一切。

但这也意味着让科技精英夜不能寐的灾难性风险变得更可以想见。LLM已

经非常强大，并且改进得如此之快，许多研发它们的人都被吓坏了。最大模型的能力超出了它们的创造者的理解和控制。正如本系列下一篇文章将解释的那样，这会产生各种各样的风险。 ■



Generative AI

Large, creative AI models will transform lives and labour markets

They bring enormous promise and peril. But how do they work?

SINCE NOVEMBER 2022, when OpenAI, the company which makes ChatGPT, first opened the chatbot to the public, there has been little else that the tech elite has wanted to talk about. As this article was being written, the founder of a London tech company messaged your correspondent unprompted to say that this kind of AI is “essentially all I’m thinking about these days”. He says he is in the process of redesigning his company, valued at many billions of dollars, around it. He is not alone.

ChatGPT embodies more knowledge than any human has ever known. It can converse cogently about mineral extraction in Papua New Guinea, or about TSMC, a Taiwanese semiconductor firm that finds itself in the geopolitical crosshairs. GPT-4, the artificial neural network which powers ChatGPT, has aced exams that serve as gateways for people to enter careers in law and medicine in America. It can generate songs, poems and essays. Other “generative AI” models can churn out digital photos, drawings and animations.

Running alongside this excitement is deep concern, inside the tech industry and beyond, that generative AI models are being developed too quickly. GPT-4 is a type of generative AI called a large language model (LLM). Tech giants like Alphabet, Amazon and Nvidia have all trained their own LLMs, and given them names like PaLM, Megatron, Titan and Chinchilla.

The London tech boss says he is “incredibly nervous about the existential threat” posed by AI, even as he pursues it, and is “speaking with [other] founders about it daily”. Governments in America, Europe and China have

all started mulling new regulations. Prominent voices are calling for the development of artificial intelligence to be paused, lest the software somehow run out of control and damage, or even destroy, human society. To calibrate how worried or excited you should be about this technology, it helps first to understand where it came from, how it works and what the limits are to its growth.

The contemporary explosion of the capabilities of AI software began in the early 2010s, when a software technique called “deep learning” became popular. Using the magic mix of vast datasets and powerful computers running neural networks on Graphics Processing Units (GPUs), deep learning dramatically improved computers’ abilities to recognise images, process audio and play games. By the late 2010s computers could do many of these tasks better than any human.

But neural networks tended to be embedded in software with broader functionality, like email clients, and non-coders rarely interacted with these AIs directly. Those that did often described their experience in near-spiritual terms. Lee Sedol, one of the world’s best players of Go, an ancient Chinese board game, retired from the game after Alphabet’s neural-net-based AlphaGo software crushed him in 2016. “Even if I become the number one,” he said, “there is an entity that cannot be defeated.”

By working in the most human of mediums, conversation, ChatGPT is now allowing the internet-using public to experience something similar, a kind of intellectual vertigo caused by software which has improved suddenly to the point where it can perform tasks that had been exclusively in the domain of human intelligence.

Despite that feeling of magic, an LLM is, in reality, a giant exercise in statistics. Prompt ChatGPT to finish the sentence: “The promise of large language models is that they...” and you will get an immediate response.

How does it work?

First, the language of the query is converted from words, which neural networks cannot handle, into a representative set of numbers (see graphic). GPT-3, which powered an earlier version of ChatGPT, does this by splitting text into chunks of characters, called tokens, which commonly occur together. These tokens can be words, like “love” or “are”, affixes, like “dis” or “ised”, and punctuation, like “?”. GPT-3’s dictionary contains details of 50,257 tokens.

GPT-3 is able to process a maximum of 2,048 tokens at a time, which is around the length of a long article in *The Economist*. GPT-4, by contrast, can handle inputs up to 32,000 tokens long—a novella. The more text the model can take in, the more context it sees, and the better its answers will be. There is a catch—the required computation rises exponentially with the length of the input, meaning slightly longer inputs need much more computing power.

The tokens are then assigned the equivalent of definitions by embedding them into a “meaning space” (as shown in Step 2 of the graphic) where words that have similar meanings are located in nearby areas.

The LLM then deploys its “attention network” to make connections between different parts of the prompt. Someone reading our prompt, “the promise of large language models is that they...”, would know how English grammar works and understand the concepts behind the words in the sentence. It would be obvious to them which words relate to each other—it is the model that is large, for example. An LLM, however, must learn these associations from scratch during its training phase—over billions of training runs, its attention network slowly encodes the structure of the language it sees as numbers (called “weights”) within its neural network. If it understands language at all, an LLM only does so in a statistical, rather than a

grammatical, way. It is much more like an abacus than it is like a mind.

Once the prompt has been processed, the LLM initiates a response. At this point, for each of the tokens in the model's vocabulary, the attention network has produced a probability of that token being the most appropriate one to use next in the sentence it is generating. The token with the highest probability score is not always the one chosen for the response—how the LLM makes this choice depends on how creative the model has been told to be by its operators.

The LLM generates a word and then feeds the result back into itself. The first word is generated based on the prompt alone. The second word is generated by including the first word in the response, then the third word by including the first two generated words, and so on. This process—called autoregression—repeats until the LLM has finished.

Although it is possible to write down the rules for how they work, LLMs' outputs are not entirely predictable; it turns out that these extremely big abacuses can do things which smaller ones cannot, in ways which surprise even the people who make them. Jason Wei, a researcher at OpenAI, has counted 137 so-called “emergent” abilities across a variety of different LLMs.

The abilities that emerge are not magic—they are all represented in some form within the LLMs' training data (or the prompts they are given) but they do not become apparent until the LLMs cross a certain, very large, threshold in their size. At one size, an LLM does not know how to write gender-inclusive sentences in German any better than if it was doing so at random. Make the model just a little bigger, however, and all of a sudden a new ability pops out. GPT-4 passed the American Uniform Bar Examination, designed to test the skills of lawyers before they become licensed, in the 90th percentile. The slightly smaller GPT-3.5 flunked it.

Emergent abilities are exciting, because they hint at the untapped potential of LLMs. Jonas Degrave, an engineer at DeepMind, an AI research company owned by Alphabet, has shown that ChatGPT can be convinced to act like the command line terminal of a computer, appearing to compile and run programs accurately. Just a little bigger, goes the thinking, and the models may suddenly be able to do all manner of useful new things. But experts worry for the same reason. One analysis shows that certain social biases emerge when models become large. It is not easy to tell what harmful behaviours might be lying dormant, waiting for just a little more scale in order to be unleashed.

The recent success of LLMs in generating convincing text, as well as their startling emergent abilities, is due to the coalescence of three things: vast quantities of data, algorithms capable of learning from them and the computational power to do so (see chart). The details of GPT-4's construction and function are not yet public, but those of GPT-3 were published in 2020 by OpenAI in a paper titled "Language Models are Few-Shot Learners".

Before it sees any training data, the weights in GPT-3's neural network are mostly random. As a result, any text it generates will be gibberish. Pushing its output towards something which makes sense, and eventually something that is fluent, requires training. GPT-3 was trained on several sources of data, but the bulk of it comes from snapshots of the entire internet between 2016 and 2019 taken from a database called Common Crawl. There's a lot of junk text on the internet, so the initial 45 terabytes were filtered using a different machine-learning model to select just the high-quality text: 570 gigabytes of it, a dataset that could fit on a modern laptop. In addition, GPT-4 was trained on an unknown quantity of images, probably several terabytes. By comparison AlexNet, a neural network that reignited image-processing excitement in the 2010s, was trained on a dataset of 1.2m labelled images, a total of 126 gigabytes—less than a tenth of

the size of GPT-4's likely dataset.

To train, the LLM quizzes itself on the text it is given. It takes a chunk, covers up some words at the end, and tries to guess what might go there. Then the LLM uncovers the answer and compares it to its guess. Because the answers are in the data itself, these models can be trained in a “self-supervised” manner on massive datasets without requiring human labellers.

The model’s goal is to make its guesses as good as possible by making as few errors as possible. Not all errors are equal, though. If the original text is “I love ice cream”, guessing “I love ice hockey” is better than “I love ice are”. How bad a guess is turned into a number called the loss. After a few guesses, the loss is sent back into the neural network and used to nudge the weights in a direction that will produce better answers.

The LLM’s attention network is key to learning from such vast amounts of data. It builds into the model a way to learn and use associations between words and concepts even when they appear at a distance from each other within a text, and it allows it to process reams of data in a reasonable amount of time. Many different attention networks operate in parallel within a typical LLM and this parallelisation allows the process to be run across multiple GPUs. Older, non-attention-based versions of language models would not have been able to process such a quantity of data in a reasonable amount of time. “Without attention, the scaling would not be computationally tractable,” says Yoshua Bengio, scientific director of Mila, a prominent AI research institute in Quebec.

The sheer scale at which LLMs can process data has been driving their recent growth. GPT-3 has hundreds of layers, billions of weights, and was trained on hundreds of billions of words. By contrast, the first version of GPT, created five years ago, was just one ten-thousandth of the size.

But there are good reasons, says Dr Bengio, to think that this growth cannot continue indefinitely. The inputs of LLMs—data, computing power, electricity, skilled labour—cost money. Training GPT-3, for example, used 1.3 gigawatt-hours of electricity (enough to power 121 homes in America for a year), and cost OpenAI an estimated \$4.6m. GPT-4, which is a much larger model, will have cost disproportionately more (in the realm of \$100m) to train. Since computing-power requirements scale up dramatically faster than the input data, training LLMs gets expensive faster than it gets better. Indeed, Sam Altman, the boss of OpenAI, seems to think an inflection point has already arrived. On April 13th he told an audience at the Massachusetts Institute of Technology: “I think we’re at the end of the era where it’s going to be these, like, giant, giant models. We’ll make them better in other ways.”

But the most important limit to the continued improvement of LLMs is the amount of training data available. GPT-3 has already been trained on what amounts to all of the high-quality text that is available to download from the internet. A paper published in October 2022 concluded that “the stock of high-quality language data will be exhausted soon; likely before 2026.” There is certainly more text available, but it is locked away in small amounts in corporate databases or on personal devices, inaccessible at the scale and low cost that Common Crawl allows.

Computers will get more powerful over time, but there is no new hardware forthcoming which offers a leap in performance as large as that which came from using GPUs in the early 2010s, so training larger models will probably be increasingly expensive—perhaps why Mr Altman is not enthused by the idea. Improvements are possible, including new kinds of chips such as Google’s Tensor Processing Units, but the manufacturing of chips is no longer improving exponentially through Moore’s law and shrinking circuits.

There will also be legal issues. Stability AI, a company which produces an image-generation model called Stable Diffusion, has been sued by Getty

Images, a photography agency. Stable Diffusion's training data comes from the same place as GPT-3 and GPT-4, Common Crawl, and it processes it in very similar ways, using attention networks. Some of the most striking examples of AI's generative prowess have been images. People on the internet are now regularly getting caught up in excitement about apparent photos of scenes that never took place: the pope in a Balenciaga jacket; Donald Trump being arrested.

Getty points to images produced by Stable Diffusion which contain its copyright watermark, suggesting that Stable Diffusion has ingested and is reproducing copyrighted material without permission (Stability AI has not yet commented publicly on the lawsuit). The same level of evidence is harder to come by when examining ChatGPT's text output, but there is no doubt that it has been trained on copyrighted material. OpenAI will be hoping that its text generation is covered by "fair use", a provision in copyright law that allows limited use of copyrighted material for "transformative" purposes. That idea will probably one day be tested in court.

But even in a scenario where LLMs stopped improving this year, and a blockbuster lawsuit drove OpenAI to bankruptcy, the power of large language models would remain. The data and the tools to process it are widely available, even if the sheer scale achieved by OpenAI remains expensive.

Open-source implementations, when trained carefully and selectively, are already aping the performance of GPT-4. This is a good thing: having the power of LLMs in many hands means that many minds can come up with innovative new applications, improving everything from medicine to the law.

But it also means that the catastrophic risk which keeps the tech elite up at

night has become more imaginable. LLMs are already incredibly powerful and have improved so quickly that many of those working on them have taken fright. The capabilities of the biggest models have outrun their creators' understanding and control. As the next article explains, that creates risks, of all kinds. ■



熊彼特

企业试水ChatGPT类服务

假以时日，这可能将带来收获

每个财报季都会产生新的流行语。在各大公司准备最新一季财报时，许多老板肯定会把一个词挂在嘴边——生成式AI。自打AI聊天机器人ChatGPT惊艳面世，老板们就一直垂涎生成式AI提高生产率的潜力。苏黎世保险集团（Zurich）正在使用定制版ChatGPT来简化冗长的索赔文件。玩具制造商美泰（Mattel）运用DALL-E设计新玩具，DALL-E是另一个根据文本提示生成图像的AI工具。生物技术公司AbSci利用这项神奇新技术来辅助开发治疗性抗体。许多其他公司也都开始试水这一陌生领域。

知识经济的工具制造商更是全情拥抱着这股创新热潮。微软宣布了连串产品升级计划，将可以减轻办公室员工的工作负担，从起草电子邮件、汇总文件内容到写代码等等。微软云计算部门的AI主管埃里克·博伊德（Eric Boyd）在形容公司繁忙的发布安排时说，“一天当一周用。”竞争对手谷歌同样在改装升级自家的工具套件。分别为创意设计人员、销售人员和金融精英提供软件的Adobe、Salesforce和彭博也是如此。类似ChatGPT的法律AI助理Harvey和写作AI助手Jasper等创业公司正快速而密集地崛起。

尽管各种试验如火如荼，企业仍不确定该如何利用AI的新能力。博伊德表示，大多数公司不是低估就是高估了该技术的能力。人们正在研究哪些工作最适合通过AI重塑。ChatGPT和DALL-E背后的公司OpenAI在3月发表了一项研究，盘点了在各种职业里，使用生成式AI可把工作效率提高至少一半的任务占多大比例。排在前面的是涉及大量程式化写作、数字处理或计算机编程的职业，例如律师助理、金融分析师和网页设计师。

企业不太可能马上把这类岗位全部裁撤掉。生成式AI也许能胜任草拟初稿的工作，但还是要依靠人类来发出指示和评估结果。微软把新工具套件命名为“co-pilots”就说明了这一点。职场社交网络领英的联合创始人里德·霍

夫曼（Reid Hoffman）最近出版了新书《即兴》（Impromptu，此书是在一个机器人的协助下写就的），在书中劝告用户要“像对待一位本科生研究助理一样”对待ChatGPT这类人工智能。

而且，咨询公司麦肯锡的迈克尔·崔（Michael Chui）认为，随着程序员、推销员和其他白领员工的生产率提升，还没有什么证据表明公司会想撤掉这些职位。软件最终可能会像一位风险投资家预言的那样吞噬世界，但目前还只是蚕食到世界的边缘而已。而且大多数公司肯定会更在意提升销售额而非减少销售员。然而，试图利用生成式AI的企业还是会面对各种障碍。首先，许多公司需要反思初级员工的角色，应视其为有待培训的学徒，而不是要催促其干活的劳力。对于IT系统笨重过时、数据集分散的公司而言，要充分利用生成式AI可能也是件难事。有利的一面是，驱动ChatGPT的这类大型语言模型比早期的AI系统更善于处理非结构化的数据集，咨询公司贝恩的合伙人罗伊·辛格（Roy Singh）指出。该公司最近与OpenAI签署了合作协议。

其他顾虑也可能拖慢对该技术的采用。谷歌云计算部门首席技术专家威尔·格兰尼斯（Will Grannis）指出，在采用新技术上，企业的准则要比消费者的高得多。保护机密或敏感数据就是担忧之一，这已导致从摩根大通到国防承包商诺斯罗普格鲁曼（Northrop Grumman）的公司禁止员工在工作中使用ChatGPT。苏黎世保险则不允许把客户个人信息输入到这些工具中。

一个更大的问题是可靠性。ChatGPT这类工具能给出貌似可信但违背事实的信息，这个过程被委婉地形容为“幻觉”。假如是创作宣传材料，这可能不是什么问题，但用在别的地方就是致命缺陷了。“要设计飞机机翼，就不能粗略估算。”工程软件开发商Autodesk的研究主管迈克·黑利（Mike Haley）指出。人类也会犯错。区别是，生成式AI工具目前既不解释想法，也不坦白有几成把握。因此在事关重大的场景下，人们很难信任这些工具。

人们日益担忧生成式AI可能给社会造成危害，特别是它还越变越聪明，而

这可能会让老板们对它的兴趣消减。一些人担心出现大量由AI生成的诈骗、错误信息和计算机病毒。这些忧虑促使各国政府采取行动。美国商务部正在就如何管理该技术公开征求意见。欧盟正在修改之前草拟的一份AI法案以涵盖最新的技术进展。意大利目前已禁止使用ChatGPT。

最后一个忧虑是大规模部署聪明的AI可能让员工忧心自己未来工作不保，从而打击他们的士气。不过目前来看，员工似乎是这种新技术的狂热支持者之一。职场社交应用Fishbowl在1月调查了1.2万名职场人士，发现其中43%的受访者曾使用ChatGPT这类工具来完成与工作有关的任务，大多数是在老板不知情的情况下使用。这份热情表明，没多少人会为AI取代了琐碎工作任务而难过。“没有人去读法学院是为了在文件堆里查找信息。”Harvey的联合创始人温斯顿·温伯格（Winston Weinberg）说。这可能足以鼓励公司继续尝试新技术。这应该不会是件坏事，毕竟富裕国家的生产率增长已经20年徘徊不前了。 ■



Schumpeter

How businesses are experimenting with ChatGPT-like services

In time, the approach may yield dividends

EACH EARNINGS season comes with new buzzwords. As companies ready their scripts for the most recent quarter, one phrase in particular is sure to end up on many bosses' lips—generative artificial intelligence (AI). Ever since ChatGPT, an artificially intelligent conversationalist, began dazzling the world, bosses have been salivating over the potential for generative AI to turbocharge productivity. Zurich, an insurer, is now using a customised version of ChatGPT to simplify lengthy claims documents. Mattel, a toymaker, is designing new playthings using DALL-E, another tool that conjures images based on text prompts. Absci, a biotech company, is using the new wonder to assist with the development of therapeutic antibodies. Plenty of other firms are dipping their toes in this unfamiliar water.

The toolmakers of the knowledge economy have more fully embraced the innovation frenzy. Microsoft has announced a string of product updates that will allow desk jockeys to offload tasks from drafting emails and summarising documents to writing computer code. “Like working in dog years”, is how Eric Boyd, head of AI for the tech giant’s cloud-computing division, describes the company’s hectic release schedule. Google, a rival, is likewise souping up its suite of tools, as are Adobe, Salesforce and Bloomberg, makers of software for creative types, salesmen and financial whizzes, respectively. Startups like Harvey, a ChatGPT-like legal assistant, and Jasper, a writing aid, are emerging thick and fast.

Despite all the experimentation, companies remain uncertain about how to make use of AI’s newfound powers. Most, according to Mr Boyd, either underestimate or overestimate the technology’s capabilities. Efforts are

being made to determine which jobs are the strongest candidates for reinvention. A study published last month by OpenAI, the outfit behind ChatGPT and DALL-E, looked at the share of tasks within an occupation that could be speeded up by at least half using the new technology. Topping the list were occupations involving copious amounts of routine writing, number crunching or computer programming—think paralegals, financial analysts and web designers.

It is unlikely that firms will soon dispense with such jobs entirely. Generative AI may do a good job of producing first drafts but relies on humans to give instructions and appraise results. Microsoft, tellingly, has labelled its new suite of tools “co-pilots”. In “Impromptu”, a recent book by Reid Hoffman, co-founder of LinkedIn, a social network for professionals, the author counsels users to treat ChatGPT and others “like an undergraduate research assistant”. (The book was written with the assistance of a bot.)

What's more, as coders, salesmen and other white-collar types become more productive, there is little evidence yet that companies will want fewer of them, argues Michael Chui of McKinsey, a consultancy. Software may eventually eat the world, as one venture capitalist predicted, but so far it has only nibbled at the edges. And most companies will surely choose more sales over fewer salesmen. Yet various hurdles lie ahead for businesses looking to make use of generative AI. For a start, many firms will need to rethink the role of junior staff as apprentices to be trained, rather than workhorses to be whipped. Getting the best out of generative AI may also prove tough for firms with clunky old IT systems and scattered datasets. On the plus side, large language models like the ones powering ChatGPT are better at working with unstructured datasets than earlier types of AI, says Roy Singh of Bain, a consultancy that has inked a partnership with OpenAI.

Other reservations could still slow adoption. Companies have a much

higher bar than consumers when it comes to embracing new technology, notes Will Grannis, chief technologist for Google's cloud-computing division. One concern is shielding confidential or sensitive data, a worry that has led companies from JPMorgan Chase, a bank, to Northrop Grumman, a defence contractor, to ban staff from using ChatGPT at work. Zurich does not allow customers' personal information to be fed into its tool.

A bigger concern is reliability. ChatGPT-like tools can spit out plausible but incorrect information, a process euphemistically dubbed "hallucination". That may not be a problem when dreaming up promotional material, but it is a fatal flaw elsewhere. "You can't approximate the design of an aeroplane wing," notes Mike Haley, head of research for Autodesk, a maker of engineering software. Humans err, too. The difference is that generative-AI tools, for now, neither explain their thinking nor confess their level of confidence. That makes them hard to trust if the stakes are high.

Bosses could also find their appetite for generative AI spoiled by growing worries over the risks the technology poses to society, particularly as it gets cleverer. Some fret about a barrage of AI-generated scams, misinformation and computer viruses. Such concerns are spurring governments to action. America's Commerce Department is seeking comments from the public on how it should approach the technology. The European Union is amending a planned bill on AI to encompass recent advances. Italy has, for now, banned ChatGPT.

A final fear is that rolling out clever AI could undermine the morale of staff, if they worry for their futures. Yet so far employees appear to be among the new technology's most enthusiastic supporters. Of 12,000 workers surveyed in January by Fishbowl, a workplace-network app, 43% had used tools like ChatGPT for work-related tasks—a large majority without their bosses knowing. Such enthusiasm suggests few tears shed for the loss of menial

tasks to AI. “No one goes to law school to spend time trawling through documents,” says Winston Weinberg, Harvey’s co-founder. That may be enough to encourage firms to continue experimenting. With productivity growth in rich countries languishing for two decades, that would be no bad thing. ■



经济学人视频

AI聊天机器人将如何改变互联网？（预告）

ChatGPT的出现让AI突然从虚拟走进现实。



The Economist Film

How will AI chatbots change the internet? - Trailer

With the arrival of chatbots like ChatGPT, suddenly AI seems a lot closer to fact than fiction.



先行一步

为什么锂价暴跌不会让电动汽车更便宜

抢夺这种电池金属的竞赛才刚刚开始

在对脱碳至关重要的大宗商品中，锂占据着主导地位。几乎所有类型的电动汽车电池都会用到这种被称为“白色黄金”的金属。一个电池包一般含有10公斤锂。过去两年全球电动汽车销量激增，推动锂的价格上涨了12倍，引发矿业公司蜂拥投资，也促使汽车制造商赶着签署采购协议，政府则将它列为战略材料。去年冬天大多数大宗商品价格保持稳定，但锂的价格继续走高。

此后，涨势开始逆转。今年，中国的碳酸锂（两种主要精炼锂之一）价格已经下跌了一半以上（见图表）。其中一个原因是是中国这个最大的电动车市场对电动汽车的需求正在放缓。另一个原因是福特和大众等汽车制造商因急于加入由特斯拉和中国竞争对手主导的竞赛，去年以高价签订了电池供应协议。它们现在正在重新查看协议条款，这进一步抑制了需求。

与此同时，全球锂矿供应正在快速增长。投资银行Liberum的汤姆·普莱斯（Tom Price）说，锂矿产量在2022年增长了1%，达到57.5万吨，而随着澳大利亚和智利的大型矿山投产，今年的增长可能会接近五分之一。突然的价格下跌让全球最大的两家锂矿商智利矿业化工（SQM）和雅保（Albemarle）的估值受创。但大型矿业公司不太可能遭受太大的损失。锂仍然很贵。据咨询公司Benchmark Minerals估算，碳酸锂目前的价格是2016年至2021年间均价的四倍，当时有许多大型项目开工（矿场建成大约需要五年时间）。

锂的价格尚未触底，但不太可能跌到让大型矿商无利可图的程度。价格如果跌破每吨2.2万美元，远低于目前的水平，将导致中国国内许多矿山关闭，致使供应量减少。而即使精炼锂产品已经降价，锂辉石（从锂矿中提炼锂的原料之一）的价格仍然很高，挤压了精炼厂的利润空间。它们可能

也会被迫削减产量，以支撑精炼产品的价格。

而且迹象表明需求将会复苏。4月，中国乘用车市场信息联席会的会长表示，预计今年中国的电动汽车销量将增长30%。摩根大通认为，一轮反弹会让锂市场在2023年到2024年转向供不应求。其他地区的电动汽车销售依然强劲。另一种精炼产品氢氧化锂常用于更昂贵、续航更久的电池，在中国以外的地方更受青睐，其价格一直比碳酸锂坚挺。氢氧化锂不能永久储存，这也会支撑价格。从长远来看，在美国、欧洲和中国环保政策的支持下，对锂的储能需求不断增长，可能还会让这个市场愈发吃紧。

这解释了为什么大型矿商仍在推进新项目，比如雅保投资13亿美元在美国南卡罗来纳州兴建一座氢氧化锂工厂。竞争对手股价暴跌可能会让它们有机会进一步扩张规模。3月，雅保提出以37亿美元收购澳大利亚锂矿商Liontown Resources。业内人士预计会有更多交易。汽车制造商则着急要抢到更多锂。4月，通用汽车表示将投资一家创业公司，该公司计划从以前被忽视的矿藏中提取锂，这是近期押注锂企业的一系列尝试中的最新一例。

价格的回升会让汽车制造商失望。在过去十年左右的时间里，锂电池的价格暴跌，但去年锂价飙升推动电池价格上涨了7%。最近的锂价下滑应当会让电池价格重新下跌，不过电池降价一般需要几个月时间才会转化为汽车降价，而到那时锂价可能又开始上涨了。在经历了几年的冲刺之后，白色黄金暂时刹车了。趁它还在停靠加油的功夫赶紧喘口气吧。■



Ahead of the pack

Why crashing lithium prices will not make electric cars cheaper

The race to secure enough of the battery metal is just getting started

AMONG THE commodities that are key to decarbonisation, lithium is in the driving seat. Dubbed “white gold”, the metal is needed to produce nearly all types of batteries powering electric vehicles (EVs). A single pack typically includes ten kilograms of the stuff. In the past two years turbocharged EV sales worldwide helped boost prices twelve-fold, prodding miners to invest, carmakers to sign supply deals and governments to label it a strategic material. Most commodity prices stalled this winter, but lithium continued to ride high.

The rally has since gone into reverse. Prices for Chinese lithium carbonate, one of the two main forms of refined lithium, have more than halved this year (see chart). One reason is slowing demand for EVs in China, the biggest market for them. Another is that carmakers such as Ford and Volkswagen, eager to enter a race dominated by Tesla and Chinese rivals, signed battery-supply deals at high prices last year. They are now reviewing the terms, further dampening appetite.

Global supply of mined lithium is rising fast, meanwhile. After growing by 1% in 2022, to 575,000 tonnes, it could jump by nearly a fifth this year as big mines come online in Australia and Chile, says Tom Price of Liberum, an investment bank. The sudden price slide has hit the valuations of SQM and Albemarle, the world’s largest miners of the metal. But the big miners are unlikely to suffer too much. Lithium is still expensive. Benchmark Minerals, a consultancy, estimates that carbonate prices are four times what they were, on average, between 2016 and 2021, when many big projects were commissioned (mines take about five years to build).

Prices have yet to reach a floor but they are unlikely to fall far enough to bury big miners' profits. Prices below \$22,000 a tonne, far lower than today's levels, would cause many of China's domestic mines to shut down, lowering supply. And even as the refined product has become cheaper, the price of spodumene, a feedstock used to transform lithium ores, remains high, squeezing processors' margins. They too may be forced to slash production, supporting prices of the refined stuff.

And there are signs demand will revive. In April the chief of the China Passenger Car Association said he expected sales of EVs in the country to rise by 30% this year. JPMorgan Chase, a bank, reckons a rebound will tip the lithium market into a deficit in 2023 and 2024. EV sales elsewhere remain healthy. The price of lithium hydroxide, a refined form of lithium used in more expensive, longer-range batteries, which are preferred outside China, has held up better than that of carbonate. It will help that hydroxide cannot be stored for ever. In the longer run rising demand for lithium for energy storage, supported by green policies in America, Europe and China, could make the market even tighter.

This explains why big miners are still moving forward with new projects, such as Albemarle's \$1.3bn lithium hydroxide plant in South Carolina. A slump in the share price of rivals could allow them to grow bigger. In March Albemarle offered to buy Liontown Resources, an Australian producer, for \$3.7bn. Insiders expect more deal activity. Carmakers, for their part, are anxious to secure more lithium. In April General Motors said it would invest in a startup that proposes to extract metal from previously ignored deposits, the latest in a series of recent bets on lithium ventures.

A recovery in prices would disappoint carmakers. Lithium-ion battery prices have plummeted over the past decade or so, yet last year soaring metal prices helped to push up battery costs by 7%. The recent fall in lithium prices should again mean cheaper batteries, but it typically takes months

for lower prices to translate into cheaper cars, by which point prices may be rising again. After a multi-year tear, white gold is taking a pause. Enjoy the pit stop while it lasts. ■



摸索向前

日本是如何在全球电动汽车竞赛中落败的

丰田、本田和日产这些昔日的创新者正在奋力追赶

在日本汽车零部件制造商加特可的富士二区工厂里，绿色的车间透着一股低调的自信。质检员孜孜不倦地检验将用于制造传动系统的齿轮和滑轮。机器人把零件冲压成型，再把它们翻转到生产线上。几十年来，作为日本引以为傲的汽车工业的一分子，加特可和其他制造商一道，让汽车制造技术精益求精。日本一直处于汽车工业的前沿，它开创了“准时制”生产方式，并引领了混合动力汽车的发展。但接下来这一次向电动汽车的重大演进给日本带来了焦虑。“不可否认，向电动汽车转变将是一次重大转型，”加特可的社长佐藤朋由表示，“我们必须做出彻底改变。”

电动汽车现在是汽车行业增长最快的产品领域，而到目前为止，日本及其汽车制造商在这个赛道上落于人后。2022年，纯电动汽车和插电式混合动力汽车占全球汽车销量的比例从2019年的2.6%上升到13%左右。这一比例在包括中国在内的许多市场中约为20%，而在日本仅为2%。在电动车竞赛中领先的既包括特斯拉和中国的比亚迪等新入局者，也包括德国的大众等老牌巨头。

日本汽车制造商不在其中。尽管日产和三菱在十多年前就在全球首批推出电动汽车的厂商之列，但日本今天却没有一家车厂进入全球电动汽车销量前20名。2022年，全球第一大车厂丰田总共销售了1050万辆车，其中只有2.4万辆电动车（而同期特斯拉售出130万辆）。丰田推出的首款纯电动车——名为bZ4X的SUV——因导致车轮脱落的设计缺陷在去年夏天不得不停售。

评论人士担心，在电动汽车上刚起步就卡顿可能导致整个日本汽车产业前进的车轮脱落。一些人认为这与半导体和消费电子产品上发生的事有相似之处——这两个行业最初也由日本公司主导，但它们后来没把握住国外市

场上的重要趋势，最终输给了反应更敏捷的竞争对手。鉴于汽车行业占到日本出口额的近20%，并创造了约8%的就业岗位，如果这个行业真出现类似的衰落，将对日本经济和社会产生巨大影响。

日本汽车制造商正在急起直追。佐藤恒治被任命为丰田的新社长，部分原因是为了领导丰田推进电气化。4月7日，在他上任后的首次新闻发布会上，丰田宣布了在2026年前发布十款新电动汽车、将电动车年销量提高到150万辆的计划。“我们将全面实施电气化，我们马上就可以行动起来。”佐藤表示。

本田计划在2030年前推出30款电动车，并在去年与索尼成立了电动汽车合资公司。本田把4月开始实施的企业重组定位为“加速电气化”。2月，日产表示在2030年前发布19款新电动车；它现在称电气化是“我们的战略核心”。

日本在电动汽车方面起步迟缓，一定程度上是因为它早先的成功——或者如加特可的佐藤所说，是典型的“创新者窘境”。在过去，行业领袖们对积极拥抱某项新技术心存顾虑，担心它会瓦解日本处于领先地位的领域，比如标准混合动力汽车。这种汽车同时使用内燃机和由电池驱动的电动机，其电池是从再生制动中获取能量，而不是像插电式混合动力汽车那样使用外部电力充电。日本公司里的工程师喜欢雕琢这种复杂的混合动力车，对机械结构更简单的电动汽车也不以为然。“在汽车行业，仍有很多人对发动机恋恋不舍。”佐藤表示。因为电动汽车所需的零部件比内燃机汽车少，高管们担心向电动汽车转变可能会冲击整个供应商网络（比如加特可）。车厂认为最终转向电动汽车将是轻而易举的。“当时的想法是，等到时机成熟，我们能轻松地从混合动力车转向电动车。”日本一家大型车企的前高管表示。

日本早先还错误地转向了氢能。氢能是另一种可能实现汽车零碳排放的新兴技术。日本最具影响力的车厂丰田押注氢燃料电池，认为它是通向汽车电气化的主要路径。2012年至2020年担任日本首相的安倍晋三主张要将日本打造为“氢能社会”的政策；2015年，丰田把它的第一辆氢燃料电池轿车

Mirai交付给了安倍本人。尽管氢可能在一些难以实现电气化的领域（比如钢铁生产或为长途卡车提供燃料等）的脱碳上发挥重要作用，但到目前为止，把它用于轻型乘用车的电气化不具备经济合理性。即使在已经建立了相当多的加氢基础设施的日本，丰田也难以把昂贵的Mirai卖出去：它在国内市场总共只卖出了7500辆氢燃料电池车。

作为各自气候政策的一部分，中国、欧洲和美国政府一直在不断加大对电动汽车的补贴，但日本在激励使用电动汽车方面动作不多。日本政府要求到2035年销售的车辆百分之百实现电气化，但其中包括了混合动力汽车。而其他国家的政府对“下一代汽车”的定义更为狭窄。日本对氢燃料电池汽车的补贴仍远高于电动汽车。严格的监管阻碍了电动汽车充电基础设施的铺开：日本电动汽车公共充电桩的数量仅为比其小得多的邻国韩国的四分之一左右。

日本的小心翼翼还有一部分原因是它对电动汽车技术的疑虑挥之不去。行业期刊《AutoInsight》的鹤原吉郎指出，日本车厂和政府官员“仍在质疑”：“电动汽车是消费者想要的吗？电动汽车能为消费者提供价值吗？电动汽车是减少二氧化碳排放的最好方式吗？”丰田创始人的孙子、丰田前社长丰田章男总是说：“我们的敌人是碳，而不是内燃机。”即使在佐藤（受丰田章男提携）上任后，丰田仍在坚持其所谓的“多路径”战略，将电动汽车视为各种车型方案中的一个。“我们认为，要在全球范围内最大程度地实现二氧化碳总体的净减排，就要针对世界不同地方调整解决方案。”丰田首席科学家吉尔·普拉特（Gill Pratt）表示。例如，在发展中国家，可再生能源的普及通常比在西方慢，传统的混合动力汽车或许能在过渡时期提供一种更实用、更经济的减排方式。

但一些人认为，日本汽车制造商行动太过迟缓，无法跟上那些更发达的市场上的时代变化。“它们就像德川幕府时代封闭的日本——拒绝去看世界上正在发生的事情。”管理顾问村泽义久表示。尽管过去人们提到日本车就会想到省油，进而想到环保，但它们现在却有可能成为“气候变化否定论”的代名词。根据环保组织绿色和平（Greenpeace）近期一项研究，在全球十大车厂的减排表现排名中，丰田、本田和日产这三家日本最大的车

厂垫底。

丰田在bZ4X上的失败经验表明，设计和制造顶级的电动汽车可能并不像日本公司曾经想象的那么简单。“它们过于自信了，以为自己一旦决定去做，就会主宰电动汽车市场，”村泽表示，“但事实证明，它们的产品已经过时了。”打造对消费者具吸引力的电动汽车需要更多关注软件，而日本公司一贯更重视硬件。当它们终于要挂上高速挡时，忠实客户却已经在流失了。美国研究机构S&P Global Mobility的一项研究总结道，在美国“经久不衰”的日本品牌“到了2022年被打个措手不及”。正如该研究所指出的，2022年改用电动车的消费者大多是弃用了丰田和本田。■



Fumbling the future

How Japan is losing the global electric-vehicle race

Toyota, Honda and Nissan, innovators of yesteryear, are playing catch-up

THE GREEN floors of JATCO'S Fuji Area 2 factory hum with quiet confidence. Diligent inspectors appraise the gears and pulleys that make up the Japanese car-parts maker's transmission systems. Robots stamp parts and flip them onto production lines. For decades, JATCO, like the rest of Japan's vaunted auto industry, has perfected carmaking. Japan has been at the forefront of the industry, pioneering just-in-time manufacturing and leading the development of hybrid cars. But the next big evolution—the shift to electric vehicles (EVs)—has become a source of angst. “The EV shift will be a big transformation, there's no denying that,” says Sato Tomoyoshi, JATCO's CEO. “Our company will have to change drastically.”

So far, Japan and its carmakers are lagging in the race towards EVs, the industry's fastest-growing product area. Battery-powered electric vehicles and plug-in hybrids (PHEVs) accounted for around 13% of all cars sold globally in 2022, up from 2.6% in 2019. In some markets, including China, the share is some 20%. But in Japan, it was just 2%. The firms pulling ahead in the EV race include newcomers, such as Tesla and China's BYD, and established giants such as Germany's Volkswagen.

Japanese carmakers are not among them. None is in the top 20 for global EV sales, even though Nissan and Mitsubishi released some of the world's first EVs more than a decade ago. Toyota, the world's largest car company, sold just 24,000 EVs out of its 10.5m in total sales in 2022. (Tesla sold 1.3m.) Sales of Toyota's first fully electric model, an SUV called the bZ4X, had to be paused last summer due to defects that caused the wheels to fall off.

Critics worry that this early stalling on EVs could cause the wheels to fall off the Japanese auto industry at large. Some see parallels with semiconductors and consumer electronics, industries which Japanese firms initially dominated, then missed important trends abroad and ultimately lost out to nimbler competitors. A similar decline in the auto industry, which accounts for nearly 20% of Japan's exports and some 8% of Japanese jobs, would have huge economic and social implications.

Japanese carmakers are revving to catch up. Toyota has a new CEO, Sato Koji, tapped in part to lead the company's push for electrification. At his first press conference on April 7th, Toyota announced plans to release ten new EV models and boost annual EV sales to 1.5m by 2026. "We will thoroughly implement electrification, which we can do immediately," said Mr Sato.

Honda has plans to launch 30 EV models by 2030 and set up an EV joint venture with Sony last year. The company pitched a corporate reorganisation taking effect last month as an "electrification acceleration". In February Nissan said it would release 19 new EV models by 2030; it now calls electrification the "core of our strategy".

Japan's slow start on EVs stems in part from its earlier successes—or as Mr Sato of JATCO puts it, it is a classic case of the innovator's dilemma. Industry leaders hesitated to embrace a new technology that might undermine areas in which Japan leads, such as standard hybrid vehicles, which combine an internal combustion engine (ICE) and an electric motor powered by batteries that capture energy from regenerative braking (rather than charging with outside electricity, as with PHEVs). Engineers at Japanese firms that fine-tuned complex hybrids were also unimpressed by EVs, which are simpler mechanically. "Within the industry, there are still a lot of people attached to the engine," Mr Sato says. Executives worried about the implications of the EV shift on their network of suppliers such as JATCO, given that EVs require fewer parts and widgets than ICEs. Carmakers

assumed eventually switching gears to EVs would be a cinch: “The logic was that when the time comes, we can easily shift from hybrids to EVs,” says a former executive at a large Japanese car company.

Japan also made an early wrong turn with hydrogen, another emergent auto technology with the potential to be carbon-free. Toyota, Japan’s most influential carmaker, bet that using hydrogen fuel-cells would become the leading way to electrify cars. Abe Shinzo, Japan’s prime minister from 2012 to 2020, championed policies to make Japan a “hydrogen society”; in 2015, Toyota delivered its first hydrogen fuel-cell sedan, the Mirai, to Abe himself. While hydrogen may come to play a big role in decarbonising hard-to-electrify sectors, such as steel production or fuelling long-haul trucks, it has so far turned out to make little sense as a technology to electrify light consumer vehicles. Even in Japan, which has built a fair amount of hydrogen-refuelling infrastructure, Toyota has struggled to peddle the pricey Mirai: the company has sold a total of just 7,500 fuel-cell vehicles in its home market.

While governments in China, Europe and America have increasingly subsidised EVs as part of their climate policies, Japan has done less to incentivise their adoption. The government has called for 100% of vehicles sold by 2035 to be electrified. But that would include hybrid vehicles, in contrast to other governments which have defined the next generation of vehicles more narrowly. Subsidies for fuel-cell vehicles remain much larger in Japan than those for EVs. Strict regulation has hampered the expansion of EV charging infrastructure: Japan has roughly one-quarter as many public EV chargers as South Korea, its much smaller neighbour.

Nagging scepticism about EV technology explains some of Japan’s wariness. Japanese carmakers and officials are “still questioning”, says Tsuruhara Yoshiro of AutoInsight, an industry journal: “Are EVs what consumers want? Do they provide value to them? Are they the best way to reduce CO₂?” Toyoda

Akio, the previous Toyota CEO and grandson of the company's founder, liked to say that "carbon is the enemy, not the internal combustion engine." Even under Mr Sato, a protégé of Mr Toyoda, the company is sticking to what it calls a "multi-pathway" strategy that sees EVs as one part of a diverse fleet. "We think that the way to get the most carbon-dioxide emissions reductions net overall throughout the world is to tune the solution for each part of the world," says Gill Pratt, Toyota's chief scientist. For example, in developing countries, where renewable energy uptake has generally been slower than in the West, traditional hybrids might offer a more practical and economical way to reduce emissions in the interim.

But some think Japan's carmakers are moving too late to catch up with the changing times in more developed markets. "They are like the Tokugawa shogun-era closed country—they refused to see what is happening in the world," says Murasawa Yoshihisa, a management consultant. While Japanese cars were once synonymous with fuel efficiency and therefore environmentalism, they risk coming to stand for climate denialism. Japan's three biggest carmakers—Toyota, Honda and Nissan—rank lowest among the top ten global auto companies on decarbonisation efforts, according to a recent study by Greenpeace, an environmental group.

As Toyota's experience with the bZ4X suggests, designing and building top-of-the-line EVs may not be as simple as the Japanese firms assumed. "They were so overconfident that once they decide to do it, they will dominate the EV market," Mr Murasawa says. "But their offerings have turned out to be old-fashioned." Creating EVs that appeal to consumers requires putting more focus on software, while Japanese firms traditionally prioritise hardware. Even as they at last start gearing up, Japanese companies are already losing loyal customers. Japanese brands that "built a legacy" in America have been "caught flat-footed in the context of 2022", concludes S&P Global Mobility, an American research outfit. As the study notes, consumers switching to EVs in 2022 were largely moving away from Toyota

and Honda. ■



变道

变化中的汽车行业会带来更多选择和更美好的驾车出行

未来对一些人来说可能很艰难，但对其他人来说可能如一辆新车般闪亮【专题《艰难新世界》系列之七】

自第一位驾车者启动奔驰专利电机车1号（Benz Patent Motorwagen）以来，事情几乎没有变过。130年来，由内燃机提供动力并载有四五名乘客的汽车一直在做同样的事。几家从一开始就蓬勃发展的公司（包括标致，以及梅赛德斯-奔驰的前身）一直活到了今天。但电气化、科技和自动驾驶现在可能会颠覆一个只习惯缓慢变化的行业。

传统汽车行业必须重塑自身以应对竞争——来自零开始的新来者或中国的新兴工厂，或两者兼有。新的技术要求新的经营方式，因为需要从服务中获得收入来填补销量下降以及电动汽车的利润不如内燃机汽车造成的缺口。日产的首席财务官阿西瓦尼·古普塔（Ashwani Gupta）表示，这种转变是“从一次性交易到终身参与”。并非每家公司都能做成这件事。规模对于新来者而言不是那么要紧，但对于须投钱完成大规模重组的老公司来说是个难题。实力较弱的公司，尤其是像斯巴鲁（Subaru）或马自达这样的小型日本制造商，可能唯有与更大的公司合作才活得下去。

即使大公司也能在销量下降时调整成本结构吗？在高端市场可能会更容易些，不过特斯拉以及中国的小鹏和蔚来正在迎头赶上奥迪、宝马和梅赛德斯-奔驰。主要靠卖皮卡赚钱的美国三巨头福特、通用汽车和斯特兰蒂斯的克莱斯勒要面对Lordstown、里维安和特斯拉的Cybertruck等新来者的挑战。雷诺等中等规模的欧洲车厂倚赖竞争最激烈、品牌忠诚度最低、利润空间也最低的大众市场，在抵御中国公司进袭上将迎来最艰难的一战。

中国将成为一股势力。在电动汽车赛道上的领跑地位让它不但能销往较贫穷的国家，更能打入欧洲市场。中国的汽车公司能否克服新的地缘政治冲突以打入美国市场还是个未知数，但它们会继续尝试。特斯拉在2030年可能达不到每年2000万辆的产量，但它将蚕食现有企业的市场份额。也会

有一些试图复制特斯拉成功先例的新来者实现规模化。即使许多新来者倒下，也会有一小撮公司每年生产出大约100万辆车。

这个变化中的行业可能会迎来其他玩家。如果富士康和其他公司充当制造商，要扩大规模就不大成问题了，这就为创业公司打开了方便之门。沙特阿拉伯雄厚的财力，加之想从石油产业转向多元化经济的渴望可能使它成为汽车制造业的一股势力。在沙特主权财富基金的支持下，Lucid将开始在吉达每年生产15万辆车。另一家获沙特支持的公司Ceer想与富士康合作造车。打造一个电池和原材料工业也在沙特的计划清单上。而科技巨头可能也会有发言权。一直有传言称，苹果进军汽车制造的努力可能会从CarPlay车载系统扩展到自己造车。索尼正与本田合作生产电动汽车。中国的阿里巴巴、华为、腾讯和小米都在汽车产业上有所规划。

但是，如果说汽车行业有很多新鲜事，那么它也有很多似曾相识的事。从中国手中夺取电动汽车优势正在引发新的保护主义。对于转向不那么复杂、需要的工人更少的电动汽车会带来什么影响，以及随着内燃机逐步退出舞台将有多少人被淘汰，各界的估计不一。但对于岗位会减少这件事没有什么争议。“在某些地方，人绝对是太多了。这毫无疑问。”福特的老板吉姆·法利（Jim Farley）指出。该公司2月宣布因电动化而在欧洲裁员3800人。

从木头和铁制成的摇摇晃晃的古怪装置，到轮子上的自动驾驶超级计算机，这一路已经经历了诸多起起伏伏。最近的这场剧变可能是自卡尔·本茨灵机一动以来最深刻的一次。汽车行业的规模、覆盖面和对个人出行的影响将发生变化。如果当今贸易紧张局势和补贴战的最终结果是去全球化，那么新来者的到来可能会提高成本而降低效率，让汽车变得更昂贵，而整个行业更低效。

然而，更乐观的预测是，创业公司和新进的中国公司将迫使其他所有汽车制造商加快电气化，推出让旅程更美好的软件，提供更多利用汽车出行并完成相关支付的方式。这可以让人们建立与汽车的新型关系，把车用作愉快的工作和娱乐场所，而不仅仅是从一个地点到另一个地点的载具。未来

对一些人来说可能是艰难的，但对其他人而言，却可能如一辆闪闪发光的新车般明亮。 ■



Changing lanes

A changing car industry should result in more choice and better motoring

The future may be hard for some, but for others it could be as bright as a shiny new car

SINCE THE first motorist sparked up a Benz Patent Motorwagen, little has changed. Cars powered by an ICE and carrying four or five passengers have done the same job for 130 years. Several firms that flourished at the outset (including Peugeot and what became Mercedes-Benz) survive. But electrification, tech and autonomous driving may now upend an industry used only to slow change.

The legacy industry must reinvent itself to cope with competition from new carmakers starting from scratch or emerging from China—or both. New technologies demand new ways of doing business as revenues from services are needed to plug the gap of dwindling volumes and EVs that are not as profitable as ICE cars. Ashwani Gupta, chief financial officer of Nissan, says the switch is from “one time transaction to lifetime engagement”. Not every firm will manage it. While scale is less of an issue for newcomers, it matters for existing firms that must pay for massive restructuring. Weaker ones, especially small Japanese makers like Subaru or Mazda, may not survive unless they team up with bigger ones.

Can even big companies adjust their cost structures as volumes decline? It may be easier at the upper end of the market, although Tesla as well as China’s Xpeng and Nio are snapping at the heels of Audi, BMW and Mercedes-Benz. America’s big three of Ford, GM and Stellantis’s Chrysler, which make most of their money selling pickups, face new entrants such as Lordstown, Rivian and Tesla’s Cybertruck. Middling European carmakers such as Renault, which rely on the mass market where competition is

fiercest, brand loyalty is lowest and profit margins are slimmest, will have the hardest job of all to fend off the Chinese.

China will be a force because its EV leadership lets it add European sales to those in poorer countries. Whether its car firms can fight through new geopolitical tensions to crack the American market is less clear, but they will keep trying. Tesla may not be making 20m cars a year by 2030 but it will eat away at the market share of incumbents. And some newcomers, seeking to emulate Tesla's success, will manage to reach scale. Even if many newcomers do not survive, a handful will be making 1m or so cars a year.

The changing industry may let others in. If Foxconn and others operate as manufacturers, scaling up is less of a problem, opening the door to startups. Saudi Arabia's deep pockets and urge to diversify from oil could make it a force in carmaking. Lucid, backed by the Saudi sovereign-wealth fund, is due to start production of 150,000 cars a year in Jeddah. Ceer, another firm backed by the kingdom, aims to make cars with Foxconn. Building a battery and raw-material industry is also on the Saudi list. And big tech may also have a say. Rumours persist that Apple's assault on carmaking may extend beyond CarPlay into making vehicles itself. Sony is teaming up with Honda to make EVs. China's Alibaba, Huawei, Tencent and Xiaomi all have designs on the industry.

But if there is much that is new about the car industry there are still many reminders of the past. Wrestling the EV advantage from the Chinese is triggering a new protectionism. Estimates vary over the effect of shifting to less complex EVs that require fewer workers and how many will lose out as the ICE winds down. But there is little disagreement that there will be fewer jobs. "We absolutely have too many people in some places, no doubt about it," notes Jim Farley, boss of Ford, which announced 3,800 job cuts in Europe in February, citing EVs as the cause.

The road from rickety contraptions of wood and iron to self-driving supercomputers on wheels has had many twists and turns. The latest upheavals are perhaps the most profound since Carl Benz's brainwave. The size, reach and impact of the car industry on personal mobility will change. If the eventual outcome of today's trade tensions and subsidy wars is deglobalisation, the arrival of new entrants may raise costs and reduce efficiency, making cars less affordable and the industry less efficient.

Yet a more optimistic forecast is that startups and new Chinese entrants will force every other carmaker to speed up electrification, to bring forward software that makes journeys better, and to provide more ways to use and pay for trips by car. This could forge a new relationship with the car as a pleasant place to work and play as well as a way to get from A to B. The future may be hard for some, but for others it could be as bright as a shiny new car. ■



大撒把

自动驾驶汽车要来了，但很慢

传统公司的下一个挑战是适应自动驾驶【专题《艰难新世界》系列之六】

比私家车更便宜、更方便的全自动驾驶电动机器人出租车一度似乎威胁到了整个行业。自动驾驶技术公司无比视（Mobileye）的老板阿姆农·沙舒亚（Amnon Shashua）说，六年前大家以为没人会再买车了。汽车制造商充其量将只是“白标”供应商，向优步等网约车公司或掌握自动驾驶软件的科技巨头提供廉价的量产硬件。机器人出租车继而将成为向集成系统转变的关键，这套系统将公共交通与私人电动滑板车和电动自行车车队结合在一起。这种移动平台将为可能用到多种出行方式的旅程提供一键式支付。智能手机应用将提供集成、高效和绿色的城市旅行，费用只是拥有汽车的成本的零头。

这一前景有数据的支持——数据表明年轻人不再那么热衷于拥有甚至驾驶汽车。有证据表明，富裕国家痴迷于屏幕的年轻人宁愿死死盯着智能手机，也不愿坐到驾驶座上；拿驾照的年轻人比例下降也证明了这一点。不可避免的结果似乎是汽车销量暴跌。然而事实是，自动驾驶汽车和出行服务可能正在为一些能把这些业务做好的公司创造新机会。

要破除的第一个误区是以年轻人正在永久性放弃驾驶。在汽车狂热的美国，每千人拥有约890辆车，只有1%的新车是由24岁以下的人购入的。1983年至2018年间，16岁持有驾照的人的比例从46%下降到26%，但年龄更大的人群的降幅更小。1983年，35至39岁人中95%拥有驾照，而2017年为91%。在英国，21岁以上拥有驾照的比例在20年内几乎没有变化。正如他们推迟安家或生孩子等其他许多事情一样，年轻人只是在推迟拿驾照。欧美新车购买者的平均年龄也远超过50岁。

第二个误解是特斯拉的辅助驾驶功能Autopilot可提供该公司声称的“完全自动驾驶”体验。能随时去往任何地方、无需目视也无需动手的自动驾驶

——行话中的“5级”——距离广泛推广还得等些年头。钻进日产最先进的自动驾驶汽车在伦敦南部伍尔威奇的一个试验区转一圈，就能知道为什么了。这辆车吸引人们注意的不是它平稳安全的行驶，而是车顶鞋盒大小的激光雷达阵列——这些基于激光的传感器与雷达、摄像头和高清地图协同工作。它们确保汽车知道自己在哪里（精确到厘米），并告诉它要避开哪些其他道路使用者、行人和静态物体。但它们需要装满后备箱的计算机和一位“安全驾驶员”，以防车辆遇到数据无法响应的“边缘”情况。

在监管更宽松的地方，机器人出租车更发达。通用汽车的子公司Cruise于2022年2月在旧金山向公众推出了付费无人驾驶乘车，如今正在亚利桑那州的凤凰城和得克萨斯州的奥斯汀推广。Waymo是谷歌母公司Alphabet的自动驾驶部门，在凤凰城和旧金山开展业务。优步的应用使用来自韩国现代汽车和美国供应商Aptiv的合资企业Motional的汽车，在拉斯维加斯提供线上呼叫自动驾驶车辆服务。亚马逊在其位于旧金山的办公室之间提供机器人出租车，由它在2020年以13亿美元收购的自动驾驶创业公司Zoox运营。在中国，科技公司百度正在多个城市运营类似的服务。网约车巨头滴滴以及与汽车公司广汽合作的无人驾驶汽车创业公司文远知行正在中国一些城市测试机器人出租车。

然而，乘坐机器人出租车要变成家常便饭还要等很久。这类服务目前被“地理围栏”圈定在特定区域。Cruise在旧金山的30辆车目前必须避开繁忙的金融区。运营时间可能会被限制在不太拥堵的时段，并且需要安全驾驶员或远程监控。随着技术成本的下降，机器人出租车可能会更多地铺开来。瑞银认为，到2040年，这个市场每年的收入可能达到2.1万亿美元，尽管这仍将仅占所有行驶公里数的6%。但高昂的成本、盈利遥遥无期，加上商业模式尚不确定，使得大多数汽车制造商的计划都不那么宏伟。

“大规模实现盈利的全自动驾驶汽车还有很长的路要走”，这是福特老板吉姆·法利（Jim Farley）的结论。大众和福特于2022年10月关停了它们的机器人出租车合资企业Argo AI。就连Alphabet的投资者也对Waymo的成本感到紧张。汽车制造商和科技公司现在正在采用一种更为演进性的方法。这样做好处是，汽车制造商可以效仿特斯拉的做法，对预装在汽车中或

作为订阅服务开启的高级驾驶辅助系统收费，从而更快地获得利润。特斯拉利用从其近300万辆汽车中收集的数据开发了自己的系统。但它的Autopilot仍然需要驾驶员保持专注并将双手放在方向盘上。“2+级”和“3级”自动驾驶将首先让司机松开方向盘，将视线从高速公路上移开，尽管车内人员必须随时准备好在有需要时停止吃东西、发送电子邮件或看电影。

梅赛德斯-奔驰的老板康松林说，这样的系统将提供工作或休闲时间。法利补充说，“未来的自动驾驶技术——脱手、不用目视高速公路的驾驶——有可能重新定义我们与车辆的关系。”福特正在投资于2+/3级系统。要掌握自动驾驶，大多数老牌汽车制造商的结论都是自己需要与科技公司合作并分享收入。麦肯锡估计，到2035年，仅乘用车的自动驾驶就可以产生4000亿美元的销售额。

与对其他软件的想法一样，汽车制造商希望保留一些控制权。无比视于2017年被英特尔以150亿美元收购并于最近上市。当它明确了汽车制造商不愿冒险使用未知技术这一点后，它从一种“黑匣子”方法转向了其竞争对手高通和英伟达的开源系统。它表示其系统将在2025年准备就绪，价格约为15,000美元，与特斯拉的Autopilot相同。梅赛德斯-奔驰可能是第一个与特斯拉展开竞争的。其3级系统Drive Pilot已被内华达州批准用于公共道路，预计将于今年晚些时候上市。麦肯锡估计，到2035年，每十辆新车中可能有四到六辆具备自动驾驶能力。

巨头科技公司可能会为保持美国和中国汽车制造商的领先地位做出最多努力。瑞银认为，中国有潜力引领自动驾驶汽车的大规模部署。2020年，中国政府制定了2025年战略：大规模生产3级车辆，并在部分地区推出机器人出租车。与美国一样，中国的自动驾驶行业里有科技巨头、创业公司和老牌汽车制造商，它们都在努力服务于痴迷科技的庞大的中国市场。激光雷达、雷达和摄像头制造商以及地图公司之间的竞争非常激烈。地方政府也参与进来，设立了测试区并指定数千公里适合自动驾驶汽车测试的道路。

传统汽车行业也在重新思考另一项业务。在单单卖车已失去吸引力之时，

这项业务似乎提供了替代方案。当成本仅为购车零头的叫车服务和其他出行服务不断增长，而优步、来福车和滴滴的市值飙升时，汽车制造商迅速采取行动。不过网约车和汽车共享并没有兑现早先的承诺。在获得任何回报之前大量投资（优步、来福车和滴滴从未实现过年度盈利）、微薄的利润率，以及监管机构的关注阻碍了网约车服务的发展。汽车公司正在尝试新的方式来销售出行。斯特兰蒂斯的出行业务部门把汽车租赁、汽车共享、停车和充电服务整合在一起。丰田的Kinto部门正在开发无缝、联合的多模式联运和支付系统、汽车共享，以及灵活的订阅。

许多公司正在效仿特斯拉，采用直销和新的融资方案与客户建立直接关系，以便更轻松地收集其数据并向他们销售服务。作为融资方案的补充，更灵活的全包月度订阅降低了使用私家车的前期成本和忠诚度，这可能会吸引年轻的驾车者。中国公司正在使用订阅来吸引欧洲客户，例如吉利旗下的领克，该公司称自己为汽车界的奈飞。

自动驾驶最终应该会把长途汽车旅行从一件苦差变为对时间更好的利用。对于汽车制造商来说，这将是一种通过提供系统来赚钱的方式。更多的车内空闲时间也应该会创造机会来销售升级的信息娱乐等新功能以及流媒体音乐和电影等服务。新的出行方式是从拥有转向使用的又一个标志。■



Hands off the wheel

Autonomous vehicles are coming, but slowly

The next challenge for legacy firms is to adapt to autonomy

FULLY AUTONOMOUS electric robotaxis, cheaper and more convenient than a private car, once seemed to threaten the entire industry. Six years ago it was assumed that nobody would buy cars any more, says Amnon Shashua, boss of Mobileye, an autonomous-driving tech firm. At best carmakers would be “white label” suppliers of cheap mass-produced hardware to ride-hailing firms such as Uber or tech giants that had mastered self-driving software. In turn robotaxis would be key for the shift to integrated systems that wove together public transport with private fleets of e-scooters and e-bikes. Such mobility platforms would provide one-click payments for a journey that might use several methods of transport. Smartphone apps would provide integrated, efficient and green urban travel at a fraction of the cost of car ownership.

The promise was backed by data suggesting that young people are no longer so keen to own or even drive cars. Evidence that the screen-obsessed youth of the rich world would rather be glued to a smartphone than slide into a driving seat is supported by the falling proportion obtaining driving licences. The inevitable outcome seemed to be plunging car sales. Yet in fact autonomous vehicles (AVs) and mobility services may be creating new opportunities for firms that can get them right.

A first myth to dispel is that the young are giving up driving for good. In car-mad America, which has around 890 cars per 1,000 people, only 1% of new cars are bought by people under 24. The share of 16-year-olds with a licence fell between 1983 and 2018, from 46% to 26%, but the decline for older people was less precipitous. In 1983 95% of 35- to 39-year-olds had a

licence compared with 91% in 2017. In Britain the proportion of over-21s with licences has hardly budged in 20 years. Just as they are deferring much else, such as settling down or having children, young people are simply getting their driving licences later. The average age of a buyer of a new car in Europe and America is also well over 50.

A second myth is that Tesla's Autopilot, its driver-assistance feature, offers the "full self-driving" experience that the company claims. The go-anywhere-anytime, eyes-off-hands-off autonomy—"level 5" in the jargon—is years away from widespread roll-out. A trip in Nissan's most advanced AV around a test zone in Woolwich in South London shows why. The car attracts attention not for the driving, which is steady and safe, but for the rooftop array of shoebox-sized lidars, laser-based sensors that work in tandem with radars, cameras and high-definition maps. These ensure the car knows where it is to the nearest centimetre and tells it what other road users, pedestrians and static objects to avoid. But they require a boot-full of computers and a "safety driver" in case the vehicle meets an "edge" case that the data cannot respond to.

Where regulators are more relaxed, robotaxis are more developed. Cruise, a subsidiary of GM, is adding paid driverless rides in Phoenix, Arizona, and Austin, Texas, to the service that it launched for the public in San Francisco in February 2022. Waymo, the self-driving arm of Alphabet, Google's parent company, operates in Phoenix and San Francisco. Uber's app with vehicles from Motional, a joint venture between South Korea's Hyundai and Aptiv, an American supplier, allows the hailing of self-driving rides in Las Vegas. Amazon is running robotaxis between its offices in San Francisco, operated by Zoox, a self-driving startup that it bought for \$1.3bn in 2020. In China Baidu, a tech firm, is operating similar services in several cities. Didi, a ride-hailing giant, and WeRide, an AV startup that has teamed up with GAC, a car firm, are testing out robotaxis in some Chinese cities.

Yet it will be a long time before jumping in a robotaxi is commonplace. Services are “geofenced” to specific areas. Cruise’s 30 cars in San Francisco must for now avoid the busy financial district. Hours of operation may be limited to less congested times and safety drivers or remote monitoring are required. As the cost of the technology falls, robotaxis may spread. UBS, a bank, thinks the market could be worth \$2.1trn a year in revenues by 2040, though that would still be only 6% of all kilometres driven. But high costs and distant profits allied to uncertainty over business models mean that most carmakers have less grandiose plans.

“Profitable, fully autonomous vehicles at scale are a long way off,” is the conclusion of Jim Farley, the boss of Ford. VW and Ford pulled the plug on Argo AI, their robotaxi joint venture, in October 2022. Even Alphabet’s investors are nervous about the costs of Waymo. Carmakers and tech firms are now adopting a more evolutionary approach. This has the benefit of profits arriving sooner by allowing carmakers to follow Tesla’s lead and charge for advanced driver-assistance systems, preloaded in their cars or switched on as subscription services. Tesla has developed its own system using data gathered from its fleet of nearly 3m vehicles. But its Autopilot still requires drivers to stay attentive and keep their hands on the wheel. “Level 2+” and “level 3” autonomy will start by letting drivers let go of the wheel and take their eyes off the road on motorways, although a human must be ready to break off from eating, sending emails or watching a film if need be.

Mr Kallenius, the boss of Mercedes-Benz, says such systems would offer time for work or leisure. Mr Farley adds that “future automated driving tech—hands-free, eyes-off highway driving—has potential to redefine our relationship with our vehicles.” Ford is investing in level 2+/level 3 systems. To master AV, most established carmakers have concluded that they need to team up and share revenues with tech firms. McKinsey reckons that autonomous driving for passenger cars alone could produce sales worth \$400bn by 2035.

As with other software, carmakers want to retain some control. Mobileye, acquired by Intel in 2017 for \$15bn and recently floated, switched from a “black box” approach to the open-source system of its competitors, Qualcomm and Nvidia, when it became clear that carmakers were reluctant to risk unknown tech. It says its system will be ready by 2025 and, at roughly \$15,000, will cost the same as Tesla’s Autopilot. Mercedes-Benz may be the first to give Tesla competition. Drive Pilot, its level 3 system, has been approved by Nevada for public roads and should be available later this year. McKinsey reckons between four and six out of ten new cars may have autonomous-driving capability by 2035.

It is the huge tech firms that may do the most to keep American and Chinese carmakers ahead. UBS argues that China has the potential to lead in the mass deployment of self-driving cars. In 2020 the government laid out its strategy for 2025: the large-scale production of level 3 vehicles and the launch of robotaxis in some areas. As in America, China’s AV industry has tech giants, startups and incumbent carmakers all hard at work to serve a large market of tech-obsessed Chinese. Competition is fierce among makers of lidars, radars and cameras, and map firms. Local governments have pitched in by creating test zones and designating thousands of kilometres of roads as suitable for autonomous-car testing.

The established industry is also rethinking another business that seemed to offer an alternative when merely selling cars lost its appeal. When ride-hailing and other mobility services that came at a fraction of the cost of car ownership were growing and the values of Uber, Lyft and Didi were soaring, carmakers were quick to get in on the act. Yet ride-hailing and car-sharing have not lived up to their early promise. Massive investment before any return (Uber, Lyft and Didi have never made an annual profit), tight margins and the attention of regulators have hobbled ride-hailing. Car firms are trying out new ways to sell mobility. Stellantis’s mobility arm lumps together car rentals, car-sharing, parking and recharging. Toyota’s

Kinto unit is developing seamless, joined-up multi-modal transport and payment systems, car-sharing and flexible subscriptions.

Many firms are copying Tesla by adopting direct sales, as well as new financing packages, to establish a direct relationship with customers in order to collect their data and sell them services more easily. Financing deals are being supplemented with more flexible all-inclusive monthly subscriptions that lower the up-front cost and commitment of using a private car, which may attract younger motorists. Chinese firms are using the subscriptions to attract customers in Europe, such as Lynk&Co, owned by Geely, which calls itself the Netflix of cars.

Autonomous driving should eventually change long car journeys from a chore to a better use of time. For carmakers it will be a way to make money from supplying the systems. More free time in cars should also create opportunities to sell new features such as upgraded infotainment and services such as streaming music and films. The new approach to mobility is one more sign of a switch from ownership to usership. ■



软件洗牌

汽车的软件现在与硬件一样重要

科技公司造车比车厂变身科技公司更容易【专题《艰难新世界》系列之五】

参观一下柏林的蔚来中心（在中国已有100家这样的门店构成的销售网络），可以看到一种根本性变化正在发生的证据。在这里仍然可以买到汽车，但与传统经销商不同的是，汽车只占了门店的一小部分面积。蔚来将自己视为一个生活方式品牌和一家科技公司。“重点是用户体验”，总裁秦力洪说。使用蔚来即是享受出行旅程和拥有一个围绕其品牌建立的社区。它的汽车配备了高清屏幕和最先进的音响系统。在柏林，车主、对蔚来汽车感兴趣的人或其他任何人都可以光顾蔚来中心的咖啡吧和会议室，购买当地采购的品牌商品，甚至可以把孩子留在高科技游乐区。

过去人们通常用机械的精湛度来区分汽车品牌，这种机械水平体现在内燃机的性能、设计和间隙（德语单词Spaltmass，意思是车身面板之间细小的均匀间隙，行业新来者很难复制）之中。现在的买家不费这个心思了。咨询公司麦肯锡估计只有8%的人是“汽车迷”，他们纯粹因为喜欢驾驶而开车。未来的司机和乘客希望充分利用他们的出行旅程。和实现这一点相关的特性和功能有赖于软件而不是硬件。咨询公司中国汽车洞察（Sino Auto Insights）的涂乐直言：“客户不关心面板间隙。”让特斯拉的技术保鲜的软件升级更为重要。

大众汽车软件部门Cariad的老板德克·希尔根伯格（Dirk Hilgenberg）表示，汽车将成为家庭和工作之间的“第三生活空间”。软件会控制性能、驾驶功能和坐在车内的体验。自动刹车、自动车道保持和变道、自适应巡航控制和自动停车等安全功能已经上市。随着自动驾驶变得普遍，其他功能将变得更为有用并使驾乘变得更有趣。其中包括对信息娱乐等功能的巨大改进——最好的导航地图、音响系统和观看电影或玩电子游戏的屏幕，还有先进的语音控制（这在中国尤为重要）。为汽车制造商供货的科技公司哈曼（Harman）的老板迈克尔·毛泽（Michael Mauser）描述了智能设备

如何改变了消费者的期望：他们对花10万美元买的汽车与300美元的智能手机有相同的个性化需求。

麦肯锡的约翰内斯·戴希曼（Johannes Deichmann）表示，成熟的汽车行业一直擅长按时按预算交付汽车，但不善于考虑汽车的商业价值。越来越高的连接性（据瑞银称，到2030年五分之四的汽车将联网）将允许对软件进行无线更新。对于汽车制造商来说，这意味着新的销售机会。对于车主来说，这意味着在购买新的特性和功能时，他们的车可以不断更新和改进。传统汽车制造商将最难复制创业公司和中国公司的优势——软件是创业公司最重要的元素，而中国公司的客户要求并期望汽车无缝扩展他们的数字生活方式。

软件可以很赚钱。瑞银预测到2030年，软件年收入将达到7000亿美元。但它补充说，这只能弥补其他收入的下降，因为销售增长微乎其微，同时成本上升，利润下降。对于汽车制造商来说，即便只是为了能保持原地踏步，掌握软件也已经变得至关重要。但老牌公司必须重新审视自己致力于精湛机械工程的商业模式。该行业以七八年左右的车型周期运作，研发在生产开始前就冻结了。这种从容不迫的步伐与软件的时间尺度相去甚远——每周或每月发布小更新，一年一次大更新，就像智能手机那样。

大型汽车制造商纷纷声称自己是科技公司，但知情的观察人士察觉到变革的阻力。秦力洪表示，蔚来和其他中国公司从零开始同时开发软件和硬件。一张白纸的设计可以包含更集中和高效的计算系统，而当前的内燃机车型集成了供应商各自开发的技术，使汽车集合了数百个电子控制单元。推出全新的电动汽车至少可以让成熟的公司重新设计他们的计算架构。

长期专注于机械的公司难以设立部门来开发在今天使品牌与众不同的软件，或是与如今和传统供应商一样重要的科技公司达成为交易。据经纪公司盛博的丹尼尔·罗斯卡（Daniel Roeska）称，欧洲汽车产业高管的平均年龄为55岁，平均已在该行业工作22年。他冷冷地指出，对于需要“比以往任何时候都更加敏捷和创新”的公司来说，这“不是经验和能力的正确组合”。高德纳的佩德罗·帕切科（Pedro Pacheco）也同样毫不留情，他暗示

一些公司不想改变它们的企业文化，而是“在脚踝上绑着铁球奔跑”。

汽车制造商正在任命首席软件官，在“软件日”介绍战略并设立软件部门。位于辛德尔芬根的梅赛德斯工厂耗资2亿欧元新建了一座七层大楼，将容纳该公司3000名软件工程师中的三分之一。大众汽车于2020年设立的软件部门Cariad在不远处的英戈尔施塔特拥有一个大型厂区，供其6000名软件员工使用。斯特兰蒂斯的目标是到2024年拥有4500名软件工程师。通用汽车曾计划在2022年雇用8500名技术人员。但只有沃尔沃和法拉利的首席执行官具有技术背景。

在内部完成多少工作和哪些工作仍然是一个大问题。大众表示，其曾经宣称的自行开发60%的软件的雄心只是强调软件重要性的一种手段，而不是实际目标。大多数汽车公司已决定内部开发不超过20%到30%。正如瑞银所说，想要包揽一切的汽车制造商“注定了代价高昂的败局”，而那些“百分百依赖外部软件堆栈”的制造商则是“损害品牌资产.....的最糟糕案例”。大多数汽车制造商意识到它们应该只专注于自己能做得更好的事情。

这意味着要明确哪些工作最好保留在内部，但同时要努力保持对从外部购买的东西的掌控力。梅赛德斯-奔驰的康松林表示，传统汽车公司的角色是成为“房子的建筑师”。奔驰正在创建自己的操作系统并与最好的承包商合作，例如做芯片的英伟达，并加深与谷歌的合作伙伴关系以改进导航系统。康松林认为，汽车公司作为集成商的角色仍然至关重要，因为没有一家科技公司能够为驾驶和充电、舒适性（例如照明和按摩座椅）、信息娱乐和自动驾驶这四个独立领域提供现成的软件。

汽车制造商需要与那些同样将汽车业务视为潜在新收入来源的科技公司达成交易。但驾驶者是想要一个专有系统，还是某种更接近于他们已经从自己的手机上熟悉了的东西？2022年，雷诺宣布深化与谷歌的Android Automotive的合作关系以加快数字化转型，谷歌这个系统让驾驶者可以访问手机功能和应用程序。盛博问道，汽车制造商是否应该“放弃控制，而采用消费者似乎已经很顺手的平台？”丰田首席科学家吉尔·普拉特（Gill Pratt）同样提出，汽车软件必须成为智能手机生态系统的无缝组成部分。

然而，这存在将用户体验拱手让给科技公司的风险。最新版本的Apple CarPlay将于9月发布，可将iPhone连接到汽车的信息娱乐屏幕。它通过接管汽车屏幕，为地图、驾驶信息和与智能手机应用的连接提供更加顺畅便捷的体验。但苹果会保存驾驶者的数据。一些人认为汽车行业对软件的缓慢反应意味着游戏已经结束。出行投资基金红蓝资本（RedBlue Capital）的奥拉夫·萨克斯（Olaf Sakkers）表示，苹果公司已经赢得了“车内体验”，而传统公司“已经输了，但表现得好像没有输一样”。

对于特斯拉和其他新来者来说，这几乎不是问题。创新和快速推出新的软件功能就是它们工作的核心。咨询公司ZoZoGo的迈克尔·邓恩（Michael Dunne）认为，特斯拉的软件比老牌公司领先五年。大多数人认为，在用户体验方面它们落后于中国公司。希尔根伯格也认为他的公司可以从中国公司的决策速度和产品上市速度中学到很多东西。即使是西方的创业公司也无法跟上步伐。软件公司Luxoft汽车部门的约翰·马金（John Makin）表示，里维安和西方创业公司速度很快，但中国公司更快，能数小时或数天而不是数周或数月内推出更新。

要把旧世界的汽车制造结合以科技行业的速度和敏捷性来做好软件这部分，对于传统公司来说尤其困难。有些公司至少有正确的想法，但对许多公司来说，这将被证明是几乎不可能做到的。这可能为掌握了现在所需的技术技能的新进入者创造了一个巨大的机遇。 ■



The software shuffle

Software is now as important as hardware in cars

It is easier for a tech firm to make cars than a carmaker to become a tech company

A VISIT TO Nio house in Berlin, which is modelled on a network of 100 similar establishments in China, offers evidence of a fundamental change. Here you can still acquire a car, but unlike a traditional dealership only a small fraction of the floorspace is taken up by vehicles. Nio sees itself as a lifestyle brand and tech firm. The “focus is on the user experience”, says Lihong Qin, its president. Using a Nio is about enjoying the journey and the community built around its brand. Its cars are packed with high-definition screens and state-of-the-art sound systems. In Berlin owners, potential owners or anyone else can drop by the coffee bars and meeting rooms, buy locally sourced branded goods, or even leave their children in a high-tech play area.

The usual way of differentiating car brands by mechanical excellence was personified by the ICE’s performance, design and Spaltmass (a German word for slim regular gaps between bodywork panels that are hard for newcomers to reproduce). Nowadays buyers are no longer so bothered. McKinsey, a consultancy, reckons that only 8% are “petrolheads” who love driving for its own sake. Future drivers and passengers want to make the most of their trips. The features and functions that do this rely on software rather than hardware. Tu Le of Sino Auto Insights, a consultancy, puts it bluntly: “customers don’t care about panel gaps.” The software updates keeping Tesla’s technology fresh matter more.

Dirk Hilgenberg, boss of Cariad, VW’s software division, says the car will be a “third living space” between home and work. Software controls performance, driving features and the experience of sitting in the vehicle.

Safety features such as automatic braking, automatic lane-keeping and changing, adaptive cruise control and automatic parking are already available. Others will make things more fun and become increasingly useful as autonomous driving becomes common. These include huge improvements to such features as infotainment—the best navigation maps, sound systems and screens to watch films or play video games—and advanced voice controls, a particularly important feature in China. Michael Mauser, boss of Harman, a tech firm supplying carmakers, describes how smart devices have changed the expectations of consumers: spending \$100,000 on a car comes with the same demand for personalisation as a \$300 smartphone.

The established car industry has been good at delivering cars on budget and on time but not at considering the business case of the car, says Johannes Deichmann of McKinsey. Increasing connectivity—by 2030 four cars in five will be internet-enabled, says UBS—will allow over-the-air updates to software. For carmakers that means new opportunities to sell things. For owners it means vehicles can be continuously updated and improved when they buy new features and functions. Legacy carmakers will have the hardest job replicating the advantages of startups, for which software is the most important element, and Chinese firms, whose customers demand and expect a seamless extension of their digital lifestyles in their cars.

Software can be lucrative. UBS forecasts \$700bn a year in revenues by 2030, but adds that this will compensate only for declining revenues elsewhere as negligible growth combines with higher costs and lower profits. Mastering software has become vital for carmakers just to stand still. But established firms have to rethink a business model dedicated to mechanical-engineering excellence. The industry operates on roughly seven- or eight-year model cycles, with research and development frozen before the start of production. This leisurely pace is far removed from software's timescales, with small updates coming weekly or monthly and big overhauls perhaps

every year, as they do for smartphones.

Big carmakers have done a good job of claiming to be tech companies, but informed observers detect a resistance to change. Mr Li says that Nio and other Chinese firms starting from scratch develop software and hardware together. Clean-sheet designs can incorporate more centralised and efficient computing systems, whereas current ICE models integrate separate bits of technology developed by suppliers, making cars a mass of hundreds of electronic control units. At least the launch of all-new EVs allows established firms to redesign their computing architecture.

Firms that have long had a mechanical mindset struggle to set up the units needed to develop the software that now makes brands distinctive or to strike deals with tech firms that today matter as much as traditional suppliers. According to Daniel Roeska of Bernstein, a broker, the average European car executive is 55 and has worked in the industry for 22 years. He drily notes that this is “not the right mix of experiences and capabilities” for firms that need to be “more agile and innovative than ever before”. Gartner’s Pedro Pacheco is equally damning, suggesting that some firms don’t want to change their corporate culture and are “running with an iron ball around their ankle”.

Carmakers are appointing chief software officers, presenting strategy at “software days” and setting up software divisions. A new seven-storey building at the Mercedes plant in Sindelfingen, built at a cost of €200m, will house a third of the firm’s 3,000 software engineers. Cariad, the software unit created by VW in 2020, has a large site in Ingolstadt, not far away, for its 6,000 software employees. Stellantis aims to have 4,500 software engineers by 2024. GM had planned to hire 8,500 techies in 2022. But only Volvo and Ferrari have CEOs with a background in tech.

How much and what to keep in-house remains a big issue. VW says its

once-stated ambition to develop 60% of its own software was a means to reinforce the importance of software rather than an actual target. Most car firms have settled on developing no more than 20-30% in-house. As UBS puts it, carmakers that want to do everything are “set up for expensive failure” but those relying “100% on an external software stack” are the “worst case...for brand equity”. Most carmakers realise that they should concentrate only on what they can do better.

That means having a clear view of what is best kept in-house but also trying to stay in control of what is bought in. Ola Kallenius of Mercedes-Benz says the role of legacy car firms is to become the “architect of the house”. It is creating its own operating system and teaming up with the best contractors, such as Nvidia for chips, and deepening a partnership with Google to improve navigation systems. Mr Kallenius argues that car firms still have a vital role as integrators, as no tech firm can deliver off-the-shelf software for all four separate domains of driving and charging, comfort (such as lighting and massaging seats), infotainment and autonomy.

Carmakers need to strike deals with tech firms that are also eyeing their business as a potential source of new revenues. But do drivers want a proprietary system or rather something closer to what they are already familiar with from their phones? In 2022 Renault announced a deepening of its relationship with Google’s Android Automotive, which lets driver access phone features and apps, to speed up its digital transformation. Bernstein asks if carmakers should “forgo control and adopt a platform that consumers appear to readily accept?” Gill Pratt, Toyota’s chief scientist, similarly suggests that car software must be a seamless part of the smartphone ecosystem.

Yet this runs the risk of ceding users’ experience to the tech firms. The latest version of Apple’s CarPlay, due in September, connects iPhones to a car’s infotainment screen, offering a more seamless experience for maps,

driving information and connections to smartphone apps by taking over the screens in cars. But Apple will keep the data on drivers. Some think the slow reaction of the industry to software means the game is already up. Olaf Sakkers of RedBlue Capital, a mobility investment fund, says that Apple has already won the “in-car experience” and that legacy firms have “already lost but are acting like they haven’t”.

For Tesla and other newcomers this is hardly an issue. Innovating and rapidly turning out new software features is at the core of what they do. Michael Dunne of ZoZoGo, a consultancy, reckons Tesla’s software is five years ahead of the established firms. Most agree they are behind the Chinese when it comes to user experience. Mr Hilgenberg agrees that his firm has much to learn from the speed of decision-making and time to market of Chinese firms. Even Western startups cannot keep pace. John Makin of the automotive division of Luxoft, a software company, says Rivian and Western startups are quick but the Chinese are quicker still, rolling out updates in hours or days rather than weeks or months.

Getting the software right by marrying the speed and agility of the tech industry to the old world of carmaking will be especially hard for legacy firms. Some at least have the right idea, but for many it will prove all-but impossible. And that could create a big opportunity for the new entrants that have mastered the tech skills now needed. ■



准入门槛

新来者造车越来越容易

电气化正在降低汽车行业令人生畏的进入壁垒【专题《艰难新世界》系列之三】

大众汽车总部所在的公司城沃尔夫斯堡（Wolfsburg）单调乏味。大多数高管选择住在周边的乡村或距这里一小时火车车程的柏林。沃尔夫斯堡的功能就是为一个汽车制造帝国服务，这个帝国在2019年（新冠疫情爆发前）生产了近1100万辆汽车，并长久与丰田和雷诺-日产-三菱联盟争夺全球最大车厂宝座。似乎不可思议的是，一家如此强大的公司——从沃尔夫斯堡庞大的装配车间、专用发电站和装饰着巨大公司标志的办公大楼可见一斑——会受到威胁。

大众集团的老板们想要重塑这家公司以充分利用老牌车厂的强项，例如强大的品牌、大规模制造能力和资金，同时向特斯拉和中国人学习如何变更业务赛道。大众代表着美国电动汽车创业公司老板亨里克·菲斯克

（Henrik Fisker）所说的“〔老牌公司〕须维持存活的巨型机器”。投资银行杰富瑞（Jefferies）的菲利普·霍舒华（Philippe Houchois）表示，规模对于分摊该行业高昂的固定成本，以及产生现金流来支持向电动车的转型很重要。但是，他又说，“要把过去习得的那一套忘掉很困难”。

自亨利·福特的胭脂河工厂（River Rouge）用从其下属矿山或橡胶种植园获得的原材料生产出闪亮的新车以来，汽车行业已经完善了自我。通过把尽可能多的环节外包给供应商，车厂得以专注于设计和营销、管理复杂的供应链、按严格的公差制造，以及整合从博世（Bosch）、大陆

（Continental）、德尔福（Delphi）和电装（Denso）等“一级”供应商那里获得的机械技术。外包降低了成本，但也把技术进步留给了其他公司。

马斯克的创新是借鉴了科技行业的“全栈”商业模式，让胭脂河工厂与时俱进。现在，垂直整合可确保创新性和业务敏捷度，同时留下更多利润。其结果让购车者和投资者都满意。2012年，特斯拉生产了约3100辆车，收入

为4.13亿美元；到2022年，这些数字达到140万辆和810亿美元。2010年的首次公开募股对特斯拉的估值为17亿美元；对特斯拉可能主导汽车行业的信念推动其市值在2021年11月攀升至1.2万亿美元。此后，一轮科技股抛售和对特斯拉业绩的担忧让它回落至6500亿美元，但仍比排在它后头的五家汽车公司的总和还要高。

特斯拉的崛起并非一帆风顺。它在2010年以仅仅4200万美元的价格从通用汽车和丰田手中收购了加州弗里蒙特（Fremont）的一家工厂。但马斯克在2018年所说的“产能地狱”差点让他的公司破产。自那以后，它已经建造了五座新的电池或汽车工厂，并计划在墨西哥再建一个。马斯克已经重申了他的信念，即特斯拉到2030年将生产2000万辆车。大多数分析师认为500万辆的目标更实际些，但即便是这个数字也依然是巨大的成就。摩根士丹利银行的亚当·乔纳斯（Adam Jonas）认为“由特斯拉带向市场的创新〔将〕成为行业标准”。

原因之一是垂直整合的回归，这主要是为了保障原材料的供应。大众的首席财务官阿尔诺·安特列兹（Arno Antlitz）表示，“电池供应是转型的一个制约因素”。大众的电气化计划是所有老牌车厂中最为宏伟的：它希望到2030年，在北美和中国销量的一半以及欧洲的80%都是电动车。但电池制造由中国、日本和韩国主导。前十大公司中六家是中国公司，供应了全世界60%的电池。中国还牢牢控制着锂、石墨和镍等原材料以及加工产能。

为打破中国的支配地位，车厂已经开始绕开已有的供应链。特斯拉是第一个直接与矿业公司签署“承购”协议的公司，其他汽车制造商也已纷纷效仿。福特与矿业巨头必和必拓（BHP）签约购镍，从另一行业巨头力拓（Rio Tinto）采购锂。通用汽车已与澳大利亚的CTR公司签约采购锂，并从另一家矿商嘉能可（Glencore）采购钴。丰田与松下的电池合资企业将从阿根廷采购锂。特斯拉已经在德克萨斯州动工建造一座锂精炼厂。

另一种变化是走向“超级电池工厂”。大多数车厂都与成熟电池企业建立了合资公司，例如通用汽车与韩国的LG化学（LG Chem）合资，梅赛德斯-奔驰与全球最大的电池制造商宁德时代合资。大众的专门电池部门

PowerCo计划到2030年向五家工厂投资200亿欧元，此外已与沃尔沃联合投资了特斯拉前员工彼得·卡尔森（Peter Carlsson）经营的瑞典创业公司Northvolt。PowerCo的老板凯·穆勒（Kai Müller）解释说，大众有充足财力继续掌控自己的电池供应。把它交给一家合资企业意味着投入一半的资金，却把方向盘交给第三方。

其他职能正转向公司内部。带来新特性和功能的软件大多将由车厂开发。特斯拉自己生产部分电池、芯片、电机和动力总成的其他部分。它甚至自己制作座椅。中国的比亚迪最初是一家生产电池的科技公司，如今为其新车型制造除玻璃和轮胎以外的几乎所有东西。

车厂自己也在进军充电业务。特斯拉的超级充电网络（Supercharger）可能会成为一项大业务，因为该公司已向其他汽车开放该网络，高盛估计此举每年可带来250亿美元收入。Juniper Research认为，到2027年，充电业务将在全球范围内带来3000亿美元的收入，高于2023年的660亿美元。大众根据它在2015年卷入“柴油门”丑闻后签署的协议，向Electrify America项目投入了20亿美元。通用汽车已为北美的4万个充电桩投资7.5亿美元。与宝马、福特、现代和大众共同持有Ionity股份的梅赛德斯-奔驰计划斥资10亿美元，与全球最大充电公司之一ChargePoint一起运营一项美国业务。

汽车制造巨头不会像行业新来者那样轻松实现垂直整合。正如胡梅尔所指出的，把所有东西都转回内部的成本太高了。然而，对于新公司而言，规模、经验、品牌和获得资本都已不再是成功的巨大障碍，就像中国的经验所表明的那样。 ■



Barriers to entry

It is getting easier for new entrants to make cars

Electrification is lowering the industry's daunting barriers to entry

WOLFSBURG, THE company town that Volkswagen calls home, is drab. Most executives choose to live in the surrounding countryside or in Berlin, an hour away by train. Its function is to serve a carmaking empire that churned out nearly 11m cars in 2019 (pre-pandemic) and has vied with Toyota and the Renault-Nissan-Mitsubishi alliance to be the world's biggest carmaker. It seems inconceivable that such a mighty firm, epitomised by Wolfsburg's vast assembly halls, dedicated power station and towering offices adorned with giant company logos, could be under threat.

VW bosses want to reinvent the firm so as to make the most of established carmakers' strengths, such as powerful brands, mass-manufacturing prowess and money, while learning from Tesla and the Chinese how to change their business. VW is symbolic of what Henrik Fisker, boss of an American EV startup, calls "a giant machine [incumbents] have to keep alive". Philippe Houchois of Jefferies, an investment bank, says size matters to spread the industry's high fixed costs and to generate the cashflows to pay for the EV transition. But, he adds, it is "hard to unlearn the past".

The industry has refined itself since Henry Ford's River Rouge factory, where raw materials acquired from mines or rubber plantations owned by the company went in one end, and a shiny new car came out the other. By outsourcing as much as they can to suppliers, firms have concentrated on design and marketing, managing complex supply chains, manufacturing to exacting tolerances and integrating the mechanical tech acquired from "tier 1" suppliers, such as Bosch, Continental, Delphi and Denso. Outsourcing has reduced costs but left tech advances to others.

Mr Musk's innovation was to bring River Rouge up to date, borrowing the "full stack" business model from the tech industry. Vertical integration now ensures innovativeness and agility while keeping more profits. Car buyers and investors like what they see. In 2012 Tesla made around 3,100 cars and had revenues of \$413m; by 2022 those numbers were 1.4m cars and \$81bn. An initial public offering in 2010 valued Tesla at \$1.7bn. The belief that it might come to dominate the car industry propelled its market capitalisation up to \$1.2trn in November 2021. A tech sell-off and concerns about Tesla's performance then dragged it back down to \$650bn, but that is still more than the next five car companies combined.

Tesla's rise was not struggle-free. It acquired a factory in 2010 in Fremont, California, for just \$42m from GM and Toyota. But the "production hell" that Mr Musk described in 2018 nearly tipped his firm into bankruptcy. Since then it has built five new battery or car plants and has plans for another in Mexico. Mr Musk has restated his belief that Tesla will be making 20m cars by 2030. Most analysts reckon 5m is nearer the mark, yet that would still be a huge achievement. Adam Jonas of Morgan Stanley, a bank, suggests that the "innovations brought to market by Tesla [will] become the industry standard".

One reason is that vertical integration is back, not least to ensure supplies of raw materials. Arno Antlitz, VW's chief financial officer, says "battery supply is a constraint on transformation". VW has the most ambitious electrification plans of any established carmaker: it wants half its sales in North America and China and 80% in Europe to be electric by 2030. But battery-making is dominated by China, Japan and South Korea. Six of the top ten firms are Chinese, supplying 60% of the world's batteries. China also has a firm grip on raw materials, such as lithium, graphite and nickel, and also on processing capacity.

Breaking China's domination has meant bypassing established supply

chains. Tesla was the first to sign an “offtake” agreement directly with a mining company. But other carmakers have followed suit. Ford has signed deals with BHP, a mining giant, for nickel and Rio Tinto, another industry titan, for lithium. GM has signed deals to get lithium from CTR in Australia and cobalt from Glencore, another miner. Toyota’s battery joint-venture with Panasonic will source lithium from Argentina. Tesla has commissioned a lithium refinery in Texas.

Another change is the move towards “gigafactories”. Most carmakers have joint ventures with established battery firms, such as GM’s with South Korea’s LG Chem or Mercedes-Benz’s with China’s CATL, the world’s biggest battery-maker. PowerCo, VW’s dedicated battery unit, plans investment of €20bn in five factories by 2030, adding to a partnership with Volvo in Northvolt, a Swedish startup run by Peter Carlsson, a former Tesla man. Kai Müller, boss of PowerCo, explains that VW has the financial clout to stay in control of its battery supply. Leaving it to a joint venture would mean putting up half the money but handing direction to a third party.

Other functions are moving in-house. Much of the software for new features and functions will be developed by carmakers. Tesla makes some of its own batteries, chips, motors and other bits of the powertrain. It even makes its own seats. China’s BYD, which began life as a tech firm producing batteries, makes almost everything for its new models bar glass and tyres.

Carmakers are also entering the charging business themselves. Tesla’s Supercharger network could become a big business, as the firm has opened it up to other cars, a move that Goldman Sachs reckons could be worth as much as \$25bn a year. Juniper Research thinks that charging could rake in \$300bn in revenues globally by 2027, up from \$66bn in 2023. As part of the deal to resolve the “dieselgate” scandal that embroiled VW in 2015, the company put \$2bn into Electrify America. GM has invested \$750m in 40,000 charging points in North America. Mercedes-Benz, which has a

stake in Ionity with BMW, Ford, Hyundai and VW, plans to spend \$1bn on an American business that it intends to manage along with ChargePoint, which is one of the world's biggest charging companies.

The carmaking giants will not manage vertical integration as easily as newcomers can. As Mr Hummel notes, it is too expensive to bring everything back in-house. Yet for new firms, scale, experience, brands and access to capital are no longer huge barriers to success, as the experience of China is showing. ■



新挑战

中国正在引领对老牌车厂的挑战

传统汽车行业的最大资产已不像过去那么值钱【专题《艰难新世界》系列之四】

上世纪初，至少有100家美国公司手工制造昂贵的汽车。规模生产的经济效益使得这个行业逐渐集中到了少数超大公司手中。现在这个过程开始逆转。有人说仅在中国就有300家电动汽车制造商。电池和电机都可以买现成的，也就不再需要再花几十亿美元研发好几种内燃机以满足一系列车型的不同要求。一种电池可以有多种尺寸；一种电机可适用于多种车辆，性能特点则用软件微调。因此，较小的产量就可以实现盈利。

给车做一张效果图和一套精美的幻灯片很简单。即便是手工制造几辆车也不难。但是，梅赛德斯-奔驰位于辛德尔芬根（Sindelfingen，靠近该公司位于斯图加特的总部）的庞大的56号工厂表明，规模化制造却是极其复杂的。每款高档S级轿车都提供多种级别的内饰，以及从高档木材和皮革到复合制动器的多种选择，需要机器人穿梭车把成千上万个零部件在准确的时间放到装配线上的正确位置。此外还要无线控制电动工具来根据扭矩设置拧紧相应的螺栓。

新来者面临的挑战是复制这个过程。有利的一点是，电动汽车的零部件比内燃机汽车少，也更易组装。新来者通常只生产一种或几种型号，功能选择也很少。即便是特斯拉也只生产了四款车型，不过很快还会上市cybertruck皮卡，而且马斯克承诺推出一款便宜的车型Model 2，起价在25,000美元左右。简洁降低了成本，转化为更高的利润。特斯拉表示，Model 2的生产成本将是它目前最小的车型Model 3的一半。在汽车行业里，面向大众市场的公司的营业利润率可能不超过5%，宝马或梅赛德斯等高端汽车制造商一般把10%视为重大成就，而特斯拉的利润率达到了亮眼的15%左右。

但汽车制造“仍是一项规模化的业务”，投行林肯国际（Lincoln

International) 的约翰·麦克卢尔 (John McClure) 说。新来者并不会最先拿到电动车用的电池和芯片的供应。借鉴科技行业的剧本，小公司可以找到另一种轻资产的方法。创立于2016年的美国电动汽车公司Fisker使用合同制造商Magna。Magna通常受雇于车厂来负责利基装配线，比如早期试运行或小批量车型（它生产捷豹唯一一款纯电动车iPace）。它将生产Fisker的中档车Ocean，售价35,000美元起。Fisker自己将生产其余车型。

和专门的装配商合作或许能降低制造风险。Fisker将与以生产苹果的iPhone闻名的中国企业富士康一起生产更便宜的小车型Pear。中国汽车制造商吉利旗下拥有瑞典的沃尔沃，并持有梅赛德斯-奔驰10%的股份，它已与富士康达成协议来为第三方生产汽车。2021年，富士康还购入了洛兹敦汽车 (Lordstown Motors) 位于俄亥俄州的电动汽车厂的股份。如果说有哪家公司的野心比特斯拉还大，那么富士康的长期计划是全球一半的电动汽车都由它来制造。

从特斯拉崛起并引来众多追随者，以及中国公司瞄准欧洲市场可以看出，有关打造一个汽车品牌的难度的旧规则正在被打破。由于新老公司都是从头开始，电动车买家可能并不太看重知名品牌。在品牌忠诚度一向更弱的大众市场上就更是如此。高端汽车制造商在留住客户方面往往做得更好。在中国企业试图征服世界时，人们对新品牌的开放态度可能会帮它们一把。中国车展的地位日益上升也印证了中国汽车产业的崛起。经纪商盛博指出，中国的汽车出口目前增长迅速：2022年出口量增长51%，达到320万辆，而2011至2020年的年增速仅为2%。中国公司过去向南亚和美洲的较贫穷国家出口廉价的内燃机汽车，如今聚焦欧洲和电动汽车。

比亚迪和长城汽车（旗下有经济实惠品牌欧拉和高端魏牌）都在去年10月的巴黎车展上展示了吸引目光的电动汽车。两家中国电动汽车创业公司蔚来和小鹏正在欧洲各地销售汽车，去年它们以及理想汽车各自在中国卖出超过12万辆车。数据公司施密特汽车 (Schmidt Automotive) 称，加上上汽集团旗下的名爵和吉利的极星，中国在2022年占到西欧电动汽车销量的6.2%。这一份额看起来势必还会增长。比亚迪计划在欧洲建造一家电动汽车工厂（它已经表示不会选址脱欧后的英国）。咨询公司高德纳预测，到

2026年，全球销售的电动汽车中超过50%将是中国车。

中国企业可以依赖它们服务本土市场的巨大规模和低成本、对电池业务的掌控，以及获得慷慨的国家资金的机会。但中国市场已经成熟，而国内产能过剩，两者叠加使得出口对未来增长至关重要。低产量和电池的高成本使得西方的老牌车厂很难转向靠生产电动汽车赚钱。盛博计算出，更换传动系统会使传统公司的成本增加多达50%，这主要是因为电池，而这又使得这些车的利润低于其内燃机同类产品。福特表示其电动汽车部门今年将亏损30亿美元。斯特兰蒂斯的老板卡洛斯·塔瓦雷斯（Carlos Tavares）直言不讳：“要与中国人抗衡，我们必须拥有可比的成本结构。”盛博指出，中国的电动汽车“在续航里程和能效方面与全球品牌不相上下，价格却更低”。比亚迪的Atto 3在德国的售价为38,000欧元，比大众类似的纯电动车型ID.4便宜10%到20%。

塔瓦雷斯赞成对中国电动汽车征收更多关税。但其他欧洲公司面临两难境地。斯特兰蒂斯在中国销售的汽车很少，而大众、宝马和梅赛德斯-奔驰的大部分利润依赖中国，并且还是那里的大生产商。大众在中国有33家合资工厂和十万名中国员工。任何在欧洲惩罚中国汽车制造商的举动都可能招致报复。

随着中国购车者喜好的变化，欧洲公司在中国市场上获利的能力正在减弱。欧洲品牌曾经是身份象征，但它们面对快速发展的本土竞争对手反应迟缓，这正在打击自身销量。2021年，外国车厂的销售占比自中国成为一个大型市场以来首次降至一半以下。密切关注中国的咨询公司ZoZoGo的迈克尔·邓恩（Michael Dunne）表示，曾经人们在意的是外国名牌，但现在买家想要的是创新。

容易获得资本也可能助力中国公司。但其他新来者也不费力气地找到了它们需要的现金。私募股权、科技公司甚至老式车厂都已经在向任何看起来有可能成为下一个特斯拉的创业公司注资。福特、通用汽车和克莱斯勒的大部分利润都依赖皮卡，这类车的电气化潮流说服了亚马逊、福特和大型资产管理公司普信（T. Rowe Price）投资于2009年创立的美国电动皮卡公

司里维安（Rivian）。它的R1T可与福特最畅销皮卡的电动版F150 Lightning相媲美，毫无疑问将与今年上市的通用汽车和克莱斯勒的电动皮卡一较高下。中国的小鹏汽车已从国内的投资公司和中国科技巨头阿里巴巴那里获得融资。

那些纸上计划宏大但可出售车辆很少的公司也在IPO或通过特殊目的收购公司（SPAC）上市时吸引了巨额估值。里维安在2021年上市后不久估值接近1300亿美元。蔚来的估值最高时达970亿美元。但对特斯拉估值的急剧调整以及投资者对科技股的疑虑重创了许多新来者，它们本已在汽车生产上遭遇难关，达不到生产和销售目标。里维安和蔚来现在的估值在120亿至150亿美元之间。小鹏的股价是2022年峰值的七分之一。

对于新来者来说，问题关乎它们烧掉多少现金以及还能在这场赛事中坚持多久。获沙特阿拉伯主权财富基金支持的电动汽车创业公司Lucid Motors在2月份的业绩发布会上指出，自己有足够的资金撑到2024年。这听着可不像是对长期前景的有力保证。砸向造车新势力的巨额资金开始枯竭，而传统企业那边还在大量销售内燃机汽车。新来者需要扩大规模，老企业需要转型。这对于两边来说都非易事。 ■



The new challenge

China is leading the challenge to incumbent carmakers

The legacy industry's greatest assets are not worth as much as in the past

AT THE START of the 20th century at least 100 American firms were handmaking expensive cars. The economics of mass production led to the concentration of the industry in a few vast firms. Now the process has gone into reverse. In China alone some say there are 300 EV-makers. Batteries and electric motors, which can be bought off the shelf, obviate the need to spend billions developing several ICES to serve a range of cars with different requirements. One sort of battery can come in a variety of sizes; one sort of motor will suit a variety of vehicles with performance characteristics tweaked by software. So profitability can be reached from smaller volumes.

Creating an artist's impression of a car and a slick presentation is simple. Even making a handful of cars by hand is not hard. But Factory 56, located at Mercedes-Benz's mammoth plant in Sindelfingen near the company's base in Stuttgart, shows that manufacturing at scale is hugely complex. Each high end S-Class is available in several levels of trim and with a variety of options, from exclusive woods and leathers to composite brakes, requiring thousands of parts to be brought to the correct place in the assembly line at just the right moment on robot shuttles. Power tools are controlled wirelessly to tighten the right bolts for torque settings.

The challenge for a newcomer is to replicate this process. It helps that EVs have fewer parts and are easier to assemble than ICE cars. New entrants often make only one or a handful of models, with few options. Even Tesla makes just four, though the cybertruck, a pickup, will soon be available and Mr Musk has promised a cheap Model 2 starting at around \$25,000. Simplicity reduces costs, which translates into higher profits. Tesla says

the production costs for its Model 2 will be half those of the Model 3, its current smallest vehicle. In an industry where mass-market firms' operating margins can be in low single figures and premium carmakers such as BMW or Mercedes have generally counted 10% as a triumph, Tesla's margin is an impressive 15% or so.

Yet carmaking "is still a scale business", says John McClure of Lincoln International, a bank. Newcomers will not be first in line for batteries and chips in EVs. Drawing on the tech playbook, small firms could find a different, asset-light approach. Fisker, an American EV firm founded in 2016, is using Magna, a contract manufacturer usually employed by carmakers for niche assembly such as early production runs or smaller volume models (it makes Jaguar's only full-electric model, the iPace). Magna will manufacture the firm's mid-range Ocean, which costs from \$35,000. Fisker will do the rest.

The practice of teaming up with specialist assemblers may reduce the risks of manufacturing. Fisker will manufacture the Pear, a small cheaper model, with China's Foxconn, better known for making Apple's iPhones. Geely, a Chinese carmaker that owns Sweden's Volvo, and has a 10% stake in Mercedes-Benz, has a deal with Foxconn to make cars for third parties. In 2021 Foxconn also bought a share in Lordstown Motors' EV factory in Ohio. If any company has greater ambitions even than Tesla, Foxconn's long-term plan is to manufacture half the world's EVs.

Tesla's rise, its gaggle of followers and the Chinese firms eyeing sales in Europe suggest that old rules about the difficulty of establishing a car brand are breaking down. Because firms old and new are starting from scratch, EV buyers may put less store by established brands. This is especially true in the mass market, where brand loyalty has always been weaker. Premium carmakers tend to do a better job of hanging on to customers. Openness to new brands could give the Chinese firms a leg-up as they try to conquer the

world. The growing importance of Chinese motor shows is further evidence of China's rise. Chinese exports are growing fast: 51% by volume in 2022 to 3.2m vehicles, after expanding by only 2% a year in 2011-20, says Bernstein, a broker. Chinese firms that once exported cheap ICE cars to poorer countries in South Asia and the Americas are now focusing on Europe and EVs.

Both BYD and Great Wall Motor (GWM) with Ora, its budget brand, and upmarket Wey, displayed attractive EVs at October's Paris Motor Show. Two Chinese EV startups, Nio and Xpeng, are selling cars across Europe and, along with Li Auto, they sold over 120,000 cars apiece in China last year. Along with MG, which is owned by SAIC, and Geely's Polestar, China accounted for 6.2% of EV sales in western Europe in 2022, says Schmidt Automotive, a data firm. That share seems sure to grow. BYD plans to construct a European EV factory (and not, it has already said, in post-Brexit Britain). Gartner, a consultancy, predicts that by 2026 more than 50% of EVs sold globally will be Chinese.

Chinese firms can lean on the vast scale and low costs of serving their home market, their grip on the battery business and their access to generous state funding. But the maturity of China's market and excess capacity at home combine to make exporting crucial for future growth. Low volumes and the high cost of batteries make it hard for Western legacy firms to switch to making EVs profitably. Bernstein calculates that swapping drive trains increases costs for legacy firms by up to 50%, mostly because of the battery, which in turn makes these vehicles less profitable than their ICE equivalents. Ford says its EV division will lose \$3bn in 2023. Carlos Tavares, boss of Stellantis, is blunt: "to fight the Chinese, we will have to have comparable cost structures." Bernstein notes that Chinese EVs are "on par with global brands on range and efficiency, and yet less expensive". BYD's Atto 3 sells for €38,000 in Germany, making it 10-20% cheaper than VW's similar all-electric ID.4.

Mr Tavares favours more tariffs on Chinese EVs. But other European firms face a dilemma. Unlike Stellantis, which sells few cars in China, VW, BMW and Mercedes-Benz rely on the country for much of their profits and are big producers there. VW has 33 factories with joint-venture partners and 100,000 Chinese employees. Any move to punish Chinese carmakers in Europe could invite retaliation.

The ability of European firms to cash in on the Chinese market is now waning as the tastes of Chinese car buyers change. European brands once conferred status but their slow response to fast-moving domestic competitors is hitting sales. In 2021 foreign carmakers accounted for less than half of sales for the first time since China became a big market. Once it was all about flashy foreign brands, but innovation is what buyers want now, says Michael Dunne of ZoZoGo, a consultancy that closely watches China.

Easy access to capital may also be a boost for Chinese firms. But other newcomers have also had little trouble finding the cash that they need. Private equity, tech firms and even old-fashioned carmakers have poured money into any startups that looked as if they might become the next Tesla. Electrifying the pickups that Ford, GM and Chrysler rely on for most of their profits persuaded Amazon, Ford and T. Rowe Price, a big money manager, to invest in Rivian, an American EV pickup firm that was founded in 2009. Its R1T is a match for Ford's F150 Lightning, the electric version of its bestselling pickup, and will doubtless stand up to electric pickups from GM and Chrysler that are going on sale this year. China's Xpeng has raised money from domestic investment firms and Alibaba, a Chinese tech giant.

Firms with big plans on paper but few vehicles to sell have also attracted huge valuations at initial public offerings or by going public via special-purpose vehicles. Rivian was valued at nearly \$130bn shortly after it floated in 2021. Nio hit a peak of \$97bn. But the savage readjustment of Tesla's

valuation and investors' doubts about tech shares have battered many newcomers that have struggled with carmaking, missing production and sales targets. Rivian and Nio are now valued in the \$12bn-15bn range. Shares in Xpeng are at one-seventh of their peak in 2022.

For the newcomers it is a question of how much cash they burn and how long they can keep in the race. Lucid Motors, an EV startup backed by Saudi Arabia's sovereign-wealth fund, noted at a results presentation in February that it had enough to reach 2024, hardly a ringing endorsement of its long-term prospects. The lavish sums being thrown at new carmakers are drying up even as the established industry still sells ICE cars in large numbers. The newcomers need to scale up; the established industry needs to transform. Neither will find the task easy. ■



汽车行业

有关汽车制造的一切同时在变

专题作者西蒙·怀特认为，该行业必须重塑自我以跟上步伐【专题《艰难新世界》系列之二】

开着世界上第一辆汽车去兜风相当麻烦。“奔驰专利汽车”于1886年在德国上路，需要从药房购买“去污剂”作为燃料，手动润滑机械部件，并装满油箱和水箱。然后你得转动一个大飞轮来启动发动机，抓住控制前轮的舵柄，向前推动操纵杆以接合传动带来让车跑起来。每开10到15公里就得这样再来一遍，因为油和水用完了。然而，利用内燃机为“马车”提供动力来自由旅行的想法很快流行起来。

一个年收入接近3万亿美元的巨大行业已经发展起来，为大众提供交通服务。超过10亿辆汽车在世界各地的道路上运送乘客。除了德国人之外，还有许多先驱者。法语为英语提供了coupé（双门小轿车）、chauffeur（司机）和cabriolet（敞篷车）等词。美国在1908年通过福特T型车发展了大规模生产，然后在1950年代推出了巧妙的营销。日本发明了超可靠性和准时制（JIT）生产。欧洲为豪华、精密的工程和新技术（如防抱死制动器和安全气囊）树立了标杆。

在该行业历史的下一阶段，以技术为本的公司和中国人将脱颖而出。伊隆·马斯克的特斯拉公司在各地拉动了电动汽车的发展。中国可能是一个后来者，但它正在快速成长。直到1980年代，中国只造出了少数几辆汽车，例如载着毛泽东前往阅兵式和拖拉机工厂的红旗豪华轿车。但近40年来，中国崛起为经济超级大国创造了相应的汽车行业。中国在2009年超过美国成为世界上最大的汽车市场。去年它超越德国成为世界第二大汽车出口国。

特斯拉和中国公司成为强有力的竞争者反映了该行业前所未有的动荡。明显的转变是电气化。尽管少数汽车制造商仍在尝试氢燃料电池，但锂离子电池已成为关键技术。在2022年，全球售出的新车中约有十分之一是电池

驱动的电动汽车。再算上插电式混合动力车（结合使用较小的电池和内燃机），则共有13%也就是约1050万辆汽车实现了电气化。

中国的新能源汽车（电动车以及插电式混合动力车）销量为610万辆。但特斯拉是全球最大的电动汽车制造商，2022年销量为130万辆。中国的比亚迪在纯电动汽车方面排名第二，而如果要算新能源汽车的话就遥遥领先。在老牌车厂中，大众汽车集团（VW）正在推进最大胆的电气化转型。但它仅排在第三位，电动汽车销量为57万辆，占其总销量的7%。

电气化正在改变汽车制造业。老品牌依靠内燃机的复杂性和高成本来阻止竞争者。你得花费10亿美元开发内燃机，再花10亿美元建设冲压机、涂装车间和生产线，才能将一家新公司的产能扩大到每年15至20万台，这形成了巨大的进入壁垒。难怪，从第二次世界大战到特斯拉的到来，具有全球影响力的新品牌寥寥无几。做成这件事的公司，例如日本的丰田和日产以及韩国的现代起亚，都是依靠了政府的支持和受保护的国内市场。

电池和电动机相对简单，这消除了许多进入壁垒。中国（包括理想汽车、蔚来汽车和小鹏汽车）和美国（例如菲斯克、洛兹敦、路西德和里维安）的许多创业公司如今都在效仿特斯拉。电气化为中国的老牌汽车制造商助了一臂之力，它们长期以来因内燃机技术的巨大障碍而无法进入全球市场。中国已吸引国有和私营企业建立国内电动汽车产业，部分原因是为了避开汽油动力。

一批新竞争者的到来将加剧这个行业的激烈竞争，尤其是因为汽车销售可能已经过了高峰期。此前中国急切的买家给这个市场带来了数十年来最大的推动力。但现在刹车已经踩下。自2018年以来的三年里，市场饱和、经济恶化以及新冠疫情都促成汽车销量下降。全球汽车产量也已达到顶峰，2017年约生产了7300万辆乘用车。中国需求放缓之际，在所有现代汽车上密集部署的芯片又发生供应短缺。到2022年，全球汽车产量已降至6200万辆左右。

各方预测的差异很大，但汽车销量的未来增长很可能充其量只是缓慢的。

咨询公司高德纳的佩德罗·帕切科（Pedro Pacheco）认为，销售额最终会回到2019年的水平，但再高不了多少了。另一家咨询公司麦肯锡提出了一系列情景，预计到2035年每年的数字将在7000万到9500万之间，但在这个数字的高端，大部分增长将出现在非洲、印度、拉丁美洲和东南亚的新兴市场，而这些市场的大部分需求将是廉价汽车。几乎可以肯定欧洲和美国已经达到顶峰，而中国很可能很快就会达到顶峰。即使是乐观主义者也认为，在2019年之后的十年里，中国的年增长率仅为2.3%，而此前十年的增长率接近7%。

传统汽车制造商面临着巨大的挑战，因为后来者，尤其是中国公司，很可能拥有明显的优势。梅赛德斯-奔驰的老板康林松（Ola Kallenius）并没有低估更换传动系统和推翻内燃机130年历史的“艰巨工业任务”，但表示“软件方面正在发生的事情更大”。过去，汽车品牌是由机械工程的精湛程度定义的，体现在汽车的操纵稳定性、马力、引擎盖徽章的身份，以及高端汽车关上车门时令人舒适的“闷响”。

未来，汽车品牌将主要通过使用体验来区分，而如今这更多地取决于软件而不是硬件。由软件定义的车辆类似于车轮上的超级计算机，将具有越来越多的特性和功能，例如信息娱乐、环境照明和语音控制，所有这些都可以在车辆出厂后通过无线（OTA）升级而改进。这将为汽车生产商开辟新的获利方式。

许多老牌公司都在嫉妒地看着特斯拉，它声称自己是一家碰巧制造汽车的科技公司。特斯拉扎根于硅谷，在软件领域取得了决定性的领先地位。然而在中国，特斯拉只是几家电动汽车制造商之一。中国汽车制造商、创业公司和与之合作的科技公司正在提供远远超过其他地方的体验。比亚迪、蔚来和小鹏都提供车载卡拉OK麦克风，在这一点上打败了特斯拉。中国的年轻人期望甚至要求他们的汽车能够无缝扩展其数字生活方式，这正在为世界其他地区设定行进方向。

自动驾驶的竞赛也在进行中。尽管通往完全自动驾驶汽车的道路上布满了障碍，但一种更有限的“解放双手”自驾模式——先是在高速公路上接管驾

驶任务，最终适用于某些城市环境——已接近商业部署。汽车制造商正在重新考虑它们在网约车和汽车共享方面的参与度，关于出行的大问题已经变成了如何最好地从汽车的使用而不仅仅是对汽车的拥有中赚钱，这引发了对汽车零售的重新思考。

最后的考验来自新的地缘政治紧张局势，尤其是在美国和中国之间。关税上涨、对技术转让的限制越来越多、供应链回流以及对本土制造业的更多补贴都有可能阻止甚至逆转全球化进程。汽车制造商们会发现要适应这种变化尤为困难。

对于传统公司而言，所有这一切都需要进行重大变革和重新设计。它们依然有许多优势：制造技能、强大的品牌，以及在这个大把烧钱的行业中获得大量资本的机会。然而，创业公司没有那些几十年来埋头研究机械工程的孤立组织所背负的沉重历史遗产，也不被成本高昂的复杂产品组合拖累。并非所有传统公司都能在即将到来的大转型中幸存下来。■



The car industry

Everything about carmaking is changing at once

The industry must reinvent itself to keep pace, says Simon Wright

GOING FOR A spin in the first car was a bother. The Benz Patent Motorwagen, which hit German roads in 1886, needed “stain remover” from a pharmacy for fuel, mechanical parts greased by hand, and oil and water tanks filled. Then you had to spin a large flywheel to start the engine, grasp the tiller that controlled the front wheel, and push forward the lever to engage a drive belt that set the vehicle in motion. Repeat the process every 10-15km when fuel and water ran out. Yet the freedom to travel by powering a carriage with an internal-combustion engine (ICE) soon caught on.

A giant industry with annual revenues of nearly \$3trn has grown to provide transport to the masses. Over 1bn cars heave passengers along the world’s roads. There were many pioneers beside the Germans. The French provided words like coupé, chauffeur and cabriolet. America developed mass-manufacturing with the Ford Model T in 1908 and then slick marketing in the 1950s. Japan invented ultra-reliability and just-in-time production. Europe set the mark for luxury, sophisticated engineering and new technologies such as antilock brakes and airbags.

The next phase of the industry’s history will be one in which tech-centric firms and the Chinese come to the fore. Elon Musk’s Tesla has kickstarted electric vehicles (EVs) everywhere. China may be a newcomer but it is growing fast. Until the 1980s the country knocked out only a handful of cars such as the Hongqi limousine that whisked Mao Zedong between military parades and tractor factories. But a 40-year rise to economic superpowerdom has created a car industry to match. China overtook America as the world’s biggest market in 2009. Last year it passed Germany

as the world's second-largest exporter.

The emergence of Tesla and the Chinese as serious competitors reflects unprecedented upheaval in the industry. The obvious shift is electrification. Although a few carmakers are still trying hydrogen fuel cells, lithium-ion batteries have become the key technology. In 2022 around one new car in ten sold worldwide was a battery-powered electric vehicle (EV). Adding plug-in hybrids (PHEVs), which combine a smaller battery with an ICE, and 13% of total sales, or around 10.5m vehicles, were electrified.

China accounts for 6.1m sales of what it calls new-energy vehicles (EVs and PHEVs). But Tesla is the world's biggest EV-maker, selling 1.3m cars in 2022. China's BYD is second for battery-only cars and is way ahead when counting new-energy vehicles. Of the old guard Volkswagen Group (VW) is the boldest electrifier. Yet it is only in third place, with 570,000 EV sales, 7% of its total.

Electrification is changing carmaking. The old brands have relied on the complexity and cost of ICEs to keep competitors at bay. Having to spend \$1bn to develop an ICE and another \$1bn for the presses, paint shop and production lines to scale up a new firm to 150,000-200,000 units a year creates huge barriers to entry. It is little wonder that, from the second world war until Tesla's arrival, new brands that made the transition to global significance were few and far between. Those that did, such as Toyota and Nissan in Japan and Hyundai-Kia in South Korea, leant on government support and protected home markets.

The relative simplicity of batteries and electric motors knocks down many of these barriers to entry. A host of startups in China (including Li Auto, Nio and Xpeng) and America (such as Fisker, Lordstown, Lucid and Rivian) are now following Tesla's lead. Electrification has given a leg-up to China's established carmakers, which were long kept from global markets by the big obstacle of ICE tech. China has cajoled state-owned and private companies

to build a domestic EV industry partly so as to sidestep petrol power.

The arrival of a clutch of new competitors will make a highly competitive industry even more so, not least because car sales may have already passed their peak. China's eager buyers gave the market its biggest turbo-boost in decades. But the brakes are now on. Car sales fell over the three years starting in 2018, as a saturated market, a worsening economy and the impact of covid-19 all took their toll. Global car production also peaked, at around 73m passenger cars in 2017. Slowing Chinese demand has been compounded by a shortage of the chips that are liberally sprinkled around all modern vehicles. By 2022 global production of cars had fallen to around 62m.

Forecasts vary widely, but future growth of car sales is likely to be sluggish at best. Pedro Pacheco of Gartner, a consultancy, reckons that sales will eventually return to 2019 levels but they will never go much higher. In a range of scenarios McKinsey, another consultancy, puts the annual number anywhere between 70m and 95m by 2035, but at the upper end most of the growth will be in emerging markets in Africa, India, Latin America and South-East Asia, where the bulk of demand will be for cheap cars. Europe and America have almost certainly peaked already and China is likely to do so soon. Even optimists see growth in China at barely 2.3% a year over the decade after 2019, compared with nearly 7% during the previous ten years.

Legacy carmakers face a big challenge since newcomers, especially the Chinese, are likely to have a clear advantage. Ola Kallenius, boss of Mercedes-Benz, does not underestimate the "monumental industrial task" of swapping drive trains and overturning 130 years of ICE history but says that "what's happening on the software side is bigger". In the past car brands were defined by the adeptness of the mechanical engineering that went into their handling, their horsepower, the status of their bonnet badges and the satisfying "clunk" of closing the doors of a pricier car.

In future cars brands will be differentiated mainly by the experience of using them, which is now determined more by their software than their hardware. Software-defined vehicles, which nowadays resemble supercomputers on wheels, will have ever more features and functions such as infotainment, ambient lighting and voice controls, all improved by over-the-air (OTA) updates after a vehicle has left the factory. That will open up new ways for the car producers to cash in.

Many established firms are looking jealously at Tesla, which claims to be a tech company that happens to make cars. From its roots in Silicon Valley, Tesla has gained a decisive lead in software. Yet in China Tesla is but one of several EV-makers. Chinese carmakers, startups and the tech companies they have joined up with are delivering experiences that far exceed what is available elsewhere. BYD, Nio and Xpeng have all beaten Tesla to provide in-car karaoke microphones. Young Chinese who expect and even demand that their vehicles provide a seamless extension of their digital lifestyles are setting a course for the rest of the world.

The race to autonomous self-driving is also on. Though the road to fully autonomous cars is littered with obstacles, a more limited “hands-off” autonomy that takes over driving duties initially on motorways and eventually in some urban settings is close to commercial deployment. Carmakers are rethinking their involvement in ride-hailing and car sharing, with the big question over mobility becoming how best to monetise the use rather than the mere ownership of cars, triggering a rethink of car retailing.

A final test comes from new geopolitical tensions, notably between America and China. Rising tariffs, growing restrictions on tech transfers, a reshoring of supply chains and greater subsidies for home-grown manufacturing all threaten to halt or even reverse the process of globalisation. Carmakers will find adjusting to such a change especially challenging.

For legacy firms all this requires big change and re-engineering. They retain many advantages: skills in manufacturing, powerful brands and access to massive amounts of capital in an industry that eats through it. However, startups are not weighed down by the heavy legacy of siloed organisations that have for decades been dedicated to mechanical engineering and are encumbered by a complex portfolio of products that heap on costs. Not all legacy firms will survive the coming transformation. ■



电气化

未来属于电动汽车

汽车产业正在迅速且不可逆转地电气化【专题《艰难新世界》系列之一】

卡尔·本茨（Carl Benz）可能是把无马马车和内燃机成功合二为一的第一人。但在他之前人们已经在捣鼓电池了。早在1830年代，苏格兰人罗伯特·安德森（Robert Anderson）就发明了一辆雏形电动车，但最后没能成功。即使到了1890年代，汽车产业随着法国和美国的公司加入竞争真正开始腾飞，电力驱动仍占优势。在1900年的美国，道路上行驶的电动车数量几乎是汽油车的两倍。但接下来，低成本大规模制造的福特T型车、不断发展的石油工业和更广泛的汽油供应终结了电池动力的旅程。

电池动力曾有过不温不火的回归，比如通用汽车在1996年推出EV1。但直到2003年特斯拉问世，电池电动革命才真正掀起。这继而又加快了道路交通脱碳的努力，推动电动汽车和插电式混合动力车从十年前占新车销量的0.2%上升到2022年的13%。这一跃升趋势看来必将持续。数据公司彭博新能源财经（Bloomberg NEF）称，到2025年，电动汽车将占新车销售的近四分之一，在欧洲和中国将接近40%。即使是保守估计，到2040年全球销售的新车约四分之三将是纯电动的，因为更好的电池甚至会让插电式混合动力车也变得多余。

严格的排放法规大力推动了电动汽车的普及。欧盟2月份通过的一项法律草案可能意味着到2035年将全面禁止新的内燃机汽车销售（不过德国获准放行碳中性合成燃料车）。政府和城市正在遏制影响本地空气质量的碳排放和其他排放。中国计划到2025年新能源车销售占到整体汽车销量的20%，到2035年完全淘汰仅使用内燃机的汽车。即使在美国这个汽油车狂热国，总统拜登也于4月12日公布了严限车辆排放的提案，其中最严格的一项要求到2032年，销售的汽车中约三分之二由电池驱动。为支撑这一目标，拜登正在向国内电动汽车行业发放巨额补助。《2022年削减通胀法案》（IRA）这一庞大的清洁能源一揽子措施为那些使用美国产电池（且

原材料须由本国或盟友供应)的美国产电动车的销售提供补贴。

汽车制造商也在相应地砸下大笔资金：据路透社报道到2030年将达到1.2万亿美元左右。美国的通用汽车公司表示它将在2035年全面电动化。福特希望其欧洲业务到2030年全电动化。斯特兰蒂斯集团(Stellantis，在2021年由菲亚特克莱斯勒与持有雪铁龙和标致PSA集团合并而来，其最大股东Exor部分持有《经济学人》母公司)计划到2030年，其欧洲所有的新车以及美洲产量的一半都将是电动车。大众汽车表示，到2033年，其旗下同名品牌在欧洲将只生产电动车，而高端品牌奥迪将于同年在全球实现全电动化。

购买电动汽车的最大“劝退”因素——价格和续航——正在慢慢被克服。锂和镍等原材料供应瓶颈收紧导致电池价格在2022年略有上涨，而电池价格仍占一辆新电动汽车成本的40%到50%左右。但自2008年以来，规模和新技术已经将价格压低了90%之多。更好的电池意味着更长的续航里程，这在一定程度上缓解了人们对公共充电基础设施铺开速度缓慢的担忧。丰厚的补贴和不断增加的新车型，意味着人们不再只有特斯拉和少数不吸引人的“合规”汽车可选。拥有一辆电动汽车的总成本——包括运行成本、维修和耗电在内——已经和某些内燃机汽车大致相当。到本个十年末，大多数电动车的标价将与内燃机汽车持平——而它们的运行成本更低。■



Electrification

The future lies with electric vehicles

The car industry is electrifying rapidly and irrevocably

CARL BENZ may have been the first person successfully to marry the horseless carriage with the ICE. But early dalliances with batteries predate him. As early as the 1830s Robert Anderson, a Scot, developed a rudimentary EV, but it was not a success. Even after the car industry really took off in the 1890s, as French and American firms joined the fray, electric power was still in the ascendancy. In America in 1900, almost twice as many electric-as petrol-driven vehicles were on the road. Then the Ford Model T, cheaply made by mass production, a growing oil industry and a wider availability of petrol sealed the fate of battery power.

Despite half-hearted resurrections such as the EV1 from General Motors in 1996, it was not until Tesla's arrival in 2003 that the battery-electric revolution began in earnest. This, in turn, hastened efforts to decarbonise road transport, propelling EVs and PHEVs from 0.2% of new-car sales a decade ago to 13% in 2022. The surge is set to continue. By 2025 EVs will account for nearly a quarter of sales, says Bloomberg NEF, a data firm, and closer to 40% in Europe and China. Even conservative estimates reckon that by 2040 around three-quarters of new-car sales worldwide will be fully electric, as better batteries make even PHEVs redundant.

Tough emissions regulations have done much to promote EVs. A draft law approved by the European Union in February may mean a total ban on new ICE cars by 2035 (though Germany has won an exception for cars using carbon-neutral synthetic fuels). Governments and cities are cracking down on carbon and other emissions that affect local air quality. China is demanding that 20% of cars must be NEVs by 2025, with a full switch away

from cars with only an ICE by 2035. Even in America, the land of the petrolhead, Joe Biden unveiled on April 12th proposals for strict limits on vehicle emissions, the toughest of which would require around two-thirds of car sales to be battery-powered by 2032. The president is backing this up with huge handouts to domestic EV industries. The 2022 Inflation Reduction Act, a vast clean-energy package, subsidises sales of America-made EVs with domestic-made batteries from raw materials supplied at home or from allies.

Carmakers are duly investing vast sums: around \$1.2trn by 2030, according to Reuters, a news agency. America's GM says it will go all-electric by 2035 and Ford wants its European arm to do the same by 2030. The goal of Stellantis (whose largest shareholder, Exor, part-owns The Economist's parent company), formed by a merger in 2021 of Fiat Chrysler and PSA Group, owner of Citroën and Peugeot, is for all new cars in Europe and half its American output to be EVs by 2030. Volkswagen says its namesake brand will be EV-only by 2033 in Europe and that Audi, an upmarket sibling, will go fully electric worldwide by the same year.

The biggest deterrents to buying an electric car—price and range—are slowly being overcome. Tightening bottlenecks for raw materials, such as lithium and nickel, caused battery prices, which are still around 40-50% of the cost of a new EV, to rise slightly in 2022. But scale and new tech have pushed prices down by as much as 90% since 2008. Better batteries mean longer ranges, partly alleviating concerns about a slow rollout of public charging infrastructure. Generous subsidies and an ever-increasing choice of new models mean that Tesla and a handful of unattractive “compliance” cars are no longer the only choices. The total cost of owning an EV, including running costs, repairs and fuel, is already roughly equivalent to some ICE cars. By the end of this decade the sticker price of most EVs will be equal to that of ICE cars—and they will be cheaper to run. ■



【首文】来自中国的滚滚车轮

为什么世界应该欢迎来自中国车企的竞争

去全球化对驾车者和地球都没好处

如果还需要新证据来证明中国对全球汽车产业的重要性，在4月18日开幕的上海车展上就能找到。世界上其他大型车展都已被永久取消或降级，中国的车展却吸引了来自许多国家的1000家参展商，展出了100款新车型。

就在几年前，中国汽车还是设计蹩脚、做工粗糙。如今，它们在设计和制造工艺上都已基本上与外国车不相上下，在由软件驱动的数字体验方面更已赶超，而这一方面将定义未来的汽车品牌。不过对于全世界而言，中国汽车的崛起甚至还更为重要。要遏制全球变暖，至关重要的一歩是用更清洁的电池动力车取代排放碳的汽油动力车。而中国既是全球最大的电动汽车市场，也是全球最大的电动汽车生产国。

在过去的一个世纪里，由内燃机驱动的汽车取得了巨大的成功，为大众带来了机动性，也为股东带来了丰厚的利润。一小批大型汽车制造商稳步推进它们的产品，并在全球范围内组织起越来越复杂的供应链。这使得车辆价格降低，也给乘车者带来了更高的舒适度和安全性。来自日本汽车制造商（在20世纪70年代闯入快车道）和韩国公司（在90年代进入）的竞争刺激了全球的创新。

如今，这个全球年收入接近3万亿美元的行业正经历着迄今最激烈的剧变。老牌车厂正忙不迭地转向电气化、改进软件，并为自动驾驶做准备。

这种颠覆在一定程度上源自特斯拉的成功——既是作为一家电动汽车制造商，也作为一家以技术为业务核心的公司。但这也是由于来自中国的竞争加剧造成的。在政府补贴的支持下，中国本土企业正从西方竞争对手那里赢得市场份额。最大的两家本土车厂比亚迪和长安目前的国内市场份额为18%，年销量在400万辆左右。在信息娱乐和智能手机无缝集成方面，中国汽车制造商的创新力尤其突出。与此同时，良好的开局和庞大的规模已

经帮助比亚迪成为低端电动汽车市场的领导者。总体而言，来自中国的竞争正把曾经领跑的日本公司抛在后头。

全世界的驾车者都将从更便宜、更环保的汽车中获益。但这场争夺市场主导地位的竞争是否还能继续下去？中国崛起为电动汽车超级大国之时，地缘政治气候正在恶化，保护主义在西方日益受青睐。

在美国，路上见不到几辆中国车，它们被征收的关税已经高到吓人。此外，总统拜登的《通货膨胀削减法案》（IRA）使出了激励和补贴措施，试图将北美变成电动汽车重镇，鼓励当地人购买本国生产的汽车和零部件。人们还担心塞满传感器的中国汽车可能会收集大量敏感数据。（中国已经禁止特斯拉汽车进入军事基地以及举行党的会议的城市，大概是出于同样的担忧。）

在欧洲，中国汽车制造商正在站稳脚跟，并计划大举推进。一些欧洲公司正在呼吁提高关税。政客们希望能推出类似美国通胀法案的举措来保护欧洲的汽车工业以及其他种类的制造业。

隐私和国家安全这两方面的风险都是警惕汽车制造商滥用数据的正当理由。然而，它们也有可能充当粗暴的保护主义的借口。这么做可能会保住一些国内就业机会，代价却是伤害更为广大的驾车者。来自中国汽车制造商的激烈竞争将迫使本土企业更加努力地创新。这应该会使电动汽车变得更便宜，从而帮助地球，而更大的好处是造福驾驶者。

中国公司正在竞相改进自动驾驶汽车，并通过软件增强的大屏幕、情绪照明和其他玩意儿让驾驶体验更愉快。在过去，试图把日本车和韩国车拒之门外是愚蠢之举，现在给中国车设置路障也一样。 ■



Great wheels from China

Why the world should welcome competition from Chinese carmakers

Deglobalisation would be bad for drivers and the planet

IF FRESH EVIDENCE were needed of the importance of China to the global car industry, the Shanghai motor show, which opened on April 18th, provides it. The world's other big jamborees have been permanently cancelled or downgraded, but China's showcase has attracted 1,000 exhibitors from many countries with 100 new models on show.

Only a few years ago Chinese cars were poorly designed and shoddily put together. Today they are mostly as good as foreign ones in both respects, and surpass them in the software-driven digital experience that will define car brands in the future. Yet for the world as a whole, the rise of Chinese cars will be more significant still. To curb global warming, it is essential to replace carbon-spewing petrol-powered vehicles with cleaner battery-powered ones. And China is both the world's biggest market for, and maker of, electric vehicles (EVs).

Vehicles powered by internal combustion have been a great success story over the past century, bringing mobility to the masses and fat profits to shareholders. A handful of giant carmakers have made steady improvements to their products and assembled ever more complex supply chains spread across the globe. This has brought greater comfort and safety to passengers, as well as low prices. Competition from Japanese carmakers (which roared into the fast lane in the 1970s) and South Korean firms (which did so in the 1990s) spurred innovation worldwide.

Today the industry, with nearly \$3trn in annual global revenues, is experiencing its most radical upheaval yet. Established carmakers are

scrambling to electrify, improve their software and prepare for autonomous driving.

The disruption is in part a result of Tesla's success, both as a maker of EVs and as a firm that puts technology at the heart of its business. But it is also caused by greater competition in China, where local firms, supported by state subsidies, are winning market share from Western rivals. BYD and Changan, the country's two biggest homegrown firms, now have a domestic market share of 18%, and sell around 4m cars a year. China's carmakers are especially innovative when it comes to infotainment and the seamless integration of smartphones. A healthy head start and huge scale, meanwhile, have helped BYD become a leader in EVs at the cheap end of the market. All told, the competition is leaving Japanese firms, once leaders, in the dust.

The world's drivers stand to gain from cheaper and greener cars. But can the race for market dominance continue? China's emergence as an EV superpower is taking place just as the geopolitical climate worsens, and protectionism is finding greater favour in the West.

In America, where few Chinese cars roam the roads, tariffs on them are already forbidding. In addition, President Joe Biden's Inflation Reduction Act (IRA) uses incentives and subsidies to try to turn North America into an EV powerhouse, encouraging locals to buy domestically made cars and components. Fears also swirl that sensor-packed Chinese cars might guzzle sensitive data. (China has barred Tesla cars from military bases and cities holding party meetings, presumably out of the same concerns.)

In Europe, where Chinese carmakers are gaining a foothold and planning a big push, some domestic firms are calling for higher tariffs. Politicians want an IRA-like effort to protect the continent's car industry, along with other sorts of manufacturing.

Risks to privacy and national security both warrant vigilance against the misuse of data by carmakers. There is a risk, however, that these also become excuses for crude protectionism. That may preserve some domestic jobs, but only by harming a much larger number of drivers. A sharp jolt of competition from Chinese carmakers would force domestic firms to innovate harder. That should make EVs cheaper, helping the planet, and better, benefiting motorists.

Chinese firms are racing to improve autonomous cars, and to make riding more pleasurable with software-enhanced big screens, mood lighting and other goodies. Just as it was foolish to try to keep out Japanese and South Korean cars, it would be foolish now to erect road blocks against Chinese ones. ■



主权迷雾基金

欢迎来到石油美元权力新时代

数千亿石油财富都花在了哪里?【深度】

欧洲各地的金融区突然冒出一群求贤若渴的猎头。上午十点左右的工歇时间里，他们一边喝着咖啡，一边向一流投资基金公司的员工推荐免税的工作、黄金签证和美好的前景。这些职位就来自这些公司的客户：海湾的主权财富基金。

过去要说服人们去多哈工作十年可不容易，但现在这些职位给出的报酬非常丰厚，许多挖角目标还会自告奋勇前往沙漠“出差”探探那里的总部。去年10月，猎头们挖走了欧洲最大的资产管理公司东方汇理（Amundi）的二把手，让他到管理着一万多亿美元资产的阿布扎比投资局（以下简称ADIA）部署人工智能。现在，猎头们正在为卡塔尔投资局（QIA）搜罗基础设施投资主管，为沙特的公共投资基金（以下简称PIF）物色财务监管。这两只基金管理的资金加起来又是一万多亿美元。

战争和制裁推高了碳氢化合物的价格，让燃料出口商赚得盆满钵满。在之前的石油繁荣期，他们会把收益再次投资到西方的资本市场，通过离岸银行抢购一些中规中矩、流动性非常强的资产。这种做法是基于一个心照不宣的协议：美国会向沙特和其他友好国家提供军事援助并购买石油，而作为交换，这些国家会用石油美元填补山姆大叔经常账户的巨额赤字。蜂拥而至的猎头表明，这项协议正在瓦解。现在已成为主要石油出口国的美国已经不是那么上心的生意伙伴。海湾国家受到亚洲的诱惑，并且渴望修复与以色列的关系，近期还想修复与伊朗的关系，不再觉得自己非得讨好白宫。4月2日，沙特及其盟友进一步将原油日产量削减至近400万桶（相当于全球产量的4%），这一助力推高油价的举动激怒了美国。同时，它们也认为自己可以更加随心所欲地使用手中堆积如山的现金。

据本刊估计，在2022至2023年，海湾石油国家的经常账户盈余可能达到近

7000亿美元。然而在这一地区，除了并没有掌握太多这部分财富的各国央行，财富宝库的不透明人尽皆知。为了弄清这些资金的去向，本刊仔细检查了政府账目、全球资产市场以及负责投资这些财富的公司的交易室。我们的调查显示，回流西方的资金开始变少。越来越多的资金被用于推进国内的政治目标以及在国外赢得影响力，使得全球金融体系变得更不透明。

大发横财的不仅仅是海湾国家。去年，由于俄罗斯削减供应，挪威加大了对欧洲的天然气出口，从碳氢化合物销售中获得了创纪录的1610亿美元税收，较2021年激增150%。即便是受到制裁的俄罗斯，这类收入也增长了19%，达到2100亿美元。但赚得最盆满钵满的还是海湾国家，因为它们生产成本低、有闲置产能和地理便利。咨询公司睿咨得能源（Rystad Energy）估计，2022年，它们从碳氢化合物出口中获得了6000亿美元的税收。

并不是所有海湾国家都能真正受益。巴林和伊拉克的政府过于臃肿，虽然有更多的进账，也不过勉强实现收支平衡。这些财富大部分进了科威特、卡塔尔、阿联酋和沙特这四个海湾合作委员会（GCC）最大成员国的腰包。数据公司Exante的亚历克斯·埃特拉（Alex Etra）估计，2022年它们的经常账户盈余合计为3500亿美元。自作为全球基准的布伦特原油价格在去年达到每桶100美元的均价以来，油价已经下跌。但埃特拉认为，即使保守地假设油价保持在85美元附近，这四大巨头在2023年仍有可能赚取3000亿美元的盈余。这将让它们在这两年里的累计盈余达到6500亿美元。

过去，这些盈余中的大部分会直接进入各央行的外汇储备。因为海合会的大多数成员国都将本国货币与美元挂钩，因此它们必须在石油繁荣时期储备或投资硬通货。然而这一次，央行的外汇储备看上去几乎没有增长。对外汇市场的干预也很少，进一步印证通常是国家财富守卫者的央行并没有得到这些盈余。

那么，这些难以追踪的钱到底去哪里了？我们的研究发现，包括国家政府、央行和主权财富基金的各类主体把它们用在了三个全新用途：偿还外

债、借给友好国家，以及收购外国资产。

先来看债务。2014年至2016年美国页岩油产量激增，加剧了石油过剩，导致了现代史上油价的最大跌幅——从每桶120美元跌至30美元。2020年，因新冠疫情引发的封控措施抑制了需求，油价再次下跌，4月一度跌至18美元。为了抵御盈余冲击，海湾国家变卖了部分外国资产，其央行出售了部分外汇储备。但这还不够，所以它们还从西方资本市场上借入了大量硬通货。

现在一些石油国家正利用走高的油价来支撑它们的资产负债表。自2021年底以来，阿联酋最富有的阿布扎比酋长国已经偿还了30亿美元——约占未偿债务总额的7%，评级机构穆迪的亚历山大·佩杰西（Alexander Perjessy）称。卡塔尔的负债减少了40亿美元，约为总额的4%。科威特自2020年以来减少了一半的负债。这种广泛的去杠杆化是个新现象——在本世纪头十年末也就是上一次石油繁荣开始时，海合会国家几乎没有债务。

海湾国家也在向有困难的朋友伸出援手——这是石油新收入的第二种用途。2022年初，高企的粮价让粮食进口大国埃及财政紧张，埃及央行获卡塔尔、沙特和阿联酋存入130亿美元。近年来，沙特还允许巴基斯坦对数十亿美元的石油采购延期付款。相较以往，这些资金附加了更多条件。由于实在不希望自己借出去的钱全部打水漂，沙特最近要求埃及和巴基斯坦须实施经济改革才能获得它更多帮助。在海湾国家的援助中，也有一些是换取了陷入困境的国家正在出售的国有资产的股份。

在这方面真正不寻常的是土耳其。过去，土耳其遇到财政困难时常常会向国际货币基金组织或欧洲的银行寻求应急资金注入。现如今，土耳其因通胀加剧和地震而濒临崩溃之时，向它注入资金的却是海湾国家。援助形式多种多样。3月6日，沙特表示将在土耳其央行存入50亿美元。据智库美国外交关系协会（Council on Foreign Relations）的布拉德·塞策（Brad Setser）估计，卡塔尔和阿联酋也与土耳其央行达成了190亿美元的货币互换协议。这三个国家都承诺参与土耳其即将举行的政府债券拍卖。

卡塔尔是土耳其的长期盟友。沙特和阿联酋直到最近还与土耳其关系冷淡，现在也开始竞相加强对该国的影响力。三个国家都觉得这是一个向土耳其总统埃尔多安施加影响的机会，埃尔多安在5月面临一场艰难的选举。土耳其的情况开创了一个先例。随着越来越多的邻国面对财政吃紧，双边授信将成为海合会的核心政策，国际货币基金组织前官员道格拉斯·雷迪克（Douglas Rediker）预计。

尽管这些对外贷款具有重要的地缘政治意义，但它们只占海湾国家巨额石油财富的很小一部分。资金外流还有一个主要渠道：外国投资。

在过去的石油繁荣期，大部分的收益再投资都来自俄罗斯和沙特这两个世界最大产油国的央行，也就是说它们购买的资产都被算作外汇储备。这些国家想要的不过是稳定的收益和别出意外。很多时候，它们把资金存放在西方的银行，或者购买超级安全的政府债券——它们的购买量如此之大，以至于人们认为是海湾国家（加上中国）的大胃口帮助营造了宽松的货币环境，助长了本世纪头十年的次贷泡沫。只有当时被称为“中东牛仔”的卡塔尔有更大胆的动作——在这儿买一家足球俱乐部，在那儿买一栋摩天大楼。

如今，俄罗斯央行的外汇储备被冻结。而自2015年穆罕默德·本·萨勒曼成为沙特的实际统治者以来，沙特央行收到的资金远远少于由他担任主席的PIF。仅仅几年时间，PIF及海湾地区同类基金的规模都得以扩大。如果碳氢化合物的价格居高不下而更多石油财富流入其中，它们的规模可能还会大大扩张。一切都表明，如今它们再投资的方式非常不同。这些方式更具冒险精神和政治考量，且不那么以西方为中心。

要弄清楚海湾国家的主权财富基金一直在做什么，要比弄清楚其他国家（如挪威）的主权财富基金的动向困难得多。海湾国家的主权财富基金并不像挪威那样，在网站上实时更新自己的战略、规模和持股情况。但也还是有迹可循的。从央行组织国际清算银行的数据来看，最开始它们大部分的现金都存放在外国银行账户中。以沙特为例，据咨询公司凯投宏观（Capital Economics）估计，2022年1月至9月此类存款价值810亿美元，

相当于这一时期经常账户盈余的54%。

或许主权财富基金一直在等待利率见顶，然后再大举投资债券。它们更有可能是在寻找那些不那么传统的资产，而这些资产需要花时间来挑选。追踪资本流入美国证券情况的国际资本流动报告（Treasury International Capital）系统的数据显示，石油出口国购买的美国国债比之前预期的要少。但它们购买股票的愿望更迫切了——而且这些数据低估了它们的胃口，因为海湾国家的主权财富基金经常通过欧洲的资产管理公司来购买美国股票。来自这类公司的一名高管说，他的一些海湾国家客户最近几个月购买了大量美国股票。

主权财富基金主要通过低成本、多元化的指数型基金来投资股票。但它们也喜欢风险更高的投资。据数据公司Global SWF称，如今，私募股权、房地产、基础设施和对冲基金等“另类资产”占到海湾国家最大的三家主权财富基金总资产的23%至37%。随着可投资资金的增加，这类资产所占的份额也明显上升。

虽然这类投资大多是通过基金进行的，但私募市场交易或收购上市公司股份等“直接”投资正在飞速增长，瑞银（UBS）的马克斯·卡斯泰利（Max Castelli）表示。2022年1月至9月，仅PIF一家的直接投资就达到180亿美元，更传统的“组合”投资则有480亿美元。主权财富基金也开始为大型收购项目提供借款，包括通过收购集团来做这件事。4月4日，PIF透露它已经收购了几十家私募股权公司的股份。

主权财富基金之所以能做到这一切，是因为它们现在具备管理投资的能力。“除非我们有什么不同寻常的东西，否则不可以向它们推介任何东西。”欧洲的一位资产经理表示。自2021年以来，ADIA已将员工人数从1700人削减至1300人，但同时又招募了一些新员工，包括由一位常春藤盟校教授共同领导的一群数学天才。目前这一轮招聘攻势表明，基金将变得更加独立，只留给投资公司提供某些特定的服务和市场情报的空间。

自去年以来，主权财富基金一直在抛售欧洲的股票，这对美国有利。但当

地人注意到了投资东移的新趋势。海湾国家基金成立了专门的团队来调研中国、印度和东南亚。“这里是它们要卖出更多石油的地方，所以他们想注资将使用这些石油的行业。”一家大型投行机构的老板表示。而当其他投资者因为担心中美紧张关系升级而从中国撤出时，它们却在加倍下注。“我们的海湾国家客户看到了填补西方投资者留下的空白的巨大机遇。”一家私募市场巨头的老板说。

所有这些都表明，主权财富基金新策略的重中之重是推进海湾国家的战略目标。其一是投射软实力。2016年，PIF向庞大的科技投资工具——愿景基金（Vision Fund）注资450亿美元。受押注失误和市场冲击的影响，愿景基金陷入困境，PIF的投资可能也因此亏损了很大一部分。但这张巨额支票却极大地提升了沙特在全球投资者中的形象——不久前在利雅得开设了办事处的一个投资者表示。这些基金还拿出资金撒向周边国家，以增强自己在该地区的影响力。PIF在巴林、埃及、伊拉克、约旦、阿曼和苏丹设立了子公司，在这些阿拉伯国家配置了240亿美元资金。

更高的声望为投资“战略性”行业里的公司带来了新机会，可再生能源就是其一。去年10月，阿联酋主权财富基金之一的穆巴达拉投资公司（Mubadala）斥资25亿美元投资了一家德国的离岸风能开发商。QIA购买了德国公用事业公司德国莱茵集团（RWE）10%的股份，以帮助它收购一家美国太阳能企业。这些投资往往是为了再引进技术或资本。

去年，PIF持股约61%的美国电动汽车制造商Lucid宣布将在利雅得建立第一家海外工厂。PIF计划向博彩业投资380亿美元，试图在沙特引进娱乐业。并非所有这类押注都会成功。当瑞信（Credit Suisse）被瑞银收购时，PIF旗下的沙特国家银行（Saudi National Bank）损失了其在瑞信80%的投资，这削弱了沙特掌控一家全球性银行的雄心。一些主权财富基金也要负起在国内投资的责任，以帮助减少本国经济对石油的依赖。PIF正在为未来派的沙特定居点提供资金，其中包括这片沙漠里的一座新城Neom——沙特统治者梦想有一天它能集海上漂浮工业综合体、全球贸易中心及豪华度假胜地于一体。

阿布扎比是主权财富基金战略演变的最佳例证。业内人士表示，阿联酋历史最长、做派最古板的基金ADIA从石油收入中分得的资金较过去有所下降。如今分得收入最多的是阿布扎比控股公司（ADQ），这是四年前成立的一个规模达1570亿美元的基金，在一些阿布扎比认为对其安全至关重要的行业里进行投资，比如买下许多能源、食品、运输和制药公司。其余的石油收入流向了穆巴达拉，它在2008年时资产规模还只有150亿美元，如今已经管理着近3000亿美元。其投资组合最初偏重大宗商品，现在更倾向于可再生能源和科技。该公司三分之二的资金投向私募市场；四分之一是国内投资。“它们的雄心没有止境。”一位交易人表示。

这些变化正在让统治家族的个人财富和政府金库之间的界限变得模糊。增长最快的基金往往由王室成员或其小集团成员运营。今年3月，阿联酋国家安全顾问谢赫·塔赫农·本·扎耶德（Sheikh Tahnoon bin Zayed）被任命为ADIA的主席（他已经是ADQ的主席；他的兄弟不久将掌管穆巴达拉）。更多的资金大多通过特殊目的实体（SPV）投向王族钟爱的项目。管理超级富豪私人财富的新型“家族办公室”也加入了这场交易盛宴。它们拥有“十位数”的可投资资金，通常会购买某一家公司五亿到十亿美元的股份，一位当地银行家表示。石油收入的去向越来越看不清了。

所有这些对西方来说都是坏消息。它分得的羹变少了还是个小问题。一个越发不透明的金融体系会让资金的流动更加隐蔽。金融观察人士认为，俄罗斯的部分石油收入就存放在海湾国家的银行，与其他客户的美元混合在一起，让它变得无法追踪。在地缘政治上变得更精明的石油国家也为像土耳其这样摇摆不定的国家创造从西方主导的机构之外获得融资的机会，让它们获得了额外的自由度。20年前，当主权财富基金刚兴起时，西方许多人担心它们可能会被用来谋求政治目标。在当时，这样的担忧言过其实。放到今天似乎更有道理了——但少有人关注它。 ■



Sovereign-stealth funds

Welcome to a new era of petrodollar power

What are the hundreds of billions of oil riches being spent on?

A PACK OF hungry headhunters has descended on Europe's financial quarters. Over coffee in the mid-morning lull, they tempt staffers at blue-chip investment funds with tax-free jobs, golden visas and gorgeous vistas at the firms' clients: sovereign-wealth funds in the Gulf.

A decade in Doha was once a hard sell, but the roles are juicy enough that many would-be recruits volunteer for desert-bound "business trips" to see headquarters. In October recruiters nabbed the second-in-command at Amundi, Europe's biggest money manager, to deploy artificial intelligence at the Abu Dhabi Investment Authority (ADIA), which oversees assets worth \$1trn. Now they are chasing others to invest in infrastructure for the Qatar Investment Authority (QIA) and oversee finance for Saudi Arabia's Public Investment Fund (PIF). Together these two funds manage another \$1trn.

War and sanctions have buoyed hydrocarbon prices, meaning fuel exporters are swimming in money. During previous booms they would recycle the proceeds in Western capital markets, snapping up pedestrian, uber-liquid assets via banks based offshore. Underpinning this was an unspoken agreement: America would offer military aid and buy oil from Saudi Arabia and friends, in exchange for which they would plug Uncle Sam's gaping current-account deficit with petrodollars. The talent-hunting party suggests the deal is crumbling. Uncle Sam, now a major oil exporter, is a less watchful partner. Gulf states, lured by Asia and eager to mend ties with Israel and, lately, Iran, no longer feel compelled to woo the White House. On April 2nd Saudi Arabia and its allies angered America by deepening crude-output cuts to nearly 4m barrels a day, equivalent to 4% of global production,

which helped lift prices. They also feel freer to use their mountains of cash however they wish.

We estimate that in 2022-23 the current-account surplus of the Gulf's petrostates may hit two-thirds of a trillion dollars. Yet outside central banks, which no longer collect much of the bounty, the region's treasure troves are notoriously opaque. To map where the money is going, The Economist has scrutinised government accounts, global asset markets and the deal rooms of companies tasked with investing the windfall. Our investigation suggests that less of the money is returning to the West. Instead, a growing share is being used to advance political aims at home and gain influence abroad, making global finance a murkier system.

The Gulf is not alone in enjoying a windfall. Last year Norway, which cranked up gas exports to Europe as Russia cut supplies, earned a record \$161bn in tax from hydrocarbon sales, a 150% jump from 2021. Even Russia, under sanctions, saw such revenue rise by 19%, to \$210bn. But it is the Gulf states, which benefit from low production costs, spare capacity and convenient geography, that are hitting the jackpot. Rystad Energy, a consultancy, reckons they pocketed \$60bn in tax from hydrocarbon exports in 2022.

Not all of them are in a position to truly benefit. Governments in Bahrain and Iraq are so bloated that even as higher revenues flow in, they barely break even. Most of the bounty is instead being accrued by the four biggest members of the Gulf Co-operation Council (GCC): Kuwait, Qatar, the UAE and Saudi Arabia. Alex Etra of Exante, a data firm, estimates their combined current-account surplus in 2022 was \$350bn. Oil prices have fallen since last year, when Brent crude, the global benchmark, averaged \$100 a barrel. Yet assuming it stays near \$85—a conservative bet—Mr Etra reckons the four giants could still pocket a \$300bn surplus in 2023. That makes a cumulative \$650bn over the two years.

In the past the majority of this would have gone straight into central banks' foreign-exchange reserves. Most members of the GCC peg their currencies to the dollar, so they must set aside or invest hard currency during booms. This time, however, central-bank reserves seem to be hardly growing. Interventions on foreign-currency markets have also been rare, confirming that the usual guardians of state riches are not getting the surplus.

So where have the elusive billions gone? Our research finds they have been used in three novel ways by a variety of actors that include national governments, central banks and sovereign-wealth funds. These are to pay back external debt, lend to friends and acquire foreign assets.

Start with debt. Between 2014 and 2016 a petroleum glut fuelled by America's shale boom caused the oil price to fall from \$120 a barrel to \$30, the steepest decline in modern history. In 2020, as covid-19 lockdowns depressed demand, prices cratered again, to \$18 in April. To withstand the earnings shock, Gulf states liquidated some foreign assets and their central banks sold part of their foreign-currency stash. But this was not enough, so they also borrowed a lot of hard currency on Western capital markets.

Now some petrostates are taking advantage of higher prices to shore up their balance-sheets. Abu Dhabi, the UAE's richest emirate, has repaid \$3bn since the end of 2021—about 7% of the total outstanding, according to Alexander Perjessy of Moody's, a ratings agency. Qatar's load has shrunk by \$4bn, or about 4%. Kuwait's has halved since 2020. This broad deleveraging is a new phenomenon: GCC countries had little debt in the late 2000s, when the previous oil boom got going.

Gulf states are also lending a hand to friends in need—the second use of the new oil money. In early 2022 the central bank of Egypt, a big food importer squeezed by high grain prices, received \$13bn in deposits from Qatar, Saudi Arabia and the UAE. In recent years, Saudi Arabia has also allowed Pakistan

to defer payment for billions of dollars in oil purchases. This money is more conditional than in the past. Eager to see at least some of its cash return, Saudi Arabia recently demanded Egypt and Pakistan implement economic reforms before giving them more help. Some of the Gulf support also comes in exchange for stakes in state-owned assets these embattled countries are putting up for sale.

The real novelty in this regard is Turkey. When squeezed, Ankara used to turn to the IMF, or European banks, for emergency-cash injections. Recently, as surging inflation and earthquakes have pushed the country to the brink, it is Gulf states that have been holding the syringe. The support takes various forms. On March 6th Saudi Arabia said it would deposit \$5bn at the country's central bank. Qatar and the UAE have also set up \$19bn in currency swaps with the institution, according to an estimate by Brad Setser of the Council on Foreign Relations, a think-tank. All three have pledged to participate in Turkey's forthcoming auctions of government bonds.

Qatar is a long-standing ally of Turkey. Saudi Arabia and the UAE, which until recently had a frosty relationship with the republic, are now competing for influence. All sense an opportunity to gain sway over Recep Tayyip Erdogan, the country's president, who faces a tough election in May. The Turkish case sets a precedent. As more neighbours face crunches, bilateral credit will become core to GCC statecraft, predicts Douglas Rediker, a former IMF official.

Yet for all their geopolitical significance, such loans account for only a fraction of the oil jackpot. That leaves the main escape channel: foreign investments.

In past booms the central banks of the world's two largest petrostates—Russia and Saudi Arabia—did much of the recycling, meaning that the assets they purchased were labelled as reserves. All these countries

wanted was stable yields and few surprises. Most often they parked the cash at Western banks or bought super-safe government bonds—so many that Gulf appetite, along with China's, is credited for helping to create the loose monetary conditions that fed the 2000s sub-prime bubble. Only Qatar, known then as the “cowboy of the Middle East”, did anything more daring: buying a football club here, a glitzy skyscraper there.

Today the Russian central bank's reserves are frozen. And since 2015, when Muhammad Bin Salman (MBS) became de facto ruler, the Saudi central bank has received far less money than PIF, which MBS chairs. In just a few years PIF and its peers across the region have swelled in size. If hydrocarbons stay expensive, and more of the bounty flows to them, they could grow much bigger still. Everything indicates that their way of recycling riches is very different. It is more adventurous and political, and less Western-centric.

Figuring out what Gulf sovereign-wealth funds have been up to is much more difficult than it would be for, say, Norway's fund. The Gulf institutions do not update their strategy, size and holdings live on their websites, as the one in Oslo does. But there are clues. Data from the Bank for International Settlements, a club of central banks, suggests that, initially, most of the cash was parked in foreign bank accounts. In the Saudi case, such deposits were worth \$81bn in the year to September, equivalent to 54% of the current-account surplus over the period, calculates Capital Economics, a consultancy.

Perhaps sovereign-wealth funds have been waiting for interest rates to peak before piling into bonds. More likely they are after less conventional assets, which take time to select. Data from the Treasury International Capital system, which tracks flows into American securities, suggest oil exporters have been buying fewer Treasury bonds than would previously have been expected. But they have been hungrier for stocks—and such numbers underestimate their appetite, because Gulf sovereign-wealth funds often buy

American shares through European asset managers. An executive at one such firm says his Gulf clients have topped up their American-stock accounts copiously in recent months.

Sovereign-wealth funds largely invest in stocks via index funds, which are low cost and offer diversification. But they also like riskier bets. Today “alternative assets”—private equity, property, infrastructure and hedge funds—represent 23-37% of total assets for the three largest funds in the Gulf, according to Global SWF, a data firm. These shares have jumped at the same time as war chests have grown.

Although such investments are often done through funds, “direct” investments—private-market deals, or acquisitions of stakes in listed companies—are growing very fast, says Max Castelli of UBS, a bank. PIF’s alone reached \$18bn in the year to September, against \$48bn for more classic “portfolio” investments. Sovereign-wealth funds have also begun to provide debt to finance large takeovers, including by buy-out groups. On April 4th PIF disclosed that it had acquired dozens of stakes in private-equity firms themselves.

Sovereign-wealth funds can do all this because they now have the ability to manage investments. “Unless we have something extraordinary, we are forbidden from pitching anything to them,” says a European asset manager. ADIA has cut its workforce from 1,700 to 1,300 since 2021, but new recruits include a group of maths whizzes co-led by an Ivy League professor. The current hiring offensive suggests funds will grow more independent, retaining investment firms only for specific services and market intelligence.

Since last year sovereign-wealth funds have been dumping European stocks, to the benefit of America. But locals notice a newer eastward tilt. Gulf funds have created specialist teams to survey China, India and South-East Asia.

“This is where they’re going to sell more oil, so they want to invest in industries that will use that oil,” says the boss of a large investment-banking franchise. And at a time when others are walking back from China, nervous of rising tensions with America, they are doubling down. “Our Gulf clients see an enormous opportunity to take space away from Western investors,” says the boss of a private-markets giant.

All of which points to an important plank in the sovereign-wealth funds’ new approach: advancing Gulf states’ strategic goals. One such objective has been to project soft power. PIF may have lost a big chunk of the \$45bn it invested in 2016 in the Vision Fund, a gigantic vehicle for tech investments that has been rocked by bad bets and market shocks. But the mammoth cheque did a great deal to raise Saudi Arabia’s profile among global investors, says one who recently opened an office in Riyadh. Funds are also setting aside capital to shower on neighbours, boosting their regional sway. PIF has set up subsidiaries in Bahrain, Egypt, Iraq, Jordan, Oman and Sudan to deploy \$24bn in the Arab countries.

Greater standing opens up fresh opportunities to invest in firms in “strategic” industries, including renewable energy. In October Mubadala, an Emirati sovereign-wealth fund, splashed \$2.5bn on a German offshore-wind developer. QIA bought 10% of RWE, a German utility, to help it acquire a solar business in America. These investments are often made with a view to reimporting knowledge or capital.

Last year Lucid, an American electric-car maker, some 61% of which is owned by PIF, said it would build its first overseas factory in Riyadh. The fund plans to splash \$38bn on gaming to try to bring entertainment to Saudi Arabia. Not all such bets turn out well. Saudi National Bank, owned by PIF, lost 80% of its investment in Credit Suisse when the firm was acquired by UBS, undermining the Kingdom’s ambition to steer a global banker. Some sovereign-wealth funds are also being leant on to invest at home, so as to

help economies cut their reliance on oil. PIF is bankrolling futuristic Saudi settlements, including Neom, a new city in the desert, which the Kingdom's rulers dream will one day be home to a floating industrial complex, global trade hub and luxury holiday resorts.

The best illustration of the sovereign-wealth funds' evolving strategy is Abu Dhabi. Insiders say that ADIA, the UAE's oldest and starchiest fund, is getting less of the oil windfall than it used to enjoy. Instead, the lion's share is going to ADQ, a four-year-old \$157bn fund which snaps up firms in energy, food, transport and pharma—industries the emirate deems core to its security. Other cash is going to Mubadala, which had just \$15bn in assets in 2008 but now oversees nearly \$300bn. Originally heavy on commodities, its portfolio favours renewables and tech. Two-thirds of its investments are in private markets; a quarter are domestic. "There is no limit to their ambition," says a dealmaker.

These shifts are blurring the line between ruling families' personal wealth and that of the sovereign. The fastest-growing funds tend to be run by royals, or members of their clan. In March Sheikh Tahnoon bin Zayed, the UAE's national-security adviser, was made chairman of ADIA (he already chairs ADQ; his brother will soon run Mubadala). More money is going on pet projects, often through special-purpose vehicles. New "family offices", which manage the private wealth of the mega-minted, have joined the deal-fest. Armed with war chests "in the ten digits", they routinely buy \$500m-1bn stakes in single firms, says a local banker. It is becoming ever harder to see where oil money goes.

All this is bad news for the West. That it gets less of the bounty is the smaller problem. A murkier financial system makes it easier for funds to move around unnoticed. Financial sleuths reckon that a share of Russia's oil earnings is deposited into banks in the Gulf, where it is mixed with dollars owned by others so as to become untraceable. More geopolitically

astute petrostates also create the chance for wavering countries, like Turkey, to get financing outside of Western-led institutions, giving them an extra degree of freedom. Two decades ago, when sovereign-wealth funds became fashionable, many in the West worried they might be used to pursue political agendas. At the time, such fears were overblown. They now seem more reasonable—but few are paying attention. ■



食物和气候变化

换一种方法衡量食物对气候的影响

《经济学人》的香蕉指数登场

吃多汁的牛排比吃煎豆腐对环境的危害更大，这应该没什么稀奇。吃素能大大减少你饮食中的碳足迹。但是，大多数植物性食物的卡路里和蛋白质含量比肉类要低，这又怎么说？这让人很难比较营养价值相同的不同食物的排放情况。

为了让食物的相对碳影响更易理解，本刊提出了一个香蕉指数（见下方图表）。它用三个指标——重量、卡路里和蛋白质——将常见的食物与不起眼的香蕉挂钩，香蕉对气候的影响和它的营养价值都较为适中。

将温室气体排放与单一食物挂钩可以让人们了解不同食物的排放等级。食肉族要遗憾了：无论你怎么切，牛肉都对环境无益。生产一公斤牛肉末产生的碳排放相当于生产109公斤香蕉（即“香蕉分”为109分）。调整为按营养价值计，牛肉的香蕉分降至54分（生产1卡路里牛肉末产生的碳排放量是生产1卡路里香蕉的54倍）。按蛋白质计算，牛肉末的香蕉分是7分。

家禽按重量计算时香蕉分为11分，按卡路里计为4分。不过，作为一种蛋白质来源，它比香蕉更环保：蛋白质含量相同时，家禽的排放仅为香蕉的五分之三。三文鱼也一样。不出所料，植物基肉类替代品还更环保，例如，一个纯素汉堡每克蛋白质的排放仅为香蕉的五分之一。（其他植物基食物，如葡萄、糖和椰奶，几乎不含蛋白质，因此香蕉分飙升。）

有些食物按某个指标计算比香蕉的排放更多，但按另一个指标算又比香蕉低得多。按重量和卡路里分别得出的排放差异最大的是橄榄油，按重量计算时它的香蕉分为6分，但按卡路里计算时为0.7分。其他的还包括早餐麦片、腰果和牛角面包——以卡路里来衡量，它们的香蕉分都会从差变好。

我们的香蕉指数依赖于某一种食物的平均排放。在现实世界里，有的生产

商比其他生产商更环保，有些食品要经过更远的路程才能到达消费者手中。但在大多数情况下，食物之间的差异远远大于它们本身的这些变量。尽管人们都在强调本地生产食品，其实运输对大多数食品总排放的影响还不到10%；就牛肉而言通常不到1%。我们的香蕉指数也没有考虑到对环境的其他影响，比如对土地和水的使用（尽管在这些方面，牛肉往往也表现不佳）。

益普索（Ipsos）为化肥公司雅苒（Yara）在欧洲进行的民意调查显示，大多数消费者希望对气候更加友好，而食品生产可能占全球排放的四分之一，因此吃东西时心怀气候应该会带来一些积极的变化。该调查显示，只有31%的受访者觉得挑选可持续食物是件容易的事。四分之三的受访者表示希望食品能贴上标签，列明它们的气候影响。研究发现，虽然没有被广泛使用，但标签会鼓励消费者选择低排放的产品。同时，我们的香蕉指数可能也有帮助。■



Food and climate change

A different way to measure the climate impact of food

Introducing The Economist's banana index

EATING A JUICY steak is worse for the environment than frying up some tofu: that much should come as no surprise. Going vegan can dramatically cut the carbon footprint of your diet. But what about the fewer calories, and lower levels of protein, found in most plant-based foods when compared with meat? That makes it hard to compare emissions of meals that are equally nutritious.

To make the relative carbon impact of foods easier to digest, The Economist proposes a banana index (see chart below). It compares popular foodstuffs on three metrics—weight, calories and protein—indexed to the humble banana, a fruit of middling climate impact and nutritional value.

Indexing greenhouse-gas emissions to a single food gives a sense of how different foodstuffs rank. Unfortunately for carnivores, beef is bad for the environment no matter how you slice it. Producing one kilogram of mince causes as many emissions as 109kg of bananas (call it a “banana score” of 109). Adjust for nutritional value, and beef’s banana score falls to 54 (one calorie of beef mince causes 54 times as much carbon emissions as one calorie of banana). By protein, it scores seven.

Poultry scores 11 bananas by weight and four by calorie. However, as a source of protein, it is more carbon-friendly than bananas: poultry protein emits just three-fifths of the same amount of banana protein. The same applies to salmon. Unsurprisingly, plant-based alternatives to meat do even better: a meat-free burger, for instance, scores just one-fifth of the emissions of bananas per gram of protein. (Other plant-based foods, such

as grapes, sugar and coconut milk, contain barely any protein which sends their banana scores soaring.)

Some foods that out-emit bananas on one metric put them to shame on another. The biggest variance between emissions by weight and calories is in olive oil, which has a banana score of six when measured by kilogram, but scores 0.7 when measured by calories. Others include breakfast cereals, cashew nuts and croissants—which all flip from bad scores to good when measuring by calorie.

Our banana index relies on average emissions for a given food. In the real world some producers are more climate-friendly than others, and some foods travel farther to consumers. But in most cases, differences between foods are much greater than these variables within them. For all the emphasis on locally produced food, transportation contributes less than 10% of most foods' total emissions; for beef it is usually less than 1%. Our banana index also does not capture other environmental impacts, such as land and water use (though here too, beef tends to fare poorly).

Polling in Europe by Ipsos for Yara, a fertiliser firm, suggests that most consumers want to be more climate-friendly—and with food production responsible for perhaps a quarter of global emissions, eating with the climate in mind would make a difference. The survey showed that just 31% of respondents found it easy to make sustainable choices. Three-quarters said they want labels that would explain the climate impact of their food. Studies have found that labels encourage consumers to choose lower-emission options, although they are not in widespread use. In the meantime, our banana index might help. ■



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巴菲特大摇日本魔力货币树

美日利差巨大带来机会

在沃伦·巴菲特宣布自己非常乐意增持日本五大贸易公司的股份之后，其中三家的股价在过去一周创下历史新高。这只是这些公司最新一轮好消息而已。2020年巴菲特90岁生日那天，他的投资公司伯克希尔·哈撒韦（Berkshire Hathaway）宣布首次购入伊藤忠商事、丸红商事、三井物产、三菱商事以及住友商事的股票，它们的市值开始一路飙升，股价上涨了64%到202%。

在某些方面，日本和巴菲特可谓天作之合。巴菲特以准确聚焦公司基本面闻名。即使是在近期美国股票遭遇抛售之后，东京股市总体上仍然便宜得多。其市盈率（基于明年的预期收益）约为13倍，而美国为18倍。伯克希尔·哈撒韦投资的这些贸易公司在日本被称为综合商社，它们给人的印象通常是古板守旧但安全可靠。这些公司的市盈率都在10倍以下，而派息稳定。

伯克希尔·哈撒韦在日本的交易也从其他方面带来启示。它说明了日本为什么也可能成为其他美国投资者眼中更诱人的目的地。4月14日，伯克希尔·哈撒韦发行了约12亿美元的日元计价债券。之前它在2019年至2022年间已经发行了78亿美元的日元债券。现在，不仅日本是伯克希尔·哈撒韦的第二大投资地，日元也成了它的第二大融资货币。即使在最近的这次债券发行之前，它已有近五分之一的债务是以日元计价的。

伯克希尔·哈撒韦并不是因为缺乏现金而发债。从这轮交易可以看出货币对冲的优势。借入日元来加仓日元资产让巴菲特可以免受日元贬值的影响。而由于美国和日本之间巨大的利率差，他可以利用年利率低于2%的长期贷款为自己的投资融资，同时继续把闲钱放在美国投资于收益率近5%的政府债券。巴菲特过去曾质疑过货币对冲的好处。如今它的吸引力

似乎不可抗拒。与借入美元相比，借入日元的成本非常低，哪怕对于那些对日本股市只有一时之兴的投资者来说，这轮交易不用想都知道是赚钱的事情。

当然，并非所有这样的投资者都能轻而易举地发行日元计价债券。但那些无法做到这点的投资者可能会利用货币政策的差异，采取更直接的货币对冲方法。远期和期货市场的价格是由两个经济体之间的利率差异决定的。在过去的18个月里，美国利率飙升而日本利率没有，意味着日本投资者正在支付大量溢价来购买美国资产并让自己免受汇率波动的影响。而反过来，当美国投资者购买日本资产时，他们会获得相当可观的溢价。

目前日元兑美元的汇率为134，但明年3月到期的货币期货让投资者有机会在127的价位卖出。这样一来，在不到一年的时间里就锁定了5%的回报率。唯一的代价是买方在此期间必须一直持有日元。对于想要持有日本股票的投资者来说，对冲的回报基本上就是额外收益。这个机会似乎不太可能消失。即使日本央行放弃其“收益率控制曲线”政策，也很少有分析师预计日本利率会大幅上升。

潜在的收益很丰厚。过去一年，MSCI美国指数的净回报率（包括资本收益和股息）为-5%。无对冲但以美元计算的MSCI日本指数回报率为1%。MSCI日本对冲指数同期上涨了12%，该指数是根据使用一个月滚动远期汇率的日本股票回报率得出的。

过去十年左右，可能只是因为美国股市令人羡慕的回报率，才没有更多投资者去享受这种日股红利。但如今大人物们开始纷纷飞往太平洋彼岸。维权投资机构埃利奥特管理公司（Elliott Management）通过入股并干预大日本印刷（Dai Nippon Printing）而获利。后者的股价今年飙升了46%。与此同时，据说美国对冲基金Citadel正准备在离开日本15年之后在东京重新开设办事处。日本市场先前经历了一段闷声产生稳定回报的时光，有了巴菲特和其他美国金融巨头打样儿，它可能会吸引来稍微多一点的注意。





Buttonwood

Warren Buffett is shaking Japan's magic money tree

Huge gaps between American and Japanese interest rates offer opportunities

SHARES IN THREE of Japan's five largest trading conglomerates reached record highs over the past week, following an announcement by Warren Buffett that he is keen to own more of their stock. It is just the latest good news for the firms. Itochu, Marubeni, Mitsui, Mitsubishi and Sumitomo Corporation have surged in value since Berkshire Hathaway, Mr Buffett's investment firm, announced its first purchases on his 90th birthday in 2020. Since then, their share prices have risen by between 64% and 202%.

In some ways Japan and Mr Buffett are a match made in heaven. Mr Buffett is famed for his unerring focus on business fundamentals. Even after a recent sell-off in American stocks the broad Tokyo market is still far cheaper. Its price-to-earnings ratio (based on expected earnings over the next year) is around 13, compared with 18 in America. The trading firms Berkshire Hathaway has invested in—known in Japan as sogo shosha—are often seen as stodgy and reliable. All have price-to-earnings ratios of below ten and pay healthy dividends.

Berkshire Hathaway's Japan trade is revealing in other ways, too. It illustrates why the country may become a more appetising destination for other American investors. On April 14th the investment firm issued around \$1.2bn in yen-denominated bonds, adding to the \$7.8bn it issued from 2019 to 2022. Not only is Japan now Berkshire Hathaway's second-largest investment location—the yen is also its second-largest funding currency. Even before the recent issuance, nearly a fifth of Berkshire Hathaway's debt was denominated in yen.

The company is not borrowing because it is short of cash. Rather, the trade reveals the advantages of currency hedging. Borrowing as well as buying in yen protects Mr Buffett from falls in the currency's value. And as a result of the gulf in interest rates between America and Japan, he can finance his investments using long-term loans charging less than 2% annually, while keeping his spare cash at home invested in government bonds earning almost 5%. Mr Buffett has questioned the merit of currency hedging in the past. Its appeal today seems to be irresistible. Borrowing in yen is so cheap relative to doing so in dollars that the trade is a no-brainer for investors with even a passing interest in Japanese stocks.

Of course, not every such investor can easily issue yen-denominated bonds. But those who cannot may exploit the monetary-policy gap with more straightforward currency hedges. Prices in forward and futures markets are determined by the difference in interest rates between the two economies in question. The surge in American but not Japanese interest rates over the past 18 months means that Japanese investors are paying an enormous premium to buy American assets and protect themselves from currency movements. American investors get a rather lovely premium when they do the same in the other direction.

The yen currently trades at 134 to the dollar, but currency-futures maturing in March next year give investors the opportunity to sell at 127 to the greenback. That locks in a 5% return over little less than a year. The only cost is that the buyer must hold yen for the whole period. For investors who want to own Japanese stocks, the return to hedging is essentially a bonus. The opportunity looks unlikely to disappear. Even if the Bank of Japan abandons its yield-curve-control policy, few analysts expect a big rise in Japanese rates.

The potential benefits are large. Over the past year, the MSCI USA index has provided net returns, including capital gains and dividends, of -5%.

The MSCI Japan index, unhedged but in dollar terms, provided a return of 1%. The MSCI Japan Hedged index, based on the returns of Japanese stocks employing one-month-rolling-currency forwards, is up by 12% over the same period.

It is probably only because of the enviable returns to American stocks over the past decade or so that more investors have not taken advantage of the Japanese bonus. But big names are beginning to jet to the other side of the Pacific. Elliott Management, an activist investor, has been rewarded for its intervention in Dai Nippon Printing. The company's shares have surged by 46% this year. Meanwhile, Citadel, an American hedge fund, is reportedly reopening an office in Tokyo, having stayed away for the past 15 years. After a period in which the Japanese market has quietly offered solid returns, the example of Mr Buffett and other giants of American finance might draw a little more attention. ■



熊彼特

三星应警惕英特尔那种自满

稳坐存储芯片市场的顶端太过安逸了

三星进军芯片业的背后有一个精彩故事。那是在1983年，当时该行业还被日本和美国的制造商主导。这家韩国财阀的创始人李秉喆宣布了新战略，浮夸地命名为《东京宣言》。他说，韩国虽缺乏石油等原材料，却拥有受过良好教育和工作勤奋的劳动力，有充分条件转向芯片制造。杰弗里·凯恩（Geoffrey Cain）在《三星崛起》（Samsung Rising）一书中描述道，不久之后，一些三星高管被要求连夜从首尔出发翻山越岭，以坚定其意志迎接挑战。他们到达了三星只用了创纪录的六个月时间就建成的第一家半导体工厂，并在早餐前立下军令状，保证取得成功。然后，他们顾不上睡觉，连续工作了16小时。

可以称之为真正的毅力，也可以称之为三星的军事化工作理念。无论如何，这家公司再竞争中异军突起，主导了全球存储芯片市场。30多年来，在用于计算机和服务器内存的DRAM领域，它一直是全球领导者，在用于手机的NAND闪存领域也保持了20多年的领先。然而，自2021年以来，存储芯片一直处于半导体行业一次繁荣-萧条周期的最前沿，这个周期始于供应短缺，继而引发资本支出激增，而现在已进入至少自2007至2009年全球金融危机以来最严重的萧条。三星电子（包括三星集团旗下的半导体、显示器和消费电子部门）眼下正承受冲击。4月7日，该公司预报一季度利润微薄，表示将削减内存芯片产量。此举是为了缓解市场的过度饱和。

长期以来，三星在内存芯片上的领先地位稳如泰山。行业预测机构Future Horizons的马尔科姆·佩恩（Malcolm Penn）表示，在每次市场低迷期它都能“坚持到最后”。三星去年的营收达到2400亿美元，这样的体量带来的规模经济让它能够比竞争对手承受更长时间的价格下行。它的智能手机业务虽然增速不如从前，但仍带来可靠的现金流，帮助它在芯片周期的低谷

继续投资。当其他公司挣扎之时，三星顺势夺走它们的市场份额。因此，其大型竞争对手已经从2000年代的十来家减少到如今的仅有两家——韩国的SK海力士（SK Hynix）和美国的美光（Micron）。三星占全球销量超过40%，遥遥领先。

在最近一轮周期中，三星一直拒绝减产。在陷入困境的SK海力士和美光表示将削减产量几个月后，三星才放弃抵抗。然而，宣布减产带来的影响令人意外。三星及两家竞争对手的股价大幅上涨。对股价反弹的一个简单解释是，每当市场领导者认输时，便是暴跌即将见底的信号。但还有一种更微妙的解读。在内存三巨头中，三星的地位可能过于安逸了，以至于它没有欲望从对手那里抢夺更多的份额。这或许会给市场带来稳定。但这也传递出一种安于现状的情绪，李秉喆泉下有知，定会脸色发白。

在去年11月对投资者的演示报告中，这种自满情绪已露出苗头。负责存储芯片销售的韩进万（Han Jin-man）承认，存储芯片有时被视为大宗商品，其价格会随着资本支出的起伏而波动。但他坚称，过去10年里资本支出已经基本稳定，DRAM三巨头都在理性投资，市场现在更加平衡。换句话说，三星似乎满足于跟随整个DRAM市场的增长而增长（它预计到2035年，DRAM市场的规模将增长两倍，达到近3000亿美元），而不是抢夺竞争对手的市场份额。

这种绝不像李秉喆作风的自我满足也表现在其他地方。咨询公司New Street Research的皮埃尔·费拉古（Pierre Ferragu）认为，三星已经丧失了在DRAM和NAND制造技术上领先于SK海力士和美光的一些创新优势。“当你不再为生存而奋斗时，就会变得自满。”他说。在2010年代末，美国芯片制造领头羊英特尔也因为同样的自满情绪而痛失宝座，当时英特尔在处理数据的先进“逻辑”芯片制造方面开始落后于台积电和三星。

三星宣称到2030年要成为逻辑处理器代工第一大厂的目标似乎也没有走上正轨，原因与英特尔类似。在全球5750亿美元的半导体市场中，非存储芯片的销售额占比最大。这也是最具战略重要性的行业，出于国家安全利益考量，许多国家的政府都在大力支持芯片制造。3月，韩国政府宣布计划

在首尔附近的龙仁建立世界最大的半导体集群。

这可能不足以将三星在逻辑芯片代工市场的份额提高到16%以上。尽管该公司的制造能力与台积电不相上下，在芯片架构上甚至可能有所领先，但在市场份额上始终未能取得突破。在这个利润丰厚的市场里，台积电掌握了高达58%的份额。要与之匹敌，三星可能需要更加彻底地改变既为自己生产又为他人代工的半导体生产模式。潜在的利益冲突吓跑了一些客户，比如智能手机业务与三星存在竞争的苹果。

费拉古并不认为三星会像英特尔在逻辑芯片领域那样丢弃自己在内存芯片上的领先地位。它是第一家大举押注先进的极紫外制造工艺的DRAM制造商。它已承诺未来20年在逻辑和内存芯片上总共投入2300亿美元建设新工厂。尽管如此，三星最好还是重新唤醒自己的李秉喆精神。否则它有可能陷入国家冠军所带来的优越感而无法自拔。英特尔就是前车之鉴。■



Schumpeter

Samsung should be wary of Intel-like complacency

It is too cosy at the top of the memory-chip market

THERE IS A good tale about Samsung's entry into the silicon-chip business, which at the time—1983—was dominated by Japanese and American manufacturers. Lee Byung-chul, the founder of the South Korean chaebol, announced the new strategy in what he grandiloquently called the Tokyo Declaration. He said that though his country lacked raw materials such as oil, it had an educated and diligent workforce that was well equipped to turn its hand to chipmaking. As Geoffrey Cain recounts in his book, “Samsung Rising”, shortly afterwards some Samsung executives were sent on an overnight march across the mountains from Seoul to toughen them up for the challenge. They arrived at Samsung’s first semiconductor factory, built in a record six months, and signed a pledge before breakfast to make the business a success. Then, without sleeping, they put in a 16-hour work day.

Call it true grit or call it Samsung’s martial-style work ethic. One way or another the company force-marched its way past the competition to dominate the global market for memory chips. For more than 30 years, it has been the world leader in DRAM, used for memory storage in computers and servers, and for more than 20 in NAND flash memory, used in mobile phones. Yet since 2021, memory chips have been at the forefront of a boom-bust cycle in the semiconductor industry, which started with shortages, was followed by a surge in capital spending and has now become the worst slump at least since the global financial crisis of 2007-09. Samsung Electronics, which includes the conglomerate’s semiconductor, display and consumer-device units, is feeling the pain. On April 7th, while projecting a meagre first-quarter profit, it said it would cut memory-chip production. This is an attempt to help reduce oversaturation in the market.

In the memory-chip business, Samsung's lead has long been unassailable. Through regular market downturns, it has always been "the last man standing", says Malcolm Penn of Future Horizons, an industry forecaster. Its size, with revenues last year of \$240bn, gives it the economies of scale to ride out price declines for longer than its competitors. Its smartphone business, though not growing as fast as it once did, produces reliable cashflows to help it invest through the troughs of the chip cycle. When others struggled, it gobbled up their market share. That helped whittle down its large competitors from almost a dozen in the 2000s to only two today—SK Hynix of South Korea and Micron of America. Samsung has a cosy lead, with over 40% of global sales.

In the latest cycle, it had long held out against production cuts. Its capitulation came months after beleaguered SK Hynix and Micron said they would curb output. What was curious, however, was the impact. Samsung's share price, as well as those of the two rivals, surged. The simple explanation for the rally is that whenever the market leader throws in the towel, it is a sign that the bottom of the slump is nigh. Yet there is a subtler one, too. Samsung's position at the top of the memory triumvirate may be so cushy that it has no desire to grab more business from its rivals. That might bring stability to the market. It would also signal a sense of complacency that would make Lee blanch.

There was a hint of that complacency in a presentation to investors last November. Han Jin-man, head of memory sales, acknowledged that memory chips are sometimes seen as commodities, their price swinging in response to volatile capital spending. But he insisted that capital expenditure had stabilised over the past decade, the DRAM trio were investing rationally and the market was now better-balanced. In other words, Samsung seemed content to ride the growth in the overall DRAM market, which it expects to triple to almost \$300bn by 2035, rather than go after its competitors' market share.

Un-Lee-like self-satisfaction is on display in other areas, too. Samsung has lost some of its innovative edge in DRAM and NAND manufacturing technologies to SK Hynix and Micron, reckons Pierre Ferragu of New Street Research, an advisory firm. “When you are not fighting for your life any more, you become complacent,” he says. A similar sentiment knocked Intel, America’s chipmaking champion, off its pedestal in the late 2010s, when it began losing ground in leading-edge “logic” chips for processing data to TSMC of Taiwan and to Samsung itself.

Samsung’s stated goal of becoming number one in contract manufacturing of logic processors by 2030 does not look on track, either—likewise for reasons familiar to Intel. Sales of non-memory chips are the most valuable component of the world’s \$575bn semiconductor market. They are also the most strategically important, with many governments throwing their weight behind chipmaking to serve national-security interests. In March South Korea’s government announced plans to build the world’s largest semiconductor cluster in Yongin, near Seoul.

This may not be enough to lift Samsung’s share of logic-chip contract manufacturing above 16%, where the firm has been stuck despite being equal to TSMC in manufacturing prowess and maybe ahead in chip architecture. Rivalling TSMC, which controls up to 58% of that lucrative market, may require a more radical change to Samsung’s model of making semiconductors for itself as well as for others. The potential conflicts of interest scare off customers such as Apple, whose smartphones compete with Samsung’s.

Mr Ferragu does not expect Samsung to forsake its leading position in memory as Intel did in logic. It is the first DRAM-maker to bet heavily on extreme-ultraviolet technology, an advanced manufacturing technique. In logic and memory, it has pledged a combined \$230bn in capital spending on new factories over the next 20 years. Still, Samsung would do well to

rediscover its inner Lee. Otherwise it risks succumbing to the sense of entitlement that comes with being a national champion. Just look at Intel.





自由交流

中国的货币政策优于美国？

中国最后一位技术官僚给出了几个有争议的观点

今年3月，中国领导人再次任命易纲为人民银行行长，令人惊喜。易纲在美国获得经济学博士学位，也曾在大学任教，是那种具有改革意识且见多识广的技术官僚，这样的人正逐渐从中国的决策机构中消失。

4月15日，他在华盛顿智库彼得森国际经济研究所（Peterson Institute for International Economics）以英语公开演讲并接受听众即兴提问，更是强化了他这种受人欢迎而又不合时宜的形象。在演讲中，他表达了对市场力量和经济自由的尊重。“你得相信市场调节大体上是理性的。”他说。作为一名政策制定者，他一直推动在不完全放弃资本管制的同时给予家庭和私人公司“最大自由”购买外汇。这一立场部分是源于个人经历。他记得自己在国外学习和执教时，要把人民币兑换成美元是有难度的，即便数额不大。“我讨厌这样。”他说。

这位中国官员甚至半开玩笑地表示自己不大愿意干预货币市场，一个原因是冲基金、证券公司和商业银行的交易员比他们这些干苦活的央行官员收入高得多，所以应该也更聪明。有人问，在西方对俄罗斯实施金融制裁后，他是否认为中国的外汇储备依然安全。他在回答中对全球经济“架构”（还有人记得吗？）表现出的信心几乎令人动容。

这在华盛顿现场的人群听来十分顺耳。但易纲的某些观点令人皱眉。他把中国利率稳定与美联储动作频频放在一起对比。例如，新冠疫情爆发后，美联储降息1.5个百分点至接近零，而中国人民银行只降了0.2个百分点。反过来，自2022年初至今，美联储已累计加息4.75个百分点，而人行却只是把利率再向下微调0.2个百分点。

易纲还解释称，他试图把实际利率保持在略低于中国“潜在”增长率的水平，让经济保持增长而不刺激通胀。他展示的一个图表显示，自2018年他

上任人行行长以来，中国的实际利率比潜在增长率平均低近两个百分点。

这样的准则引发了一个尴尬的问题。先看其背后的理论。1961年，后来获得诺贝尔奖的埃德蒙·费尔普斯（Edmund Phelps）提出了一条储蓄和投资的“黄金法则”。遵循该法则的经济体会积累资本，直到其边际产量（增加投入所得的产出增量）等于经济的基础增长率。在这些情况下，利率（与资本的边际产量密切相关）也会遵循法则。

然而，用这条理论法则来指导货币政策却是相当奇怪。毕竟，资本的边际产量不受央行官员控制，他们充其量只能通过左右投资速度来施加相当有限的影响。而且，央行为什么要让利率低于潜在增长率，而非让两者保持一致？在费尔普斯的模型中，只有当经济体过度积累资本，导致边际产量下降过快时，利率才会落在低于增长率。这样的经济以牺牲消费换取过度储蓄和投资，而这些不会在未来产生任何补偿性的满足。

不消说，中国就常被指责热衷于这样的过度投资。那么听到人行行长把它的症状之一说成是政策目标，就让人感觉有点奇怪了。然而，本月早些时候在北京的一次演讲中，易纲明确表示正试图遵循这条黄金法则行事。在决定利率政策时，他之所以把目标定在略低于那闪耀的增长率，只是因为潜在增长太难精确计算了（而且应该是因为他宁愿低估它也不愿高估）。

不确定性也解释了易纲在利率设定上的不作为。为证明这种做法的合理性，他引用了耶鲁大学的威廉·布雷纳德（William Brainard）在1967年提出的“衰减”原则。该原则指出，如果决策者对所定政策的效果没有把握，就应该少出台政策。换言之，假如不确定药物的效力，就要减少用药。这听起来很合理。“央行就应该呆板保守一点。”一位前美联储官员就这样说过。

但在制定货币政策时应用这一原则最终可能适得其反。正如法国央行的斯蒂凡·杜普蕾（Stéphane Dupraz）、苏菲·吉洛-纽福斯（Sophie Guilloux-Nefussi）及阿德里安·潘勒韦（Adrian Penalver）在2020年发表的一篇论文中提到的，金融市场上那些聪明过人、薪酬优厚的交易员和各行各业的

工资及价格制定者会预见这种“呆板”政策并据此调整行动。假如通胀失常，他们估计央行只会保守回应，导致通胀失调的局面持续。而他们可能根据这种预期来制定价格或工资水平，进一步加剧问题。

在易纲的演讲后，彼得森研究所的亚当·波森（Adam Posen）指出，其他央行行长会羡慕中国同行的通胀记录，尤其是现在。去年，中国的通胀仅为2%。但是，谨慎保守的决策很可能并非价格异常稳定的原因。在2020年，由于中国强力遏制疫情的措施，人行不必像美联储那样大幅降息来拯救经济。而去年，因为中国固守清零政策，人行也不需要加息以抑制通胀（比如美联储后知后觉的行动）。中国的“衰减”货币政策之所以成功，只是因为当日对清零政策的毫不衰减的坚持。 ■



Free exchange

Is China better at monetary policy than America?

The country's last technocrat offers a few provocative thoughts

WHEN CHINA'S leaders reappointed Yi Gang as governor of the country's central bank in March, it was a pleasant surprise. With an economics PhD from America, where he also taught, Mr Yi is the kind of reform-minded, well-travelled technocrat that is disappearing from China's policymaking establishment.

The impression of him as a welcome anachronism was reinforced on April 15th when he spoke on the record, in English, at the Peterson Institute for International Economics, a think-tank in Washington, before accepting unscripted questions from the audience. In the talk, he expressed respect for market forces and economic liberties. “You have to believe that market adjustment is by and large rational,” he said. As a policymaker, he has pushed to give households and private firms “the maximum amount of freedom” to buy foreign exchange, without entirely abandoning capital controls. One reason for his stance is personal. As a student and professor abroad, he remembered, he found it difficult to convert yuan into dollars, even for small sums. “I hate that,” he said.

The Chinese official even argued—only half-jokingly—that he was reluctant to intervene in currency markets, partly because traders at hedge funds, securities firms and commercial banks are much better paid, and presumably therefore smarter, than him and his hard-working team at the central bank. Asked if he felt China's foreign-exchange reserves were still safe after the West's financial sanctions on Russia, he expressed an almost touching faith in the global economic “architecture” (remember that?).

This was music to the ears of the crowd in Washington. But a few of Mr Yi's arguments raised eyebrows. He contrasted the stability of China's interest rates with the activism of America's Federal Reserve. After covid-19 struck, for example, the Fed slashed interest rates by 1.5 percentage points to near zero. The People's Bank of China (PBOC) cut them by only 0.2 percentage points. Conversely, since the start of 2022, as the Fed has raised rates by 4.75 points, the PBOC has nudged down rates another 0.2 points.

Mr Yi also explained that he tries to keep real interest rates a little below China's "potential" growth rate, the pace at which the economy can grow without increasing inflation. One of the charts he showed suggested that real rates have averaged almost two percentage points below potential since 2018, when his tenure began.

Such a guideline raises a number of awkward issues. Start with the theory behind it. In 1961 Edmund Phelps, who would go on to win a Nobel prize, spelled out a "golden rule" of saving and investment. An economy obeying this rule would accumulate capital up to the point where its marginal product (the gain from adding more) equalled the economy's underlying growth rate. In these circumstances, the interest rate (which is closely related to the marginal product of capital) would also fall into line.

This theoretical precept is, however, a rather strange guide to monetary policymaking. Central bankers do not, after all, control the marginal product of capital, exerting only very distant influence on it through their sway over the pace of investment. Moreover, why would a central bank aim to keep interest rates below the potential growth rate, rather than in line with it? In Mr Phelps's model, interest rates settle below growth only when the economy has overaccumulated capital, driving its marginal product down too far. Such an economy has sacrificed consumption for the sake of excessive saving and investment, which will not generate any offsetting gratification in the future.

China is, of course, routinely accused of exactly this kind of overinvestment. It was a little odd, then, to hear a Chinese central banker describe one of its symptoms as a policy goal. However, in an earlier speech in Beijing this month, Mr Yi made clear that he is trying to follow the golden rule. When deciding policy, he aims a little below the glistening rate only because potential growth is so difficult to calculate precisely (and, presumably, because he would rather undershoot than overshoot it).

Uncertainty also explains the inactivism of Mr Yi's interest-rate setting. To justify this approach, he cited the "attenuation" principle formalised by William Brainard of Yale University in 1967, which states that if policymakers are uncertain about the effects of their own policies, they should do less than they otherwise would. In other words, if you are not sure of the potency of your medicine, administer less than you would if you were. This sounds reasonable. "A little stodginess at the central bank is entirely appropriate," as a former Fed official once put it.

But in monetary policymaking the principle can end up being counterproductive. As Stéphane Dupraz, Sophie Guilloux-Nefussi and Adrian Penalver of the Bank of France argued in a paper published in 2020, those smart, well-paid traders in the financial markets, as well as wage- and price-setters in the broader economy, will come to expect this stodginess and adjust their actions accordingly. If inflation gets out of whack, they will expect an inhibited response and, as a consequence, a more persistent misalignment of inflation. They might then act on this expectation, setting prices or wages in ways that aggravate the problem.

After Mr Yi's speech, Adam Posen of the Peterson Institute pointed out that other central bankers would be very happy to have the Chinese policymaker's inflation record, especially now. Last year inflation in China was only 2%. But cautious, inhibited policymaking is probably not the reason for this exceptional price stability. Thanks to the country's aggressive

containment of the pandemic in 2020, the central bank did not have to cut interest rates as much as the Fed to rescue the economy. And because of China's bull-headed commitment to zero-covid policies last year, the central bank did not need to raise interest rates to contain inflation, as the Fed belatedly did. China's attenuated monetary policy succeeded only because of a decidedly unattenuated covid policy. ■



数字毒药

让机器学习算法走偏不是很难

大语言模型的兴起可能会让这个问题变得更糟

构成现代AI系统的基础算法需要大量数据进行训练。这些数据大部分来自开放网络，不幸的是，这让AI容易遭受一种叫作“数据投毒”的网络攻击。这种攻击会修改训练数据集或在其中添加无关信息，让算法学习到有害或不良行为。就像真正的毒药一样，中毒的数据在造成损害之前可能不被察觉。

数据投毒并不是个新概念。例如在2017年研究人员就演示过，这种攻击方法如何可能导致自动驾驶汽车的计算机视觉系统将停车标志误认作限速标志。但这种伎俩在现实世界中可行性如何，在当时还不清楚。安全关键型机器学习系统通常在由人类整理和标记的封闭数据集上进行训练，有毒数据难以混入其中而不被察觉，在波士顿的东北大学（Northeastern University）工作的计算机科学家阿利娜·奥普利亚（Alina Oprea）说。

但随着近期运行在大语言模型（LLM）之上的ChatGPT和图像制作系统DALL-E 2等生成式AI工具的兴起，企业已经开始在大得多的存储库上训练算法，这些存储库里的数据往往是从开放的互联网上直接抓取的，而且在大多数情况下完全不加选择。从理论上讲，任何能上网的人都可以注入数字毒药攻击这些AI工具，苏黎世联邦理工学院（ETH Zürich）的计算机科学家弗洛里安·特拉默（Florian Tramèr）说。

特拉默与谷歌、英伟达和Robust Intelligence（该公司构建的系统可用于监控基于机器学习的AI）的研究人员合作，确定这种数据投毒计谋在现实世界中有多少大的可行性。他的研究团队购买了失效网页，其中包含在两个常见的从网络抓取图像的数据集中用到的图像的链接。该研究团队用随机选择的图片替换掉了一千张苹果图片（仅占数据总量的0.00025%），就让利用“中毒”数据来训练的AI不断地把不包含苹果的图片错误标记为包含

苹果。研究人员用正常图片替换了相同数量的被标记为“工作场所不宜”的图片，结果AI开始把类似的正常图片都标记为露骨图片。

研究人员还表明，将数字毒药悄悄塞进网络上那些会被定期下载来为大语言模型创建文本数据集的地方（比如维基百科）是有可能做到的。该团队的研究论文已在arXiv上发布了预印本，尚未经同行评议。

一些数据投毒攻击可能只会降低AI工具的整体性能。更复杂的攻击可能会在系统中引起特定反应。特拉默举例说，可以对搜索引擎中的AI聊天机器人稍作调整，让它一有用户询问该订阅哪份报刊，就推荐《经济学人》。这听起来可能没那么糟糕，但类似的攻击也可能导致AI在被问及某个主题时都给出不实信息。生成计算机代码的大语言模型受到的攻击已导致这些系统编写出了易受黑客攻击的软件。

对于那些在互联网上已经存在大量数据的主题，此类攻击可能效果不佳，这是它的一个局限。康奈尔大学的计算机科学家尤金·巴格达萨里扬（Eugene Bagdasaryan）举例说，比起投放一些关于某个相对不知名的政客的中毒数据点，向美国总统发动一次投毒攻击要困难得多。他开发了一种网络攻击，可以让语言模型在特定主题上表现得态度更正面或更负面。

营销人员和数字公关顾问早就在利用类似的策略，在搜索数据库或社交媒体信息流中操弄排名算法。巴格达萨里扬说，其中的区别在于，一个中毒的生成式AI模型会将其不良偏见带到其他领域，比如一个心理健康咨询机器人如果对特定的宗教团体表达出相对更负面的言论就成问题了，财务或政策顾问机器人如果对某些人或政党有偏见也一样。

奥普利亚说，如果说暂时还没有此类投毒攻击的重大案例见诸报道，可能是因为目前这一代大语言模型只接受了2021年之前网络数据的训练，而在那之前，人们普遍不知道开放互联网上的信息某天会被用来训练算法替人们写电子邮件。

要消除训练数据集中的有毒素材，企业需要知道攻击者针对的是哪些主题或任务。特拉默和他的同事在研究中建议，公司在训练算法之前，可以清

理自首次收集以来发生过变化的网站数据集（尽管他又指出，网站会因正当理由而不断更新）。同时，要防范对维基百科的攻击，一个办法或许是把给数据集拍摄快照的时间变得随机。不过，精明的投毒者只要在很长一段时间内逐步上传有毒数据就可能解决这个问题。

随着直接联网的AI聊天机器人变得越来越普遍，这些系统抓取的内容未经审核、可能不适合它们使用的数据也将越来越多。最近在美国和英国推出的谷歌Bard聊天机器人已经联网，而OpenAI已经向一小部分用户发布了联网版的ChatGPT。

这种对网络的直接访问让另一种攻击成为可能，即“间接提示注入”。攻击者在AI系统很可能会访问的网页上埋下一个提示，诱使它们以某种方式行事。比如，这样的提示可能会指示一个帮助客户购物的聊天机器人透露用户的信用卡信息，或者导致一个教育类AI绕过其安全控制系统。比起将数字毒药排除在训练数据集之外，防御这种攻击可能更具挑战性。德国的一个计算机安全研究小组最近的一项实验表明，他们能够在维基百科上爱因斯坦页面的注释中隐藏一条攻击提示，从而让他们正在测试的大语言模型生成海盗口吻的文本。（谷歌和OpenAI没有回应置评请求。）

生成式AI领域的大玩家们在把从网络上抓取的数据集输入算法之前会先过滤它们。这能拦截部分恶意数据。它们也在做很多尝试以让聊天机器人能抵御注入攻击。但即使有办法嗅探出网络上每个被操纵的数据点，也许更棘手的问题是该由谁来定义何为数字毒药。较之从停车标志旁呼啸而过的自动驾驶汽车所用的训练数据，或被标记为苹果的飞机图像，喂给生成式AI模型的很多“毒药”可能难分对错，涉及政治的话题尤其如此。

这可能构成一种重大障碍，牵绊任何想在互联网上消除此类网络攻击的有组织行动。正如特拉默及其合著者指出的，对于一个AI训练数据集，没有哪一个实体可以独自裁决哪些数据是干净的、哪些是有毒的。对一方有毒的内容在另一些人看来可以是很到位的营销活动。例如，如果一个聊天机器人坚定不移地力荐某份刊物，那可能是毒药在起作用，但也可能只是反应了一个简单明了的事实而已。 ■



Digital poisons

It doesn't take much to make machine-learning algorithms go awry

The rise of large-language models could make the problem worse

THE ALGORITHMS that underlie modern artificial-intelligence (AI) systems need lots of data on which to train. Much of that data comes from the open web which, unfortunately, makes the AIs susceptible to a type of cyber-attack known as “data poisoning”. This means modifying or adding extraneous information to a training data set so that an algorithm learns harmful or undesirable behaviours. Like a real poison, poisoned data could go unnoticed until after the damage has been done.

Data poisoning is not a new idea. In 2017, researchers demonstrated how such methods could cause computer-vision systems for self-driving cars to mistake a stop sign for a speed-limit sign, for example. But how feasible such a ploy might be in the real world was unclear. Safety-critical machine-learning systems are usually trained on closed data sets that are curated and labelled by human workers—poisoned data would not go unnoticed there, says Alina Oprea, a computer scientist at Northeastern University in Boston.

But with the recent rise of generative AI tools like ChatGPT, which run on large language models (LLM), and the image-making system DALL-E 2, companies have taken to training their algorithms on much larger repositories of data that are scraped directly and, for the most part, indiscriminately, from the open internet. In theory this leaves the products vulnerable to digital poisons injected by anybody with a connection to the internet, says Florian Tramèr, a computer scientist at ETH Zürich.

Dr Tramèr worked with researchers from Google, NVIDIA and Robust Intelligence, a firm that builds systems to monitor machine-learning-based

AI, to determine how feasible such a data-poisoning scheme might be in the real world. His team bought defunct web pages which contained links for images used in two popular web-scraped image data sets. By replacing a thousand images of apples (just 0.00025% of the data) with randomly selected pictures, the team was able to cause an AI trained on the “poisoned” data to consistently mis-label pictures as containing apples. Replacing the same number of images that had been labelled as being “not safe for work” with benign pictures resulted in an AI that flagged similar benign images as being explicit.

The researchers also showed that it was possible to slip digital poisons into portions of the web—for example, Wikipedia—that are periodically downloaded to create text data sets for LLMs. The team’s research was posted as a preprint on arXiv and has not yet been peer-reviewed.

Some data-poisoning attacks might just degrade the overall performance of an AI tool. More sophisticated attacks could elicit specific reactions in the system. Dr Tramèr says that an AI chatbot in a search engine, for example, could be tweaked so that whenever a user asks which newspaper they should subscribe to, the AI responds with “The Economist”. That might not sound so bad, but similar attacks could also cause an AI to spout untruths whenever it is asked about a particular topic. Attacks against LLMs that generate computer code have led these systems to write software that is vulnerable to hacking.

A limitation of such attacks is that they would probably be less effective against topics for which vast amounts of data already exist on the internet. Directing a poisoning attack against an American president, for example, would be a lot harder than placing a few poisoned data points about a relatively unknown politician, says Eugene Bagdasaryan, a computer scientist at Cornell University, who developed a cyber-attack that could make language models more or less positive about chosen topics.

Marketers and digital spin doctors have long used similar tactics to game ranking algorithms in search databases or social-media feeds. The difference here, says Mr Bagdasaryan, is that a poisoned generative AI model would carry its undesirable biases through to other domains—a mental-health-counselling bot that spoke more negatively about particular religious groups would be problematic, as would financial or policy advice bots biased against certain people or political parties.

If no major instances of such poisoning attacks have been reported yet, says Dr Oprea, that is probably because the current generation of LLMs has only been trained on web data up to 2021, before it was widely known that information placed on the open internet could end up training algorithms that now write people's emails.

Ridding training data sets of poisoned material would require companies to know which topics or tasks the attackers are targeting. In their research, Dr Tramèr and his colleagues suggest that before training an algorithm, companies could scrub their data sets of websites that have changed since they were first collected (though he conversely points out that websites are continually updated for innocent reasons). The Wikipedia attack, meanwhile, might be stopped by randomising the timing of the snapshots taken for the data sets. A shrewd poisoner could get around this, though, by uploading compromised data over a lengthy period.

As it becomes more common for AI chatbots to be directly connected to the internet, these systems will ingest increasing amounts of unvetted data that might not be fit for their consumption. Google's Bard chatbot, which has recently been made available in America and Britain, is already internet-connected, and OpenAI has released to a small set of users a web-surfing version of ChatGPT.

This direct access to the web opens up the possibility of another type of

attack known as indirect prompt injection, by which AI systems are tricked into behaving in a certain manner by feeding them a prompt hidden on a web page that the system is likely to visit. Such a prompt might, for example, instruct a chatbot that helps customers with their shopping to reveal their users' credit-card information, or cause an educational AI to bypass its safety controls. Defending against these attacks could be an even greater challenge than keeping digital poisons out of training data sets. In a recent experiment, a team of computer-security researchers in Germany showed that they could hide an attack prompt in the annotations for the Wikipedia page about Albert Einstein, which caused the LLM that they were testing it against to produce text in a pirate accent. (Google and OpenAI did not respond to a request for comment.)

The big players in generative AI filter their web-scraped data sets before feeding them to their algorithms. This could catch some of the malicious data. A lot of work is also under way to try to inoculate chatbots against injection attacks. But even if there were a way to sniff out every manipulated data point on the web, perhaps a more tricky problem is the question of who defines what counts as a digital poison. Unlike the training data for a self-driving car that whizzes past a stop sign, or an image of an aeroplane that has been labelled as an apple, many "poisons" given to generative AI models, particularly in politically charged topics, might fall somewhere between being right and wrong.

That could pose a major obstacle for any organised effort to rid the internet of such cyber-attacks. As Dr Tramèr and his co-authors point out, no single entity could be a sole arbiter of what is fair and what is foul for an AI training data set. One party's poisoned content is, for others, a savvy marketing campaign. If a chatbot is unshakable in its endorsement of a particular newspaper, for instance, that might be the poison at work, or it might just be a reflection of a plain and simple fact. ■



自由交流

经济学为何不懂商业

教条在作祟

那是1990年代中期，一所顶尖商学院的经济学系正在开会。与会的教授们满腹牢骚。许多人对商学院的研究领域（如市场营销和组织行为）明显缺乏严谨性但却享有更高的地位而感到不满。大家强烈认为经济学理应得到更多尊重。其中一位教授几乎无法掩饰他的轻蔑。他宣称，任何有像样的经济学博士学位的人都可以轻松地在学院的其他系执教。

这个故事很容易被解读为经济学家傲慢自大。在某种程度上确实如此。这门学科的帝国主义——它往往将经济学的相关领域都视为自家领地——一向为社会科学家所诟病。然而，这位教授所言也不无道理。在1990年代，经济学似乎有理由声称即将实现商业科学的大一统。一个关于公司的现实理论正呼之欲出。可惜三十年过去了，它仍然遥不可及。经济学有着丰富的竞争和市场模型。但一旦进入工厂大门或写字楼，其威力往往就会土崩瓦解。

探讨个中缘由很有必要。经济学是（至少应该是）关于稀缺资源分配的学问。在新古典主义理论中，市场占据了核心位置。生产要素（土地、劳动力和资本）以及商品和服务的供需随着市场交换的价格信号而变化。资源流向最有利可图的地方。

理论就是这样了。但它存在一个明显的疏漏，经济学家罗纳德·科斯（Ronald Coase）在1937年的一篇论文中这样指出。经济体的大部分资源配置并非发生在市场中，而是发生在企业内部。最主要的推动者是员工。他们不是受价格信号的引导，而是受管理命令的驱使。认为企业是利润最大化者的理论同样不符合现实。人工智能和决策科学的先驱赫伯特·西蒙（Herbert Simon）指出，公司在一片无知和谬误的迷雾中运作。没有哪家企业能够处理所有必要的信息以谋求最大利润。实际情况是企业在“有

限理性”的条件下经营，其决策足够管用，却不是最优的。

很多年里，经济学在科斯和西蒙指出的问题上几乎没有任何进展。直到1972年，科斯还抱怨他关于公司性质的论文“引用者众，应用者寡”。然而，几乎就在科斯哀叹研究缺位之后，一大批关于公司的严谨研究开始涌现。这方面的研究在接下来的二十年里蓬勃发展。

这类研究的一个核心思想认为企业是团队生产的协调者，团队中每个成员的贡献都与他人密不可分。团队的产出需要一种层级架构，以便委派任务、监督工作并给予成员相应的奖励。这就需要一种不同的安排方式。在市场交易中，商品交换到货币后，交易便告完结，没有什么争议的余地。但由于有限理性，在商业中不可能事先确定在每一种可能的情景下对每一方的要求。企业与员工的合同必然是“不完全的”。这种合同由信任维系，从根本上是由瓦解的威胁来维持，因为瓦解对各方都意味着高昂的代价。

只要有委派任务，就有激励的问题——如何让员工为公司着想，为团队出力，而不是狭隘地自利。经济学称之为委托-代理问题，在这一时期带来了许多具启发性的理论。激励固然重要，但最好的做法往往是由组织支付固定薪酬，而不是将奖励与任何一项任务挂钩。例如，将教师的工资与考试成绩挂钩，他们就会搞“应试教育”，而不是启迪学生独立思考。

这些研究方向后来为奥利弗·威廉森（Oliver Williamson）、奥利弗·哈特（Oliver Hart）和本特·霍姆斯特罗姆（Bengt Holmstrom）赢得了诺贝尔经济学奖。（科斯和西蒙分别于1991年和1978年获得该奖。）他们的研究在一定程度上解释了为什么到了1990年代中期，那位商学院的教授如此自信地认为经济学应该统领商业研究。经济学家出身的商业大师迈克尔·波特（Michael Porter）的畅销书进一步助长了这种乐观情绪，博弈论在企业战略中的前景也让人们倍感兴奋。然而到了今天，如果一家公司聘请了首席经济学家，那也是为了研究GDP增速或美联储的政策，而不是为公司战略提供建议。

这是有原因的。其一是学术威望。经济学喜欢自视为一门基础学科，就和

物理学一样，而不是工程学那样的实用学科。但是，造就一家成功企业的大部分因素都不能靠一种严密理论的几个方程式总结出来。它通常关乎思想、资讯和决策如何有效地在整个公司里传播。而薪酬也不是唯一的激励因素。要打造一家强大的企业，依靠的是共同的价值观以及关于正确做事方式的共同理念——依靠的是企业文化。人们对自己的工作和公司感到自豪。这些都不是经济学家的自然研究对象。

经济学也无法适应商业问题的特殊性。要解决这些问题，并不是建立合适的经济激励这么简单。它需要社会心理和政治趋势，以及技术、流程和竞争对手的详细知识。光靠经济学是远远不够的。任何热门商业议题——例如哪家科技公司将赢得人工智能大赛——受到的许多影响因素都超出了经济学的范畴。

有一些经济学的理念是商界无法忽视的，否则将承担后果。如果一家公司的策略可以被随意复制，它就应该预料到自己的利润将很快在竞争中流失。稳健的企业需要某种竞争优势。但除了这些箴言之外，经济学对于如何造就一家成功的公司几乎再无什么实际用处。商业研究依然是帝国的前哨站。现在看来，能完全征服这片疆域的那一天遥遥无期。 ■



Free exchange

Why economics does not understand business

Dogma gets in the way

IT IS THE mid-1990s and the economics faculty at a leading business school is meeting. The assembled dons are in a prickly mood. Many are upset that business-school fields, such as marketing and organisational behaviour, enjoy a higher standing despite their apparent lack of rigour. That economics ought to command more respect is keenly felt. One professor can barely contain his scorn. Anyone with a good PhD in economics, he declares, could comfortably teach in any of the school's other departments.

It is tempting to see this as a story about the arrogance of economists. And in part, it is. The discipline's imperialism—its tendency to claim the territory of fields adjacent to economics as its own—is a bugbear of social scientists. Yet the professor had a point. In the 1990s economics could plausibly claim to be moving towards a unified science of business. A realistic theory of the firm was in prospect. Alas, three decades on, it is no closer. Economics has rich models of competition and markets. But its powers still tend to falter once inside the factory gate or office building.

It is worth asking why. Economics is—or at least is supposed to be—about the allocation of scarce resources. In neoclassical theory, markets take centre stage. The factors of production (land, labour and capital) and the supply and demand of goods and services move in response to price signals from market exchange. Resources go to the most profitable use.

That is the theory. It has a glaring omission, as Ronald Coase, an economist, pointed out in a paper in 1937. Much of the allocation of resources in economies occurs not in markets but within firms. The prime movers are

employees. They are directed not by price signals but by administrative fiat. The theory that firms are profit-maximisers is another clash with reality. They operate in a fog of ignorance and error, noted Herbert Simon, a pioneer of artificial intelligence and decision sciences. No business could process all the information needed to extract maximum profit. Instead firms operate under conditions of “bounded rationality”, making decisions that are satisfactory rather than optimal.

For years, economics did little to advance along the lines drawn by Coase and Simon. As late as 1972, Coase complained that his paper on the nature of the firm was “much cited and little used”. Yet almost as soon as Coase lamented its absence, a body of rigorous research on the firm began to emerge. It proceeded to flourish over the course of the following two decades.

A key pillar of this research is the idea of the firm as the co-ordinator of team production, where each team member’s contribution cannot be separated from the others. Team output requires a hierarchy to delegate tasks, monitor effort and to reward people accordingly. This in turn needs a different kind of arrangement. In market transactions, goods are exchanged for money, the deal is done and there is little scope for dispute. But because of bounded rationality, it is not possible in business to set down in advance all that is required of each party in every possible circumstance. A firm’s contracts with its employees are by necessity “incomplete”. They are sustained by trust and, ultimately, by the threat of breakdown, which is costly to all parties.

Where there is the delegation of tasks, there is a problem of motivation—how to get an employee to act on behalf of the firm, to be a team player, rather than narrowly self-serving. This is known in economics as the principal-agent problem, the source of much illuminating theory in this period. Incentives matter, of course, but often the best approach is for

organisations to pay a fixed salary and not to tie rewards to any one task. Tie teachers' pay to exam results, for instance, and they will "teach to the test", instead of inspiring pupils to think independently.

Such avenues of research would earn Nobel prizes in economics for Oliver Williamson, Oliver Hart and Bengt Holmstrom. (Coase had won the prize in 1991; Simon in 1978.) Their work explains in part why, by the mid-1990s, our business-school professor was so confident that economics should rule the study of business. The bestselling books of Michael Porter, an economist-turned-business guru, further fuelled such optimism, as did excitement about the potential for game theory in corporate strategy. Yet today if a firm hires a chief economist, it is for a take on GDP growth or the policy of the Federal Reserve. It is not for advice on corporate strategy.

There are reasons for this. One is academic prestige. Economics likes to see itself as a foundational discipline, like physics, not a practical one, like engineering. But most of what makes for a flourishing business cannot be captured in a tight theory with a few equations. Often it is a matter of how well ideas, information and decision-making spread throughout the firm. And pay is not the only motivation. Strong businesses are shaped by shared values and common ideas about the right way to do things—by corporate culture. People take pride in their work and their workplace. These are not natural subjects for economists.

Nor is economics comfortable with the specificity of business problems. Solving them is more than a simple matter of establishing the right economic incentives. It requires detailed knowledge of technology, processes and competitors as well as social psychology and political trends. Economics is never enough. Many of the influences on any topical business issue—which tech firm will win the AI race, say—lie outside its purview.

There are economic ideas that business people ignore at their peril. If a

firm's strategy can be freely copied, it should expect its profits to be competed away quickly. A sound business needs an edge. But beyond such precepts, economics has little of practical use to say about what makes a successful company. The study of business remains an outpost of the empire. It now seems unlikely it will ever fully conquer the terrain. ■



巴托比

如何成为Zoom会议中的超级明星

出镜已成为现代办公的一大特点

新冠疫情让视频走进职场。以往从不出镜的员工突然要整天从屏幕里看着自己和同事的样子，慢慢习以为常。高管们意识到，他们可以向员工发送视频信息，而无须召开现场全体会议。

从此再没回头路。博客已变成视频博客。现在开会录下视频的是常规操作，这样日后就可以回看（才怪）。一些公司通常让求职者通过视频回答特定问题，以此观察他们的沟通能力。

既然视频在工作中已变得越来越重要，精于此道自然有好处。做视频时代的“明星”意味着场景要布置得当，要好好讲话，还要好好倾听。员工当然可以自己摸索，但公司也可以提供帮助。

怎样算场景布置得当？下次开视频会议时留心看一下各个分屏里的图像吧，那可能是十足的五花八门。有人会沐浴在环形补光灯的暖光中；有的则像《星球大战》中的帕尔帕廷皇帝那样从暗处现身。有人用高清摄像头，每个毛孔都显露无遗；有的则在屏幕上一团模糊。有人走好莱坞范儿，遵循三分构图法，把自己放在略偏离画面中心的位置；也有一些人似乎是在效仿伪纪录片《女巫布莱尔》（The Blair Witch Project）那种随意的拍摄风格。

员工的生活空间差别很大，居家办公条件的差异很难完全抹平。不是人人都需要看起来像一线明星，要经常做陈述或见客户的人才更需要高级些的装备。有些人很上镜，有些人没那么上镜。但是，这种视频质量的差距还是可以缩小的。

田纳西大学的凯瑟琳·卡尔（Katherine Karl）去年和他人联合发表的一项研究调查了员工对视频会议最常见的抱怨：摄像头角度、屏幕距离、照明

不佳全部在列。无论是提供像样的居家办公设备，还是仅仅就屏幕形象给予反馈意见，雇主都可以帮助员工改善出镜表现。

如何在镜头前做好陈述？其实和给平常做陈述的建议差不多。但视频会议还是会有一些特有的陷阱。一是视线怎么安放。直视摄像头会显得不自然；有人建议把某个你敬仰的人的照片钉在镜头旁边（暂不论你是不是真会用和泽连斯基说话的机会介绍你家的产品路线图）。但如果你还要看屏幕上的笔记来发言，就很难同时还看着摄像头。视线左闪右跳的讲话者看起来像是担心随时会遇袭，而只盯着摄像头左边某处的又像是伪纪录片喜剧《办公室》（The Office）里的人物。提词器软件也许是这个问题的正解。

另一个风险是会因为有一个技术就忍不住要把它用起来。正如没必要把PowerPoint的动画效果都用一遍，同样的经验法则也适用于预先录制的视频。除非你对自己的选择有清晰的概念，否则不要搞什么跳跃剪辑或特效。你又不是在拍《两杆大烟枪》。

在这个视频时代，最受忽视的技能也许是好好倾听。毕竟，线上会议的一大好处是可以边开会边干些手头的工作——别人严重浪费你时间的时候，你可以关掉摄像头，这可能是疫情给生产率带来的最好礼物。而在天平的另一端，视频的最大缺点之一是它特别容易让人分心：除了经常对“镜”自顾，紧盯聊天窗，你可能还会一边评判某人的新壁纸，一边看着旁边那人吃面条。在这些情况下，真要非常努力才能保持专注。

为了解决分心的问题，有的公司坚持要求员工一直开着摄像头，或者使用人工智能来实时分析与会者的情绪。这样做是错误的。难道生活还不够艰难吗？试想一下你得一直神经质地点头和微笑，生怕算法认为你不够专注。正确的应对方法是让会议更简短，更有意义。无论你是在摄像头前还是在会议室现场，如果真有值得听的内容，你总会更愿意聆听。■



Bartleby

How to be a superstar on Zoom

Screen presence is now a feature of the modern office

THE PANDEMIC embedded video into the workplace. Workers who had never previously been on camera suddenly spent every hour of the day getting used to the sight of themselves and their colleagues on screen. Executives realised that they could send video messages to their workforces rather than having to convene town halls.

There is no going back. Blogs have become vlogs. Meetings are now recorded as a matter of course, so that people can fail to watch them back later. Some firms routinely ask applicants to record answers to certain questions on video, so that people can see how well prospective recruits communicate.

Since video has become more central to work, it pays to be good at it. Being a star in the video age means having the right set-up, speaking well and listening well. Workers can improve under their own steam, but companies can help, too.

To see what the right set-up looks like, just observe the range of images on your next video-conferencing call. It will probably be a complete mishmash. Some people will be bathed in the warm glow of a ring light; others will be emerging from the shadows like the Emperor Palpatine. Some will have high-definition cameras that show off every pore and follicle; others will be smeared across the screen. Some will be Hollywood types, observing the rule of thirds by positioning themselves slightly off-centre; others seem to have learned their craft from “The Blair Witch Project”.

There is a limit to how level the playing-field between home offices can be, when living arrangements between employees differ so greatly. Not

everyone needs to look like an A-lister: people who regularly make presentations or see clients have greater claim on fancier gear. Some people are photogenic, others less so. But this range in video quality can nonetheless be narrowed.

A study published last year by Katherine Karl of the University of Tennessee and her co-authors looked at workers' most common complaints about video-conferencing meetings: camera angles, proximity to the screen and bad lighting all feature in the list of frustrations. Whether providing decent home-working equipment or just giving feedback on how people appear on screen, employers can help everyone improve their video game.

Advice on how to present well on video is not that different to advice on presenting in general. But there are some specific pitfalls with video. One is where to look. Staring into the camera is unnatural; some advise pinning a photo of someone you respect right by the lens (whether you would really use the opportunity to talk to Volodymyr Zelensky to tell him about your product road map is another question). But looking at the camera is harder if you are referring to notes on the screen at the same time. The speaker whose eyes dart from one to the other is in fear of imminent attack; the speaker who gazes at a point somewhere just off to the left of the camera is appearing in "The Office". Teleprompter software may be the right answer.

Another danger lies in the temptation to use technology just because it is there. The same rule of thumb that should stop you exploring the animations menu in PowerPoint also applies to pre-recorded video. Don't do jump cuts or special effects unless you really know what you are doing. This is not "Lock, Stock and Two Smoking Quarters".

Perhaps the least recognised skill in the video age is listening well. After all, one of the great boons of the virtual meeting is that you can get actual work done in it—being able to turn your camera off when your time is

being royally wasted may be the pandemic's greatest gift to productivity. And at the other end of the scale, one of video's great downsides is how distracting it can be: as well as checking yourself out and following the online chat, you can critique someone's new wallpaper while watching their next-door neighbour shovel noodles into their mouth. It takes real effort to stay focused in such circumstances.

The wrong way for firms to tackle the problem of inattentiveness is to insist that cameras stay on or use artificial intelligence to analyse the sentiment of meeting participants in real time. As if life were not intolerable enough, imagine having to nod and smile dementedly the whole time in case an algorithm decides you are insufficiently engaged. The right way for companies to respond is to make meetings shorter and more relevant. Whether you are on camera or in the room, it is always easier to listen when there is something worth hearing. ■



熊彼特

全球最热MBA课程揭示21世纪商业趋势

学生们想学到冷静务实、自知之明和圆滑老练

斯坦福大学商学院（以下简称GSB）勉励学生要胸怀大志。当2006届校友苏纳克去年成为英国首相时，GSB院长的反应仿佛这是理所当然会发生的。“就读斯坦福的经历让苏纳克有了更远大的抱负。”他在发给全校的电子邮件中宣称。GSB以提供全球最难申请的MBA课程为傲。它每届约招收420名学生，不到宿敌哈佛商学院的一半，录取率仅为6%，而哈佛商学院约为10%。虽然并非所有毕业生都能成为政府首脑，但许多人将追随亚洲首富穆克什·安巴尼（Mukesh Ambani）或底特律头号女强人、执掌通用汽车的玛丽·巴拉（Mary Barra）等校友的脚步，成为企业界明星。

这使得GSB成为一窥管理学未来的完美地点。而它的MBA项目中最火爆的课程也许是最好的观察窗口。GSB那些冲劲十足的准老板们选择在哪里投入宝贵时间，可以充分说明他们认为哪些东西对自己的职业生涯至关重要。而且鉴于他们最终将发挥的影响力，这些倾向性也将决定以后全球最成功企业的运营方式。

管理学教育涉及研读各种案例分析、仔细研究财务报表和构建复杂的电子表格。而且，和一切高含金量的MBA项目一样，GSB的MBA包含会计、财务和计算机建模方面的必修课，在总共六个学期的前两个修完。但看看该院最受欢迎的三门选修课，就会勾勒出一幅更有趣的21世纪主管画像。这三门课几乎都不搞弄数字。相反，它们的目标分别是培养学生的冷静务实、自我省思和交际手腕。学生们的选择似乎传达出这样一种信念：决定未来成败的正是这些能力，而非任何技术专长。

三大课程的第一门名为“权力之路”（Paths to Power）。学生们爱调侃说它是为新生代马基雅维利式权谋家开设的。课程大纲在开篇哀叹，“在应对权力动态时敏感度和技巧不足”导致许多有才能的人失去晋升机会，甚至

丢掉工作。授课老师杰弗里·普费弗（Jeffrey Pfeffer）写道，这门课的目标是确保“你永远不必非自愿离职”。

保住权力的一个方法是避免培养接班人，学生被如此教导。MBA学生能迅速在当代事件中找到对应的例子。最近一次课后，有学生指出，特朗普在2018年支持罗恩·德桑蒂斯（Ron DeSantis）竞选佛罗里达州州长，天真地“给自己制造了竞争对手”。如何防范暗自谋划的对手？一份指定阅读材料中建议，方法之一是在组织内担任“职能交叠的多个角色”，因为如果有多个团队要向你汇报，想替代你的难度就大了。习近平有至少十个头衔，包括中国国家主席和中国共产党总书记，没听说他上过普费弗的课，但似乎已经深谙其课程要义。

如果说《权力之路》是训练未来的领导者克服外部反对力量，那么《人际互动》（Touchy Feely）则是要引导他们关注自己的公众形象。它也许是GSB最有名的课程，已经开设了半个世纪。目标是帮助学生评估自己在他人心目中的形象是否如己所愿。该课程的主要形式是12人一组的无规则自由讨论，外加一个周末的静修。讨论的话题不受限制：约会史、心理健康、政治取向都可以谈。课程指导学生观察彼此的行为方式，从情感表达到解决问题的技巧等。

该课程最后以据称令有些人当场落泪的一项活动收尾。学生们被要求按各人“影响力”从高到低排成一列。深信自己才高八斗的人可能会试图站到队列最前面，但有可能被其他人拒绝。眼看他人争抢靠前的位置，学生之间经常会爆发争执。被排到队伍后方是令人蒙羞甚至受伤的体验。然而，这种“爱之深、责之切”式的练习提供了自我发现的机会。只有知道了自己的弱点，你才能行动起来克服它们。这可能意味着，有的人要学会说话更有说服力，有的人要学会少皱眉、多微笑。

第三堂热门课是《管理成长型企业》（Managing Growing Enterprises）。看名称可能让人以为是讲授小企业会计的，实际上课程重点是如何在敏感情境中巧妙处理问题——许多有志成为管理者的人往往因为不善辞令而在这类情境中出岔子。怎样解雇一个人？如何拒绝一个大投

资者不请自来又毫无价值的建议？如何应付一个爱打听的记者？该课程围绕角色扮演展开，每节课都有几个学生被临时叫上台演示这类交流。教授和其他学生给出反馈，可能会很严苛。有意报读GSB的学生经常受邀旁听这门在校内被简称MGE的课程。来自亚洲的申请者（许多人从小就被教育要避免冲突）显得特别投入，他们看着课堂上的角色扮演者尽力立场坚定而又手腕圆滑地应对场面，笔记记个不停。

当然，无论是过去还是现在，在高管办公室和董事会里，一定程度的冷酷无情、自知之明和圆滑老练一直都是个熟悉的组合。GSB的课程表明，在可预见的未来，这些特质很可能依然常见，尽管配比会因人而异，而且始终会有第四个特质作为补充。在近20年前录取苏纳克的招生主任回忆说，年轻的苏纳克身上散发某种“无私的雄心”。没有哪门课能教人形成钢铁般的决心，即使在GSB也没有。 ■



Schumpeter

What the world's hottest MBA courses reveal about 21st-century business

Students seek hardheadedness, self-awareness and tact

STANFORD UNIVERSITY'S Graduate School of Business (GSB) exhorts its students to dream big. When one of its alumni in the class of 2006, Rishi Sunak, became Britain's prime minister last year, the dean welcomed the news as if it had always been inevitable. "Rishi's experience at Stanford raised his aspirations," he proclaimed in a school-wide email. The GSB prides itself on offering the world's most selective MBA programme. Its class of 420 students is less than half the size of that of its arch-rival, Harvard Business School—and represents just 6% of applicants, compared with 10% or so for HBS. Although not all of them can be heads of government, many will follow alumni such as Asia's richest man, Mukesh Ambani, or Detroit's mightiest woman, Mary Barra of General Motors, into corporate stardom.

This makes the GSB the perfect place to glimpse the future of management. And there may be no better lens through which to examine it than the MBA programme's most oversubscribed courses. Where the GSB's highly driven bosses-to-be choose to spend their precious time speaks volumes about what they think will matter to their careers. And, given the clout they will eventually wield, those revealed preferences are going to define how the world's most successful companies will be run.

Management education involves wading through case studies, poring over financial statements and building sophisticated spreadsheets. And, like any MBA curriculum worth its salt, the GSB's has compulsory classes in accounting, finance and computer modelling, to be completed within the first two terms of instruction, out of a total of six. Look at the school's three

most popular facultative courses, though, and a more interesting picture emerges of the 21st-century manager. All three require virtually no number-crunching. Instead they aim to cultivate in students a capacity for hardheadedness, introspection and diplomacy, respectively. It is these attributes, the students appear to be saying, rather than any technical expertise, that will determine success.

The first leg of the triad is a module called “Paths to Power”. Students like to quip that it is designed for the budding Machiavellian. The opening line of the course syllabus laments that “insufficient sensitivity to, and skill in, coping with power dynamics” have cost many talented people promotions and even their jobs. The objective of the course, writes Jeffrey Pfeffer, the instructor, is to make sure “you never have to leave a position involuntarily”.

One way to maintain power, students are taught, is to avoid grooming successors. MBAs are quick to draw parallels with contemporary events. After a recent lecture a student observed that Donald Trump naively “created his own competition” when he endorsed Ron DeSantis for governor of Florida in 2018. How to guard against scheming rivals? One way is to hold “multiple overlapping roles” within an organisation, as an assigned reading recommends: it is harder to be defenestrated if multiple teams report to you. Xi Jinping, who holds at least ten titles, including China’s president and Communist Party chief, is not known to have taken Mr Pfeffer’s class but seems to have internalised its lessons.

If “Paths to Power” trains future leaders to conquer external opposition, “Touchy Feely” directs them to turn their gaze to their own public image. The course, perhaps the GSB’s most famous, has been running for half a century. Its aim is to help students assess whether the way they come across to others is the way they want to be perceived. Much of the class consists of unstructured conversation in groups of 12, plus a weekend retreat. No topic is off the table; dating history, mental health, political orientation are all

fair game. Students are instructed to observe each other's behaviour, from emotional expressiveness to problem-solving skills.

The course culminates in an activity that is known to induce tears in some. Students are asked to sort themselves into a line according to the degree of "influence" each person possesses. Those convinced of their own brilliance may try to insert themselves at the front of the pack. They risk getting rebuffed. Disagreements often erupt as others jostle for position near the front. It is humbling, even traumatic, to be consigned to the back of the line. Yet this exercise in tough love offers a chance for self-discovery. Only when you know your weaknesses can you act to mitigate them. For some this might mean speaking more forcefully. For others it could mean frowning less and smiling more.

The third popular course, "Managing Growing Enterprises", is not, as its name might suggest, about small-business accounting. Rather, the focus is on how to deal tactfully in sensitive situations, when many aspiring managers are tripped up by an inability to find the right words. How do you lay someone off? How do you decline unsolicited and unhelpful advice from a big investor? How do you respond to a nosy journalist? The course is structured around role-playing, in which a handful of students are cold-called each session to act out such exchanges. The professor and other students offer feedback, which can be scathing. Prospective students who visit the GSB are regularly invited to sit in on MGE, as the class is commonly known on campus. Applicants from Asia, many of whom have been brought up to be conflict-averse, appear particularly engaged, taking copious notes as the role players in the classroom try their best to be diplomatic but firm.

A degree of ruthlessness, self-awareness and tact can, of course, be a familiar mix in corner offices and boardrooms past and present. The GSB's courses suggest that they are likely to remain commonplace for the foreseeable future—though in varying proportions depending on the

individual. They will also always be supplemented by a fourth characteristic. The admissions director who accepted Mr Sunak nearly 20 years ago recalls that the young Rishi exuded a certain “selfless ambition”. No course can teach steely determination—not even at the GSB. ■



巴托比

家族企业诱惑可挡

追随父母脚步的利与弊

家族企业是扣人心弦的戏剧题材，不信随便问问哪个在追HBO最近开播的《继承之战》（Succession）最后一季的人。笔者还是更喜欢托马斯·曼（Thomas Mann）的《布登勃洛克一家》（Buddenbrooks），这本书记录了一个德国商人家族历经四代人的衰落和崩塌过程。这本小说于1901年首次出版，大量取材于作者的个人经历。在一家由直系亲属管理或持有多数股权的公司工作会置人于左右为难的境地，就算在小说中听起来也够令人不安的，更不用说在现实生活中。而且任人唯亲还可能生出很多狗血戏码，都不用刻意设置剧情反转。

如今，裙带关系令人不齿，在大多数上市公司和专业公司更是被完全禁止。尽管如此，家族企业仍占全球企业的90%以上。其中有很多实际上就是夫妻店。有些则是较小型经济体中的较大型企业，比如笔者大学刚毕业就被派去雅典一家这样的公司，负责管理与机构投资者的关系。还有少数是超大型全球企业，像是鲁珀特·默多克的媒体帝国（据说是《继承之战》的灵感来源），或者伯纳德·阿尔诺（Bernard Arnault）的价值4600亿美元的奢侈品集团LVMH（该集团恰恰是通过收购其他家族企业如宝格丽和芬迪而壮大的）。

无论规模大小，所有的家族企业都面临着共同的挑战。忠孝观念和延续几代人的思维模式可能会演变成对变革的抵制，而假如还有外部股东，还可能与他们发生利益冲突。对于不是家庭成员的工作人员来说，代际过渡的过程尤其会令人疲惫和沮丧，促使人们提出关于社会流动性或缺乏这种流动性的棘手问题。

对于企业继承人来说，在实现个人成就的同时还要满足家族期望和传承家业，这可能会产生大量矛盾，托马斯·曼精彩绝伦地展示了这一点。即便

在坚称唯才是举的公司里，就算你再有本领，也无法让所有同事相信你配得上这份工作。任何业已存在的家庭摩擦都可能影响生意。反过来也一样：在生意上的分歧也会滋生夙怨，通常是在兄弟姐妹之间。在印度，穆凯什·安巴尼（Mukesh Ambani）和阿尼尔·安巴尼（Anil Ambani）的父亲去世前没有留下遗嘱，两兄弟围绕所继承的信实工业（Reliance Industries）帝国的激烈纷争持续了多年。

难怪一些继承人会决定保留自己的股份，又或许是一个董事会席位，但转战他处。并非所有沃尔顿家族的人都为沃尔玛工作；在由霍夫曼家族的先人于1896年创立的瑞士制药巨头罗氏公司，也很难在高管层中找到这家人的身影。因此，他们都躲过了被指责是“幸运精子俱乐部”的一员。巴菲特口中的这种人很可能拥有领导一个大型组织的管理技能，但从不用像其他人那样必须历经重重考验。有些家族企业没有培养出一个强大的接班人，结果落入职业经理人手中，世界上最大的两家连锁酒店希尔顿和万豪以及玩具制造巨头乐高就是例子。

对于那些还是决定要积极参与家族事业的人来说，这种选择也不一定就是一剂毒药。历史上使家族企业屹立不倒的一些逻辑如今仍然站得住脚。例如，指定继承人——例如阿尔诺的五个子女现在都管理着LVMH的部分业务——很早就接受了培养，等他们准备好接手时，已经在耳濡目染之下掌握了一些行业知识。

在个人层面上，工作不仅关乎金钱，还关乎自强和声望。自己的姓氏高挂门楣可能会给人一种使命感。维护一个帝国的基业还是很值得的，只要继承人展现激情和坚持。参与办公室八卦可能会让他们忘却自己的出身，但他们可以通过谦逊和勤恳赢得同事和下属的尊重。正经的继承人知道，仅仅是因为比独自奋斗更容易而投身人群并不能真的服众。

说到底，你应该努力让和你血脉相连的人放心地把家业交到你手上，而不要觉得他们这么做是理所当然。俗话说，“家族企业不是你从父母那里继承来的，而是你从子女那里借来的。”对这一真知灼见的漠视让《继承之战》如此引人入胜，也让威斯特-洛伊科王国（Waystar Royco）如此运转

失灵。 ■



Bartleby

The irresistible lure of the family business

The pros and cons of following in your parents' footsteps

FAMILY BUSINESS makes for compelling drama. Just ask anyone tuning in to the final season of “Succession”, which has recently begun airing on HBO. This Bartleby prefers “Buddenbrooks”, Thomas Mann’s chronicle of the decline and collapse of a German merchant family over the course of four generations. That novel, first published in 1901, drew heavily on the author’s personal experience. The dilemmas of working for an organisation which an immediate family member runs or in which they own the majority sound alarming enough in fiction, never mind real life. And nepotism can be plenty dramatic even without the plot twists.

These days it is frowned upon—most publicly listed companies and professional firms ban it. Still, family businesses make up more than 90% of the world’s enterprises. Many of them, quite literally, are mom-and-pop shops. Some are large-ish businesses in smallish economies, like the one in Athens where this guest Bartleby, straight out of university, was put in charge of managing relations with institutional investors. A handful are giant global corporations: think of Rupert Murdoch’s media empire (which allegedly inspired “Succession”) or Bernard Arnault’s \$460bn luxury conglomerate, LVMH (which, as it happens, has grown by acquiring other family firms, such as Bulgari and Fendi).

Regardless of size, all family companies face common challenges. Filial loyalty and multi-generational thinking can morph into resistance to change, and if a firm has outside shareholders, clash with their interests. The process of generational transition can be particularly draining and frustrating to the staff members who are not family, raising uncomfortable

questions about social mobility, or the lack thereof.

For the corporate heir, meeting family expectations and continuing a legacy while achieving personal fulfilment can generate a mass of contradictions, as Mann splendidly illuminated. Even in companies that insist they are meritocratic, no amount of skill will convince all your colleagues that you have actually earned your job. Any pre-existing domestic frictions might make their way into the business. And vice versa: disagreements over the business can breed feuds, often between siblings. In India, the bitter dispute between Mukesh and Anil Ambani over their inherited empire, Reliance Industries, lasted for years after their father died without leaving a will.

No wonder some heirs decide to hold on to their shareholdings, perhaps a board seat, but pursue a career elsewhere. Not all Waltons work for Walmart; it is hard to find Hoffmanns among executives at Roche, the Swiss drugmaking giant founded by their forebear in 1896. They thus avoided being accused of belonging to the “lucky sperm club”, as Warren Buffett calls those who might well possess the managerial skills to lead a large organisation but never had to jump through the same hoops as everyone else. Hilton and Marriott, two of the world’s biggest hotel chains, as well as Lego, a toymaking giant, are examples of companies which did not produce a strong successor and eventually ended up in the hands of professional managers.

For those who nevertheless decide to take an active role in the family business, it does not have to be a poison. Some of the logic that historically made family firms de rigueur continues to stand. For example, designated heirs—like Mr Arnault’s five children, all of whom now run parts of LVMH—are groomed early on, so by the time they are ready to take over they have already acquired some industry knowledge by osmosis.

At the personal level, work is not solely about money but also about

empowerment and prestige. Your name on the door may bestow a sense of purpose. Preserving the legacy of an empire can be rewarding, so long as the heir displays passion and persistence. They can probably forget being one of the gang when it comes to office gossip, but they can earn their colleagues' and subordinates' respect with modesty and hard work. The serious heir knows that showing up simply because it is easier than venturing out on their own doesn't cut it.

Ultimately, being entrusted with a business by people who share your DNA is something you ought to earn, not expect. As the adage goes, "A family business is not a business you inherit from your parents, it is a business you borrow from your children." Disregard for this nugget of wisdom is what makes "Succession" such riveting television—and Waystar Royco so dysfunctional. ■



亚洲商界精英

来会会亚洲的千禧一代富豪

他们比前辈更见多识广也更懂技术

古今中外，到处都有富裕家族不出三代就会衰败的说法。1700年去世的英国诗人约翰·德莱顿（John Dryden）曾思忖：“好日子难传三代。”据说在19世纪的美国，发达起来的人家常常会在三代内“从工装穿回到工装”。中国谚语“富不过三代”说的也是一样的意思。

随着全球超级富豪越来越多地来自新兴市场，“富不过三代”的假说正再次受到检验——尤其是在亚洲发展中国家。根据瑞信银行（Credit Suisse）的数据，2011年至2021年间，全球个人财富超五亿美元的人数从2700人增加到近7100人，亚洲人功不可没。而且在这十年中，发展中国家的富人在其中所占比例从37%上升到52%，亚洲大亨的带动作用也超过了非洲或拉丁美洲的。瑞士圣加仑大学（University of St Gallen）的研究人员称，去年，在全球家族企业500强中，亚洲有大约80家上榜，它们的总收入超过了一万亿美元（见图表1）。

总体而言，目前看来，对亚洲那些年纪渐长、正在寻找可靠的接班人来托付家业的大家长们（大多为男性）来说，“三代”假说的检验结果还是令人鼓舞的。亚洲创业一代大亨的孙辈们很可能穿着工装衬衫，但这只是他们的穿着偏好，而不是必须要穿。他们更见多识广，而长辈们是靠在经济快速发展期内蓬勃发展的本地生意（如建设、自然资源等）积累起财富。他们常把家族企业的需要和个人喜好融合在一起。

与此同时，他们深知自己有责任避免落入败家子陷阱。当他们接班时，用一位亚洲接班人的话说，能否证明“你可以制度化”，并且像“罗斯柴尔德家族那样”在几个世纪里不断创造财富，就看他们的了。（罗斯柴尔德家族成员是《经济学人》母公司的股东。）

要了解这些罗斯柴尔德的追随者的特性从何而来，就要先从他们所受的教

育说起。他们中的大多数人在国外上大学，通常是在美国。香港地产大亨郑裕彤的孙子郑志刚曾就读于哈佛大学。印尼商业王朝的后裔约翰·里亚迪（John Riady）出生于纽约，曾就读于乔治敦大学（Georgetown University），之后又分别获得宾夕法尼亚大学沃顿商学院的MBA学位以及哥伦比亚大学的法律学位。穆克什·安巴尼（Mukesh Ambani）的女儿伊莎·安巴尼（Isha Ambani）毕业于耶鲁大学，之后又在2018年从斯坦福大学商学院毕业。

海外教育经历让这些新一代大亨不同于他们的祖父辈——祖父辈中许多人从没念完大学。而他们与父辈的不同之处则在于他们进入家族企业的职业路径。郑志刚、里亚迪和安巴尼现在都和他们的父亲一样，在家族企业工作。郑志刚经营着家族的地产公司新世界发展；里亚迪是家族帝国的房地产开发商力宝卡拉瓦奇（Lippo Karawaci）的CEO；安巴尼负责信实集团的零售业务。不过，和许多同辈人一样，他们来到现在的位子走的是迂回路线。

对许多人来说，这意味着先在金融或专业服务行业工作一段时间。郑志刚的职业生涯从投资银行业开始，他曾就职于瑞银集团（UBS）。安巴尼在麦肯锡做过咨询顾问。里亚迪在私募股权公司工作过。而对另一些人来说，他们过渡的地方是风险投资和科技创业公司。泰国最大的私营公司正大集团的创始人的曾孙锅拉瓦·谢拉瓦农（Korawad Clearavanont）创办了一家科技创业公司，为应用提供社交媒体功能。马来西亚大宗商品、房地产和物流行业的亿万富翁郭鹤年的孙子郭孟雄经营着总部位于新加坡的风险投资公司K3 Ventures。

这些接班人能说流利的英语、接受国外教育并且进入了西方社交圈，这让他们成为理想的中间人——无论是在外国对亚洲的风险投资，还是亚洲对外国风投公司的投资中。这些资本流动还在增长：过去两年，在亚洲的风险投资平均每年达1500亿美元，是美国2800亿美元左右的一半多；而2012年这一数字为110亿美元，是美国的四分之一。在外国风险投资交易中的亚洲投资也在增长（见图表2）。根据数据公司Dealroom的数据，在美国，来自亚洲的投资额占比已经从十年前的不到10%上升到2022年的四分

之一左右。

允许接班人在家族企业之外工作，一定程度上是为了让他们尝试新事物。“第一代和第二代都相当传统。”香港中文大学家族企业研究中心主任区玉辉表示。但他们很乐意把孩子送出国，“那里价值观不同，经商方式也不同。”他补充道。

影响力投资和可持续发展相关工作很受千禧一代富豪的青睐。现代集团创始人郑周永的孙子郑京善没有进入现代集团，而是成立了一家名为Sylvan Group的影响力投资公司，专注于投资与联合国可持续发展目标相一致的公司。或许也受到务实主义的驱动，千禧一代富豪们在某些领域，比如不平等议题上，变得更勇于表达自己的进步观点。“在经济增长成果不被共享的社会里，他们想要拆分你，向你征税，监管你，他们假定最坏的情况。”一位接班人表示。

让接班人拥有家族企业之外的经验阅历反映了一种更为开明的培养方式。不过对老一辈人来说，这也变成一种商业上的重要考量，尤其是当家族生意向新的行业或地区散播和多元发展之时。以石化业务起家的信实集团如今是印度最大的电信公司和数字平台。力宝通过其风险投资子公司Venturra Capital在东南亚获得了更多与新生科技公司接触的机会。年轻的商界后辈比其父母拥有更广的人脉圈，这对他们的家族企业很有助益：与潜在的企业创始人、风险投资家、顾问和银行家交往，让他们能够在有吸引力的投资项目上提前锁定机会。

去年，咨询公司Campden Wealth调查了全球382个家族办公室（管理家族财富的投资公司）。它发现大多数人更希望下一代掌门人能在接班前拥有外部工作经验。在全球范围内，有54%的受访者表示，希望自己的接班人至少拥有一年的外部工作经验。而在亚洲，这一数字为58%。

由此看来，更加国际化和更自由的思维模式有望让年轻富豪们避开“三代陷阱”。但这并非没有风险。在许多发展中国家，商业帝国的建立既要有商业头脑，也要有政治敏感。2001年，当时供职于哥伦比亚大学的雷蒙德

·菲斯曼（Raymond Fisman）指出，上世纪90年代中期，每当有关印尼独裁者苏哈托健康状况恶化的传言再起，那些与政府关系密切的上市公司（其中许多是家族企业）的表现便不如那些政治联结更少的公司。类似的研究表明，在韩国，公司的政治忠诚与政府呈正相关关系：即使在上世纪80年代末韩国向民主政体和经济自由化转型之后，与执政党有关联的公司还是受益颇丰。

在许多新兴市场，与利益集团和地方权力掮客打交道仍然是做生意的重要组成部分。它可以让你确保受到优待、拿到政府合同，或者只是为了更了解常常错综复杂的官僚体制。美国的商学院不会教给亚洲年轻的商界精英这类技能。要保住自家帝国，他们还得向家中长辈们学习一二。 ■



Asian business elites

Meet Asia's millennial plutocrats

They are worldlier and techier than their forebears

THE IDEA that wealthy dynasties can go to pot in three generations pops up throughout history and around the world. John Dryden, an English poet who died in 1700, mused that “seldom three descents continue good.” In 19th-century America, successful families were said to go from “shirtsleeves to shirtsleeves” in that span of time. A Chinese proverb, fu bu guo san dai (wealth does not pass three generations) captures an identical sentiment.

As a rising share of the world’s ultra-rich comes from emerging markets, the three-generation hypothesis is being tested once again—nowhere more so than in developing Asia. Asians are helping to swell the number of individuals with fortunes of more than \$500m, which rose from 2,700 to nearly 7,100 globally between 2011 and 2021, according to Credit Suisse, a bank. The continent’s tycoons did more than their African or Latin American counterparts to push the developing world’s share of that total from 37% to 52% over the decade. The combined revenue of the continent’s 80 or so family firms that rank within the world’s 500 biggest such concerns surpassed \$1trn last year, according to researchers at the University of St Gallen in Switzerland (see chart 1).

Overall, the results of the three-generation test so far look encouraging for Asia’s ageing patriarchs (most are men) as they seek a safe pair of hands to which to entrust their legacy. The grandchildren of the region’s founder tycoons may well be in shirtsleeves, but out of sartorial choice rather than necessity. They are worldlier than their elders, who built their fortunes on local businesses that thrive in periods of rapid economic development, such as construction or natural resources. They often blend the needs of the

family business with personal preferences.

At the same time, they are keenly aware of their responsibility to avoid the prodigal trap. As they take the reins of their business houses, it is up to them to show whether, in the words of one Asian heir, “you can institutionalise” and, like “a sort of Rothschild”, keep generating wealth over centuries. (Members of the Rothschild family are shareholders in The Economist’s parent company.)

To understand what makes these Rothschild wannabes tick, start with education. Most have attended university abroad, often in America. Adrian Cheng, grandson of Cheng Yu-tung, a Hong Kong property tycoon, went to Harvard University. John Riady, the New York-born scion of an Indonesian business dynasty, attended Georgetown University, before earning an MBA at the Wharton School of the University of Pennsylvania and a law degree from Columbia University. Isha Ambani, daughter of Mukesh Ambani, graduated from Yale and then Stanford University’s Graduate School of Business in 2018.

A foreign education distinguishes the new crop of tycoons from their grandparents, many of whom never completed university. What sets them apart from their parents is their career paths into the family businesses. Like their fathers, Mr Cheng, Mr Riady and Ms Ambani all now work for these. Mr Cheng runs New World Development, the family’s property arm; Mr Riady is chief executive of Lippo Karawaci, the family empire’s property developer; Ms Ambani heads Reliance’s retail operation. But, like plenty of their peers, they took circuitous routes to get there.

For many, that means a stint in finance or professional services. Mr Cheng started his career in investment banking, including at UBS, a Swiss lender. Ms Ambani was a consultant at McKinsey. Mr Riady worked in private equity. For others, the bridge is the world of venture capital and tech

startups. Korawad Clearavanont, great-grandson of the founder of CP Group, Thailand's largest private company, launched a tech startup that provides social-media features for apps. Kuok Meng Xiong, grandson of Robert Kuok, a commodity, property and logistics billionaire from Malaysia, runs K3 Ventures, a Singapore-based VC firm.

Both in the case of foreign VC investments in Asia and of Asian investments in foreign VC firms, the heirs' fluent English, foreign education and Western social circles make them the ideal conduit. And these flows are growing: in the past two years VC investments in Asia averaged \$150bn annually, more than half of America's \$280bn or so, and up from \$11bn in 2012, when it was a quarter of America's. Asian investments in foreign VC deals are up, too (see chart 2). In America, the share from Asia has gone from less than 10% by value a decade ago to around a quarter in 2022, according to Dealroom, a data firm.

Permitting the heirs to have a professional life outside the family is partly about letting them spread their wings. "The first and second generation were quite traditional," says Kevin Au, director of the Centre for Family Business at the Chinese University of Hong Kong. But, he adds, they were happy to send their children abroad, "where values are different and business is done differently".

Impact investing and sustainability-related roles are popular among the millennial plutocrats. Rather than join Hyundai Group, Chung Kyungsun, grandson of its founder, Chung Ju-yung, has set up an impact-investment firm called Sylvan Group, which focuses on companies aligned with UN Sustainable Development Goals. The shift to more vocally progressive views in some areas, like inequality, may be driven by pragmatism, too. "In societies where economic growth isn't being shared, they want to break you up, tax you, regulate you, they presume the worst," says one heir.

Giving heirs experience beyond the family concern reflects a more open-minded parenting style. But it is also becoming a business priority for the older generation, especially as the family businesses diversify into new industries and geographies. Reliance, which made its name in petrochemicals, is now India's biggest telecoms firm and digital platform. Lippo has gained greater exposure to young technology firms in South-East Asia through Venturra Capital, its VC subsidiary. That young business scions have a wider circle of contacts than do their parents is useful for their families' firms: rubbing shoulders with would-be startup founders, venture capitalists, consultants and bankers offers opportunity for early dibs on interesting investment opportunities.

Last year Campden Wealth, a consultancy, surveyed 382 global family offices, the investment vehicles that manage dynastic wealth. It found that the majority would prefer the next generation of owners to gain external work experience before taking the reins. Globally, 54% of respondents said they expected their heirs to get at least a year of outside experience. In Asia the figure was 58%.

The more international and liberal mindset of the young plutocrats, then, holds promise for avoiding the three-generation trap. But it is not risk-free. Many developing-world commercial empires were constructed by combining business acumen and political nous. In 2001 Raymond Fisman, then at Columbia University, showed that whenever rumours about the failing health of Suharto, Indonesia's dictator, intensified in the mid-1990s, publicly listed firms that were close to the government, many of which were family-run, underperformed those with fewer political ties. Similar research suggests a positive association between the political allegiances of South Korean companies and the government: firms with ties to the ruling party benefited even after the country's transition to democracy and economic liberalisation in the late 1980s.

In many emerging markets, navigating interest groups and local power brokers remains an important part of doing business. It can ensure preferential treatment, access to state contracts or just a better understanding of the often Byzantine bureaucracy. American business schools will not teach Asia's young business elites such skills. To preserve their family empires, they will also have to learn a thing or two from their elders. ■



【首文】昂首阔步

美国惊人经济成就的启示

全球最大经济体越发一骑绝尘

假如有什么是美国各政治派系都认同的，那就是如今美国经济已然崩坏。特朗普认为贸易是一种敲诈并且美国日渐衰落，他喊着要让美国再次伟大的承诺入主白宫。现任总统拜登正斥资两万亿美元重塑经济，希望把它重建得比以前更好。美国人忧心忡忡。近五分之四民调受访者认为自己子女以后的日子会比自己的糟糕，是自1990年该调查开启以来录得的最高比例，当年只有约五分之二的受访者如此悲观。上一次有这么多人认为美国经济如此差劲是在2008年全球金融危机爆发期间。

然而，这样的焦虑掩盖了一个令人惊叹的成功故事：一种经久不衰却被低估的优异表现。美国仍是世界上最富裕、最高产、最创新的大型经济体。它在众多指标上表现出色，在全球越发一骑绝尘。

先看大家都熟悉的经济成就指标：GDP。1990年，按市场汇率计算，美国贡献了全球产出的四分之一。30年过去了，在中国经济影响力日增的同时，这个占比几乎没有变化。美国在富裕世界的支配力令人咋舌。当今，美国在七国集团GDP中的占比为58%，而1990年是40%。按购买力调整后，只有那些超级富裕的石油国家和金融枢纽的人均收入高于美国。美国的人均收入增速远高于西欧和日本。同样按购买力调整后，美国最穷的密西西比州的平均收入也超过五万美元，高于法国。

在许多增长要素方面，美国的数字也同样亮眼。相比1990年，现在美国劳动人口增加了近三分之一，而西欧和日本仅增加十分之一。而且，也许有点出人意料的是，美国这些劳动者中有更多人拥有本科或研究生学位。的确，美国人的平均工作时数比欧洲人和日本人长，但生产效率明显高于后两者。

美国公司拥有超过五分之一的海外注册专利，比中国和德国的总和还多。

全球研发投入最高的五家公司都是美国的，过去一年已总计投入2000亿美元。从笔记本电脑、iPhone到人工智能聊天机器人，其创新成果已惠及全球各地的消费者。如果投资者在1990年向标普500指数投入100美元，今天会增至超过2000美元，是他们在其他富裕国家和地区的投资收益的四倍之多。

对于上述这一切，可能有人反驳说，美国人的确收入更高，却是以社会福利制度不那么优厚为代价的。按占GDP比例来看，美国的社会福利支出确实较其他国家吝啬得多。但它已越来越向欧洲看齐，而且随着经济增长，这方面支出的增速还更快。针对工人和子女的税收抵免政策已经变得更慷慨。对最低收入人群的医疗保险已扩大覆盖范围，特别是在奥巴马任内。在1979年，美国按收入状况提供的补助相当于本国最贫困人群税前收入的三分之一；到2019年，该比例达到三分之二。得益于此，自1990年以来，美国最贫穷20%人口的收入按实际价值计算上升了74%，远超英国的水平。

美国的突出表现为世界各国提供了许多经济增长的经验。首先，规模很重要。美国胜在拥有庞大的消费市场，可以分摊研发成本，还有深厚的资本市场满足融资之需。只有中国，也许有一天还有印度，能拥有如此大规模的购买力。其他国家也曾试图模仿，但即使是那些最接近的欧洲国家也难以成为真正的单一市场。碍于破产法和合同条款的差异，以及各种监管壁垒，银行家、会计师和建筑师难以跨境出售服务。

劳动力的规模和质量也很重要。与其他富裕国家相比，美国的优势是人口较年轻，生育率也较高。其他地方要弥合这方面的差距也许不容易，但各国至少可以从美国的高移民率中得到启发。2021年，移民占美国劳动力的17%，而在老龄化的日本比例不到3%。

另一个经验是保持活力的重要性。在美国，开办公司的手续很简便，公司破产重组也很容易。灵活的劳动力市场有助就业适应需求模式的变化。今年年初Alphabet和其他科技公司纷纷裁员，在美国许多被解雇的劳动者这会儿已经在别家发挥自己抢手的技能了，或者走上了创业之路。相比之下，

下，在欧洲大陆，科技公司仍在为裁员谈判不休，而且未来在那里的招聘也可能会三思而行。

美国人应该对本国经济表现感到放心才是。按历史经验推导，即便在美国担负经济去碳成本之时，下一代人的生活水平仍将继续提高。然而，尽管增长表现强韧，还是有一些阴影。中产人群的税后收入增速低于最贫穷和最富有的人群。有一个群体陷入了困境。多年来，美国壮年男子的失业比例一直在上升，高于英国、法国和德国的水平。美国人的预期寿命落后于其他富裕国家，这可不太体面，主要原因是太多年轻人死于毒品过量和枪支暴力。在经济整体上升时解决这些问题本来是更容易的，但美国恶劣的政治斗争可没起什么好的作用。

此外，美国人越是认为本国经济是个需要纠正的问题，美国政客就越可能把未来30年弄得一团糟。尽管美国的开放在过去为其企业和消费者带来了繁荣，但特朗普和拜登都转向了保护主义，移民政治也变得有毒。短期来看，政府补贴可以促进对贫困地区的投资，但有可能减弱市场的创新动力。长远而言，这类补贴还会让虚耗资金且扭曲市场机制的游说活动更加固化。中国的崛起和应对气候变化之需都使美国面临新的挑战。这就更需要记得是什么驱动了它长期的经济辉煌。 ■



Riding high

The lessons from America's astonishing economic record

The world's biggest economy is leaving its peers ever further in the dust

IF THERE IS one thing that Americans of all political stripes can agree on, it is that the economy is broken. Donald Trump, who saw trade as a rip-off and his country in decline, came into office promising to make America great again. President Joe Biden is spending \$2trn remaking the economy, hoping to build it back better. Americans are worried. Nearly four-fifths tell pollsters that their children will be worse off than they are, the most since the survey began in 1990, when only about two-fifths were as gloomy. The last time so many thought the economy was in such terrible shape, it was in the throes of the global financial crisis.

Yet the anxiety obscures a stunning success story—one of enduring but underappreciated outperformance. America remains the world's richest, most productive and most innovative big economy. By an impressive number of measures, it is leaving its peers ever further in the dust.

Start with the familiar measure of economic success: GDP. In 1990 America accounted for a quarter of the world's output, at market exchange rates. Thirty years on, that share is almost unchanged, even as China has gained economic clout. America's dominance of the rich world is startling. Today it accounts for 58% of the G7's GDP, compared with 40% in 1990. Adjusted for purchasing power, only those in über-rich petrostates and financial hubs enjoy a higher income per person. Average incomes have grown much faster than in western Europe or Japan. Also adjusted for purchasing power, they exceed \$50,000 in Mississippi, America's poorest state—higher than in France.

The record is as impressive for many of the ingredients of growth. America has nearly a third more workers than in 1990, compared with a tenth in western Europe and Japan. And, perhaps surprisingly, more of them have graduate and postgraduate degrees. True, Americans work more hours on average than Europeans and the Japanese. But they are significantly more productive than both.

American firms own more than a fifth of patents registered abroad, more than China and Germany put together. All of the five biggest corporate sources of research and development(R&D) are American; in the past year they have spent \$200bn. Consumers everywhere have benefited from their innovations in everything from the laptop and the iPhone to artificial-intelligence chatbots. Investors who put \$100 into the S&P 500 in 1990 would have more than \$2,000 today, four times what they would have earned had they invested elsewhere in the rich world.

One retort to this could be that Americans trade higher incomes for less generous safety-nets. America's spending on social benefits, as a share of GDP, is indeed a great deal stingier than other countries'. But those benefits have become more European and, as the economy has grown, they have grown even faster. Tax credits for workers and children have become more generous. Health insurance for the poorest has expanded, notably under President Barack Obama. In 1979 means-tested benefits amounted to a third of the poorest Americans' pre-tax income; by 2019 these came to two-thirds. Thanks to this, incomes for America's poorest fifth have risen in real terms by 74% since 1990, much more than in Britain.

For the world as a whole, America's outperformance says much about how to grow. One lesson is that size matters. America has the benefit of a large consumer market over which to spread the costs of R&D, and a deep capital market from which to raise finance. Only China, and perhaps one day India, can boast of purchasing power at such scale. Other countries have sought

to mimic it. But even those in Europe, which have got the closest, have struggled to become a true single market. Differences in bankruptcy laws and contractual terms, together with a variety of regulatory barriers, prevent bankers, accountants and architects from touting services across borders.

The size and the quality of the workforce matters, too. America was blessed with a younger population and a higher fertility rate than other rich countries. That may not be easily remedied elsewhere, but countries can at least take inspiration from America's high share of immigrants, who in 2021 made up 17% of its workforce, compared with less than 3% in ageing Japan.

Another lesson is the value of dynamism. Starting a business is easy in America, as is restructuring it through bankruptcy. The flexibility of the labour market helps employment adapt to shifting patterns of demand. Already many of the workers in America who were laid off from Alphabet and other tech firms at the start of the year are applying their sought-after skills elsewhere, or setting up their own businesses. In continental Europe, by contrast, tech firms are still negotiating lay-offs, and may think twice about hiring there in future.

Americans should find the economy's performance reassuring. If history is a guide, living standards will continue to go up for the next generation, even as the country bears the costs of decarbonising the economy. Yet, resilient as the growth record has been, there are shadows. The middle class has seen its post-tax incomes rise by less than those of both the poorest and the richest. A group of people have fallen into hard times. The share of prime-age American men who are not in work has been rising for years and is higher than in Britain, France and Germany. And life expectancy in America lags shamefully behind others in the rich world, mainly on account of too many younger people dying from drug overdoses and gun violence. Tackling such problems should be easier when the economy as a whole is growing. But America's poisonous politics are no help.

In addition, the more that Americans think their economy is a problem in need of fixing, the more likely their politicians are to mess up the next 30 years. Although America's openness brought prosperity for its firms and its consumers, both Mr Trump and Mr Biden have turned to protectionism and the politics of immigration have become toxic. Subsidies could boost investment in deprived areas in the short term, but risk dulling market incentives to innovate. In the long run they will also entrench wasteful and distorting lobbying. The rise of China and the need to fight climate change both confront America with fresh challenges. All the more reason, then, to remember what has powered its long and successful run. ■



系统中的虫子

细菌和病毒在世界历史中的作用

乔纳森·肯尼迪说，微生物造就了人类【《发病机制》书评】

《发病机制》。乔纳森·肯尼迪著。皇冠出版集团，304页，30美元。
Torva，25英镑。

在智人进化的前25万年里，他们与非洲、亚洲和欧洲的其他几个人种一同生活在地球上。然而，大约5万年前，智人离开非洲，向世界各地迁徙。大约在同一时间，所有其他物种开始消失。化石记录显示，最后一批尼安德特人大约在39,000年前灭绝，只留下了智人。

其他人类为何消亡了也许是有关旧石器时代早期最大的难题。一种流行的解释是智人更聪明。历史学家尤瓦尔·诺亚·赫拉利（Yuval Noah Harari）在他的《人类简史》（Sapiens）一书中指出，在7万到3万年前，人类经历了某种“认知革命”，可能发生在某个基因突变改变了他们的思维方式之后。由于智人比其他物种更聪明，他们有更好的沟通技巧，战斗能力可能也更强。

《发病机制》（Pathogenesis）的作者乔纳森·肯尼迪（Jonathan Kennedy）认为，智人之所以胜出，有一种更好的解释：他们的免疫系统更优越。随着他们人口数量的激增，基因多样性也在增加，而且由于生活在非洲，他们比其他人类更接近赤道，接触过的携带各种微生物的动物可能也更多种多样。其中一些微生物可能具有致病性。（事实上，大多数感染人类的细菌都是人畜共患的，即它们跨越了与其他动物之间的物种壁垒。）

随着智人向世界各地迁徙，他们应该能够免受遇到的其他人类所携带疾病的侵害。然而反过来却不成立，也就是说，尼安德特人和其他人类对智人携带的疾病没那么强的抵抗力。

在此基础上，肯尼迪大幅重写了生命史，将微生物置于核心位置。“这是细菌的世界，”他写道，“而我们不过是这里的不速之客。”例如，感染影响了哺乳动物生物机制的基本要素。动物最初进化时，它们通过产卵来繁殖。但在几亿年前，一种形似鼩鼱的生物发展出了在体内孕育后代的能力。遗传学家认为这种能力不是自然进化而来的，而是在病毒将其DNA插入这种生物的基因组时突然获得的。如果没有这一感染，人类今天可能还在从卵中孵化出来。

疾病也塑造了人类文明进程。古罗马人遭遇了多重瘟疫，肯尼迪认为，由此造成的死亡和破坏不仅导致了罗马帝国的崩解，还引发了社会变革，使基督教得以统治世界。

他最惊人的一些故事来自西班牙对美洲的征服。这方面的主流说法是欧洲人拥有更好的技术和武器，可以用来征服美洲的欠发达族群。肯尼迪说，这不完全正确。

他写道，欧洲传染病的传入导致美洲人口减少了90%，从1500年的大约6050万降至一个世纪后的600万。如果说欧洲人把疾病带给了美洲人，那么美洲的病原体为何没对入侵者产生类似的影响？欧洲人具有免疫力的许多疾病源自牛、猪和羊等驯养的群居动物。在美洲，人们也驯养过动物——羊驼、豚鼠和大羊驼——但“与欧亚农场动物的祖先们不同，羊驼和大羊驼在驯化之前并没有过大规模的群居生活，这限制了疾病出现并成为地方病的机会。”美洲人应该没有从自己饲养的动物那里接触过同样多的微生物。

这本书的写作带着一点套路：只要一组新的人物出现，你就知道，传染病要来了。但它令人信服地讲述了细菌和病毒在世界史中所扮演的角色，因此这点小瑕疵无伤大雅。肯尼迪组织起令人眼花缭乱的各种材料，从欧洲封建社会向资本主义的转变，到奴隶贸易的兴起，再到1781年美国革命者在约克镇击败英军。

书中穿插的流行文化元素帮助了肯尼迪的流行病学写作：《指环王》、

《2001太空漫游》（2001: A Space Odyssey）和巨蟒剧团（Monty Python）为他的某些复杂故事提供了切入点。因此，尽管这本书的见解笼统单调，读起来还是很愉快。“强调传染病所扮演的角色并不是排除人类对世界产生影响的可能性，”他总结道，“只是，我们常常不是在自己选择的环境中创造历史，而是在微生物创造的环境中创造历史。”■



Bugs in the system

The role of bacteria and viruses in world history

Microbes maketh man, says Jonathan Kennedy

Pathogenesis. By Jonathan Kennedy. Crown; 304 pages; \$30. Torva; £25

FOR THE first 250,000 years after *Homo sapiens* evolved, they existed on Earth alongside several other species of human in Africa, Asia and Europe. Around 50,000 years ago, however, *H. sapiens* left Africa and migrated across the world; around the same time, all the other species began to disappear. The fossil record shows that the last Neanderthals died out roughly 39,000 years ago, leaving only *H. sapiens*.

Why the other humans perished may be the biggest conundrum of the early Palaeolithic age. The prevailing explanation is that *H. sapiens* was more intelligent. In his book “Sapiens”, Yuval Noah Harari, a historian, argued that the species went through a kind of “cognitive revolution” between 70,000 and 30,000 years ago, probably after a genetic mutation transformed how they thought. Since *H. sapiens* was brainier than other species, these humans had better communication skills and, presumably, better fighting ability.

According to Jonathan Kennedy, the author of “Pathogenesis”, there is a better explanation for why *H. sapiens* prevailed: their immune systems were superior. As their populations boomed, genetic diversity increased and, since they lived in Africa, much closer to the equator than other humans, *H. sapiens* would have been exposed to a greater array of animals carrying a variety of microbes. Some of those microbes would have been pathogenic. (Indeed, the majority of bugs that infect humans are zoonotic—ie, they jump the species barrier from other animals.)

As *H. sapiens* moved across the world, they would have been protected against the diseases carried by the other humans they met. The converse was not true, however, meaning Neanderthals and other humans were less resistant to the diseases carried by *H. sapiens*.

From there, Mr Kennedy goes on to rewrite much of the history of life, with microbes at the forefront. “It’s a bacterial world”, he writes, “and we’re just squatting here.” Infections have shaped fundamental elements of mammalian biology, for example. When animals first evolved, they laid eggs in order to reproduce. But a few hundred million years ago, a shrew-like creature developed the ability to grow young inside her body. Geneticists argue that this ability did not evolve naturally, but was suddenly acquired when a virus inserted its DNA into the creature’s genome. Without that infection, humans might be hatching from eggs today.

Human civilisations have been shaped by disease, too. Multiple plagues afflicted ancient Romans and Mr Kennedy argues that the death and devastation not only led to the collapse of that empire, it also set in motion the societal changes that allowed Christianity to dominate the world.

Some of his most striking stories come from the Spanish conquest of the Americas. The prevailing story here is that the Europeans had better technology and weapons with which to subdue the less advanced societies in the Americas. That’s not entirely true, Mr Kennedy says.

The introduction of infectious diseases from Europe, he writes, resulted in a 90% fall in the population in the Americas, from about 60.5m in 1500 to 6m a century later. If Europeans brought disease to those in the Americas, why didn’t American pathogens have a similar effect on the invaders? Many of the diseases Europeans had immunity to had originated in domesticated herd animals such as cows, pigs and sheep. In the Americas, people had also domesticated animals—alpacas, guinea pigs and llamas—but “unlike

the ancestors of Eurasian farm animals, alpacas and llamas hadn't lived in vast herds prior to domestication, limiting the opportunities for diseases to emerge and become endemic." People in the Americas would not have been exposed to as many microbes from their farmed animals.

There is a hint of formula about this book: as soon as a new set of characters is introduced, you know infection looms. But that is a minor quibble in a compelling account of the role of bacteria and viruses in world history. Mr Kennedy marshals a dizzying range of material, from the transition from feudalism to capitalism in Europe to the rise of the slave trade to the defeat of the British army by American revolutionaries in Yorktown in 1781.

It helps that Mr Kennedy's epidemiological writing is leavened with pop-culture references: "The Lord of the Rings", "2001: A Space Odyssey" and Monty Python provide on-ramps for some of the complex tales Mr Kennedy tells. Despite the sweeping ideas, therefore, his book is an entertaining read. "Emphasising the role that infectious diseases play doesn't exclude the possibility that humans can have an impact on the world," he concludes. "It's just that very often we don't make history in circumstances of our own choosing, but in circumstances created by microbes." ■



游戏规则改变者

人工智能将如何颠覆电子游戏

游戏制作特别耗神费力——也已经特别适合自动化

计算机的中央处理器（CPU）并不是为了让颜色鲜艳的物体在屏幕上快速闪现而设计的。所以街边游戏机的制造商发明了图形处理器（GPU），这是一组处理视频游戏视觉效果的电路，与中央处理器所做的工作并行完成。之后，GPU帮助复杂任务提速的能力找到了更广泛的用途：编辑视频、加密货币挖矿，以及最近的人工智能（AI）训练。

如今AI正在颠覆帮助它诞生的行业。生成式AI消化输入的文本、图像、音频或视频，然后创造出新的同类型输出，娱乐的角角落落都将受到它的影响。但风投公司安德森·霍洛维茨（Andreessen Horowitz）认为，游戏业的变化将会是最大的。游戏的互动性要求游戏中必须充斥耗神费力设计出来的内容：想想最新的牛仔冒险游戏《荒野大镖客2》（Red Dead Redemption 2），里面有30平方英里的景观、60小时的音乐。启用AI助手炮制这些内容或许能大大缩短耗时、减少预算。

上个月在旧金山举行的游戏开发者大会（Game Developers Conference）上，游戏开发商展示了他们最新的AI戏法。曾开发出《刺客信条》等爆款游戏的法国公司育碧（Ubisoft）推出了一款名为Ghostwriter的工具，能为游戏角色生成对话。美国DIY游戏平台罗布乐思（Roblox）推出了一款工具，可以根据“彩色玻璃”这样的文本指令绘制对应的游戏素材，还为程序员提供了一个可以自动补全代码的助手。几周前，Straight4 Studios发布了新款赛车游戏《GTR复兴》（GTR Revival）的预告，由AI提供个性化的赛车解说。

AI代表着一次“机会大爆炸”，游戏公司King的技术主管史蒂夫·柯林斯（Steve Collins）这样认为。该公司制作过热门手机游戏《糖果传奇》（Candy Crush Saga）。它在去年收购了AI公司Peltarion，用AI衡量

游戏关卡的难度。“这就好比手上有一百万名玩家任你测试。”柯林斯说。今年，另一家大型游戏开发商艺电（Electronic Arts）和谷歌都获得了在游戏测试中使用AI的专利。游戏开发“引擎”Unity计划创建一个市场，供开发者交易AI工具。Unity主管AI的丹尼·兰格（Danny Lange）希望它能“把各种资源水平的创作者放在一个更平等的竞争环境里”。

制作游戏已经比以前容易了：去年在游戏平台Steam上发布了近1.3万款游戏，几乎是2017年的两倍。游戏可能很快就会像音乐和视频行业一样——Spotify和YouTube平台上的大部分新内容都是由用户生成的。一名游戏公司高管预测，小公司会最快琢磨出因AI而变得可能的新游戏类型。上个月，英特尔高管拉贾·科杜里（Raja Koduri）离开了这家芯片制造商，成立了一家AI游戏创业公司。

不过也别觉得大公司就输定了。专注于游戏的风投公司Konvoy的乔希·查普曼（Josh Chapman）表示，如果它们一年推出六款高质量的游戏，而不是两三款，可能就会逐渐改变这个行业依靠大热作品驱动的特质。有更多选择的世界也更有利那些营销预算充足公司。而对于AI引发的日益增多的版权问题，巨头们可能有更好的对策。如果生成模型必须在开发人员拥有版权的数据上进行训练，那么那些拥有大量游戏产品的公司会比创业公司更有优势。曾参与《堡垒之夜》（Fortnite）等游戏创作的艺术家特伦特·卡尼乌加（Trent Kaniuga）上个月表示，自己的一些客户已经更新了他们的合同，禁止使用AI生成的艺术作品。

如果律师不介入，工会可能会。游戏公司委婉地把AI助手称为“副驾驶”，而不是人类替代品。但员工们不敢冒险。今年3月，成员包括游戏编剧的美国编剧工会（Writers' Guild of America）表示：“抄袭是AI程序的一个特征。”在好莱坞，它威胁要罢工。沮丧的创意人员也可能给游戏业按下暂停键。 ■



Game changer

How AI could disrupt video-gaming

Gamemaking is especially laborious—and especially ripe for automation

FLINGING BRIGHTLY coloured objects around a screen at high speed is not what computers' central processing units were designed for. So manufacturers of arcade machines invented the graphics-processing unit (GPU), a set of circuits to handle video games' visuals in parallel to the work done by the central processor. The GPU's ability to speed up complex tasks has since found wider uses: video editing, cryptocurrency mining and, most recently, the training of artificial intelligence.

AI is now disrupting the industry that helped bring it into being. Every part of entertainment stands to be affected by generative AI, which digests inputs of text, image, audio or video to create new outputs of the same. But the games business will change the most, argues Andreessen Horowitz, a venture-capital (VC) firm. Games' interactivity requires them to be stuffed with laboriously designed content: consider the 30 square miles of landscape or 60 hours of music in "Red Dead Redemption 2", a recent cowboy adventure. Enlisting AI assistants to churn it out could drastically shrink timescales and budgets.

Gamemakers showed off their latest AI tricks at the Game Developers Conference in San Francisco last month. Ubisoft, a French developer of blockbusters such as "Assassin's Creed", unveiled Ghostwriter, a tool that generates dialogue for in-game characters. Roblox, an American platform for DIY games, launched one that draws materials from text commands, like "stained glass", and an autocomplete helper for programmers. A few weeks earlier Straight4 Studios previewed a new driving game, "GTR Revival", with personalised racing commentary delivered by AI.

AI represents an “explosion of opportunity”, believes Steve Collins, technology chief of King, which makes “Candy Crush Saga”, a hit mobile game. King, which bought an AI firm called Peltarion last year, uses AI to gauge levels’ difficulty. “It’s like having a million players at your disposal,” says Mr Collins. This year Electronic Arts, another big gamemaker, and Google both received patents for using AI in game testing. Unity, a game-development “engine”, plans a marketplace for developers to trade AI tools. Danny Lange, Unity’s head of AI, hopes it will “put creators of all resource levels on a more equal playing-field”.

Making a game is already easier than it was: nearly 13,000 titles were published last year on Steam, a games platform, almost double the number in 2017. Gaming may soon resemble the music and video industries, in which most new content on Spotify or YouTube is user-generated. One games executive predicts that small firms will be the quickest to work out what new genres are made possible by AI. Last month Raja Koduri, an executive at Intel, left the chipmaker to found an AI-gaming startup.

Don’t count the big studios out, though. If they can release half a dozen high-quality titles a year instead of a couple, it might chip away at the hit-driven nature of their business, says Josh Chapman of Konvoy, a gaming-focused VC firm. A world of more choice also favours those with big marketing budgets. And the giants may have better answers to the mounting copyright questions around AI. If generative models have to be trained on data to which the developer has the rights, those with big back-catalogues will be better placed than startups. Trent Kaniuga, an artist who has worked on games like “Fortnite”, said last month that several clients had updated their contracts to ban AI-generated art.

If the lawyers don’t intervene, unions might. Studios diplomatically refer to AI assistants as “co-pilots”, not replacements for humans. But workers are taking no chances. The Writers’ Guild of America, whose members include

game scriptwriters, said in March that “plagiarism is a feature of the AI process.” In Hollywood, it is threatening strikes. Upset creatives may press pause on the games business, too. ■



梧桐

银行恐慌，社媒之过？

新技术不仅仅是加速了金融动荡

最近几周让欧美少数贷款机构陷入绝境的银行业动荡有一个新特点。与过往的危机不同，由于有了社交媒体和即时通讯应用，信息以闪电般的速度传播给不断扩大的恐慌人群。与此同时，新的数字金融工具又让神经紧绷的储户在一念之间便可取走存款，无论他们身在旧金山的办公室还是圣莫里茨的滑雪场。

硅谷银行的倒闭引起了分析师和立法者对银行挤兑速度加快的担忧，这是可以理解的。但过去十多年的新技术浪潮绝不是第一次改变人们的行为。之前的例子表现出某种模式：创新最初有助于促进繁荣，催生出憧憬未来无限可能性的泡沫，然后不断加速并放大最终的破灭。历史还表明，近期的技术变革可能会产生更加深刻的影响，在长期重塑市场面貌。

从1840年代开始，电报在美国风靡一时，它通过架空电缆传输报文，把波士顿、芝加哥、纽约和费城等此前全不相干的金融市场连接起来。1866年，海底电报电缆又使美国和欧洲之间的可靠通信成为了可能。历史学家认为，这些传递金融信息的新方法帮助消除了定价的低效。例如，美国和英国的棉花价差缩小了三分之一，波动性也有所降低。这种新的沟通方式意义重大，留下了深远影响。至今外汇交易员私下里仍将英镑兑美元的汇率称为“cable”。

但效率往往有其代价。在19世纪，电报通讯既昂贵又受限，接收到的信息还有被传递者操纵的风险。在1873年的恐慌期间，本刊记者也反复讨论新技术把恐慌从一个市场传播到另一个的破坏性影响是否多过其积极影响。一个世纪后，在1987年10月的市场崩盘中，新技术再次引发了担忧。布雷迪委员会（Brady Commission）后来调查了美国的这次崩盘，发现跨境电子通讯加剧了问题。当时的交易员和监管者都自以为仍身处过去那种相对

封闭的国内市场，但事实并非如此。

然而，技术突破加剧银行业危机只是其改造金融市场的方式之一。弗吉尼亚大学的经济历史学家约翰·汉德尔（John Handel）注意到，随着自动收报机纸带这种更先进的电报信息收发方式在19世纪后期的金融行业中得到越来越广泛的应用，垄断这种通讯的机构得以增强了自己的势力。伦敦证券交易所以及获许可从该交易所传输数据的交换电讯社（Exchange Telegraph Company）都是受益者。这帮助确立了证券交易所在全球金融市场中的角色。

从历史上看，交易成本较高而客户的财经知识较少都让银行受益，因为这意味着储户不会把太多资金转移到收益率更高的货币市场基金。如今，新的通信技术和数字金融意味着大众投资者更容易了解银行存款的替代品，也有更多机会投资它们。哥伦比亚大学、北京大学和斯坦福大学的学者最近的研究指出，在中国的银行里，储户对余额宝（一个提供货币市场基金投资的线上投资平台）的接触越多，他们提走的资金就越多。今年3月，近3000亿美元资金涌入美国的货币市场基金，新技术就可能起到了推波助澜的作用，这进一步撼动了银行的地位。

创新在过去加速了突然的市场动荡，让在19世纪需要几个月才能形成的恐慌缩短到几周。在现代，时间线进一步压缩，从几周缩短到几天，甚至几个小时。然而，这可能只是无摩擦交易和自由获取资讯（质量参差不齐）在未来几年影响金融的方式之一。过去几十年甚至几个世纪里，银行依靠高交易成本和客户的低财经素养坐享利润，这种局面可能也会变得更难维续了。■



Buttonwood

Did social media cause the banking panic?

New technology does more than just speed up financial wobbles

THE BANKING turmoil that has sent a handful of American and European lenders to the wall in recent weeks has a new feature. Use of social media and messaging apps, which spread information at lightning pace to an ever-larger group of panickers, marks a break from past crises. Meanwhile, new digital-finance tools let nervous depositors withdraw funds as soon as the notion strikes them, whether from offices in San Francisco or ski slopes in Saint Moritz.

After the fall of Silicon Valley Bank, the idea of faster bank runs is understandably causing concern among analysts and legislators. Yet the wave of new tech in the past decade and a bit is by no means the first to change behaviour. Previous examples suggest something of a pattern: innovations initially help facilitate a boom, contributing to exuberance based on a sense of futuristic possibility, before speeding up and magnifying the eventual bust. History also suggests that recent technological changes may have a deeper impact, reshaping markets in the long run, too.

From the 1840s onwards, America was blanketed by the electric telegraph, which transmitted messages by overhead wires, connecting previously disparate financial markets in Boston, Chicago, New York and Philadelphia. In 1866 reliable communication became possible between America and Europe as well, thanks to an undersea telegraph cable. Historians credit these new methods of transmitting financial information with smoothing out pricing inefficiencies. The gap between American and British cotton prices dropped by a third, for example, and volatility also declined. The new

form of communication was significant enough to have left a legacy. Among currency traders, the sterling-dollar exchange rate is still known informally as “cable”.

But efficiency often comes at a cost. In the 19th century, communication by cable was expensive and limited, and the information received at risk of manipulation by those transmitting it. During the panic of 1873, correspondents at *The Economist* went back and forth about whether the debilitating effects of new technologies, spreading panic from one market to another, outweighed the positives. A century later, new technology again provoked worries during a market crash in October 1987. The Brady Commission, which later investigated the slump in America, found that electronic communication across borders exacerbated problems. Traders and regulators believed they were in the more insulated, national markets of the past. They were not.

The effect that technological breakthroughs have on banking crises is just one way they transform financial markets, however. John Handel, an economic historian at the University of Virginia, notes that increasingly widespread use of ticker tape—a more advanced form of telegraph-transmitted messaging—in late-19th-century finance enhanced the power of the institutions that monopolised it. The London Stock Exchange and the Exchange Telegraph Company, which was licensed to transmit data from the exchange, were beneficiaries. This helped formalise the role of the stock exchanges in global financial markets.

Historically, banks have benefited from high transaction costs and the low financial literacy of customers, which together have kept depositors from moving too much money into higher-yielding money-market funds. Today new communications tech and digital finance mean the investing populace is both more aware of the alternatives to bank deposits and has more opportunity to invest in them. Recent research by academics at Columbia,

Peking and Stanford universities notes that Chinese banks where depositors have more exposure to Yu'ebao, an online investment platform offering money-market-fund investments, see more withdrawals from customers. New tech might have helped facilitate the surge of almost \$300bn into American money-market funds in March, further destabilising banks.

Innovation has sped up sudden market wobbles, truncating panics that would have taken months in the 19th century to weeks. In the modern era, timelines have contracted further, from weeks to days or even hours. Yet this may turn out to be just one of the ways in which frictionless trading and freely available information, of varying quality, affect finance in years to come. The profits banks have enjoyed for decades—or centuries—thanks to high transactions costs and low financial literacy might also become harder to sustain. ■



魔咒失效

哪些国家逃出了中等收入陷阱？

海湾地区的进步比非洲更明显

在过去半个世纪里，许多看起来前途无量的经济体卡在中等收入的平庸中没有更大起色。为了帮助其最大的客户避免这种命运，世界银行在十年前发布了一份旗舰报告，题为《2030年的中国》（China 2030）。该报告告诫要警惕“中等收入陷阱”——这是描述这一现象的术语。报告称：“在1960年的101个中等收入经济体中，只有13个在2008年成为高收入经济体。”这一引人注目的统计数据配上了类似于下图的图表。十年过去了，情况有什么改变吗？

这个问题的答案取决于使用何种中等收入定义。根据世界银行的官方划分，一个国家只有在人均GDP超过13,200美元时才能算是高收入国家。按照这个标准，中国似乎必将在一两年内摆脱中等收入陷阱。但在绘制“2030年的中国”图表时，世行采用了一种更严格的定义：按购买力平价计算，中等收入国家的人均GDP约为美国的5%至43%。

“2030年的中国”图表借鉴了经济学家安格斯·麦迪森（Angus Maddison）编制的历史GDP数据。此后，他的同事和继任者对这些估计进行修订并更新到2018年。本刊使用姊妹机构经济学人智库（Economist Intelligence Unit）的数据，将其进一步更新到2022年。

结果显示，有23个在1960年属于中等收入的国家现在已进入高收入行列。鉴于过去的十年充满挑战，这样的进展可能超出了人们预期。晋升者其中包括海湾地区的三个国家（巴林、阿曼和沙特阿拉伯）和六个欧盟成员国（克罗地亚、塞浦路斯、匈牙利、马耳他、波兰和斯洛文尼亚）。马来西亚成了进入高收入行列的亚洲小虎。非洲岛国塞舌尔也跨过了门槛。不幸的是，非洲另外两个在2008年被认为是高收入的国家——赤道几内亚和毛里求斯——却出现了倒退。

事实上，这个名单还可以进一步扩大。有七个按《2030年的中国》中的定义目前在高收入之列的国家在1960年还不是主权国家，因此没有出现在图表中。这些国家包括捷克和斯洛伐克，以及几个前苏联成员国：爱沙尼亚、哈萨克斯坦、立陶宛、拉脱维亚和土库曼斯坦。

曾经控制这些国家的俄罗斯也从1960年的中等收入国家变为2022年的高收入国家。俄罗斯经济挺住了普京的战争，表现好于预期。但今年其人均GDP可能会降至高收入门槛以下。一位俄罗斯改革者曾打趣说，他的国家被困在中等收入水平长达两个世纪。普京正在竭尽全力让它重回那个状态。 ■



Losing its bite

Which countries have escaped the middle-income trap?

Progress is more noticeable in the Gulf than Africa

OVER THE past half-century, many promising economies have become ensnared in middle-income mediocrity. To help its biggest client avoid this fate, the World Bank published a flagship report ten years ago entitled “China 2030”. The publication warned of the “middle-income trap”, a term to describe the phenomenon. “Of 101 middle-income economies in 1960, only 13 became high-income by 2008,” it claimed. This striking statistic was illustrated with a chart similar to the one below. A decade later, how has the picture changed?

Answering the question depends on the definition of middle-income employed. According to the World Bank’s official classifications, a country becomes high-income only when its GDP per person exceeds around \$13,200. By that standard, China looks set to escape the middle-income trap in a year or two. But for the purposes of the “China 2030” chart, the bank adopted a more stringent definition: middle-income countries have a GDP per person, at purchasing-power parity, of between roughly 5% and 43% of America’s.

The “China 2030” chart drew on historical GDP statistics prepared by Angus Maddison, an economist. His colleagues and successors have since revised and updated the estimates to 2018. We have further updated them to 2022 using figures from the Economist Intelligence Unit, our sister organisation.

The result is that 23 countries which were middle-income in 1960 now qualify as high-income—more progress than one might have expected over the past difficult decade. Graduates include three countries in the Gulf

(Bahrain, Oman and Saudi Arabia) and six members of the EU (Croatia, Cyprus, Hungary, Malta, Poland and Slovenia). Malaysia has joined the Asian tigers in the high-income bracket. The Seychelles, an island nation off Africa, has also crossed the threshold. Unfortunately, two other countries in the region, Equatorial Guinea and Mauritius, which were considered high-income in 2008, have moved in the other direction.

The list could in fact be expanded further. Seven countries that are now high-income by the “China 2030” definition did not exist as sovereign nations in 1960, so do not appear on the chart. These include the Czech and Slovak republics, as well as several former members of the Soviet Union: Estonia, Kazakhstan, Lithuania, Latvia and Turkmenistan.

The country that once dominated them, Russia, also moved from middle-income in 1960 to high-income in 2022. Its economy has withstood Vladimir Putin’s war better than expected. Yet its GDP per person could fall below the high-income threshold this year. A Russian reformer once quipped that his country had been trapped in middle-income for two centuries. Mr Putin is doing his best to return it to that state. ■



亚洲最大赛事

谁的经济增长会更快：印度还是印尼？

两国都在纷乱的世界里开辟致富新路径【深度】

如果你想在全球最大的20个经济体中寻找发展机会，有两个国家很突出：印度和印度尼西亚。国际货币基金组织（IMF）预测，这两个人口总计达17亿的亚洲大国将是2023年乃至未来五年里全球最大20个经济体中增长最快的国家。在一个去全球化、地缘政治动荡、自动化兴起以及能源转型的时代，这两个国家在寻求能赢得选举并避免社会动荡的政治配方的同时，也在开创经济发展的新战略。它们成功与否不仅关系到自己的国民以及对它们押下数以十亿计美元的投资者，同时还将为其他一众在本个十年及以后寻找新的可靠的发展方式的国家树立榜样。

几十年来，发展中国家遵循着一种稳妥的经济发展方式：将劳动力从农田转移到城市从事生产率更高的制造业，让他们生产出口商品，等着看经济的快速正规化。这一模式过去在韩国和台湾行之有效，也让中国大陆八亿人脱贫。但如今它不再那么奏效。许多国家和地区是闹腾的民主政体，而不是威权体制（韩国和台湾在工业化时都还是威权体制）。贸易保护主义对出口导向型增长构成了挑战。工厂正更多地应用机器人。

乍一看，印度和印尼有很多共同点。两国领导人都是2014年首次当选的魅力型领袖，而且两国都将在明年举行大选。印度总理莫迪和印尼总统佐科·维多多（Joko Widodo，常被称为佐科维[Jokowi]）都经过地方上的政治历练，并以办事得力而闻名。他们管理的国家也都很庞大（印度有14亿人口，印尼有2.8亿）、人口结构相对年轻，且民族和语言众多。

两国都经历了高速增长期：印度的GDP在过去十年中增长了71%，印尼增长了52%。主导产业都是服务业，而不是制造业（见图表1）。两国都相当开放，贸易额约占GDP的40%，每年流入的外国直接投资约相当于GDP的1.5%。两国都以非正规经济为主：90%的印度工人和60%的印尼工人都

在灰色经济中辛苦劳作。以富裕国家的标准来看，它们都是“小政府”：公共支出占GDP的比例在印度和印尼分别只有30%和18%。

这两个国家都在推进宏大的基础设施建设。自佐科维上台以来，印尼已经建造了18个港口、21个机场和1700公里的收费公路。印度每年新增一万公里高速公路。不过它们在经济上仍有巨大的追赶空间。印尼的人均国民收入为4180美元，印度约为其一半：两国都是“中低收入”经济体。

相似之处到此为止。为阐明这一点，我们从四个方面探讨两个国家：主要出口行业、产业政策、地缘政治立场，以及它们取悦选民的策略。先说能反映它们相对优势的主要出口行业。印度最重要的出口行业是技术服务。得益于每年能培养出50万名新工程师，印度在2021年占全球IT服务支出的15%。印尼的优势是大宗商品，其中像镍这样的大宗商品由于能源转型目前在全世界都有需求。到2030年，印尼将成为世界上第四大“绿色大宗商品”（用于电池和电网）生产国。

这些行业产生了大量的海外收入。2021年，技术服务占印度出口总值的17%左右，大宗商品（不包括燃料）占印尼出口总值的22%。但这些行业创造的就业机会很少：即使是印度的IT行业也只有500万名劳动者。

两国政府都希望通过产业政策来促进私营部门的发展。印度的起点更有利（见图表2）。覆盖其市场85%左右的MSCI印度指数总市值约达8300亿美元，约为GDP的24%。相比之下，印尼指数的总市值只有1230亿美元，相当于GDP的10%。印度有108家“独角兽”企业（即估值超过10亿美元的企业），仅次于美国和中国。而印尼的独角兽企业还不到12家。莫迪斥资300亿美元，押注“与生产挂钩的激励措施”，以促进包括半导体在内的14个重点行业的投资。他承诺到2070年实现温室气体“净零”排放，推出了包括建设太阳能发电厂、生产电池等诸多举措。除了绿色环保，其目的还包括创造就业机会和降低电力成本。印度的能源进口账单预计会从2021年占GDP的4%下降到2032年的2.5%。

印尼政府的王牌产业政策“下游化”聚焦自然资源。它使用“大棒”多于“胡萝卜”

卜”。印尼希望通过禁止一些原材料的出口来推动跨国公司在其本土建造精炼厂。例如在2014年，印尼禁止了镍原矿的出口。该禁令颁布前，印尼只有两家镍冶炼厂，2020年增加到了13家，到今年年底将不下30家。铝土矿的出口禁令很快会生效。印尼正在拟订计划，要向价值链的中高端进军。它的目标是在2030年将电动汽车电池的产能提升至140GWh，几乎相当于2020年全球的产量。去年，韩国现代汽车开始在印尼生产电动汽车。

在中美关系愈趋紧张之时，印度和印尼保持着不同的地缘政治立场。这些都会在几十年里影响外国投资和贸易。印尼希望在中国和西方之间保持平衡，这与它长期奉行的不结盟政策相一致。它于2021年成立的主权财富基金预计将从中国获得多达30亿美元的投资；中国也是印尼最大的外国直接投资来源国之一。印尼政府不认为自己是在坐收渔利。“印尼把印尼放在首位。”部长纳迪姆·马卡里姆（Nadiem Makarim）表示。

莫迪领导下的印度则对中国要警惕得多。它曾多次与中国发生致命边界冲突，并在此期间与美国、澳大利亚和日本组成了名为“四方安全对话”的战略集团。这对经济产生了影响。2020年，印度禁止了TikTok和其他几十个中国应用。自那以后，包括Vivo和小米在内的中国科技公司都遭遇过突击搜查和调查。作为莫迪产业战略的一部分，印度希望吸引那些正在谋求不再依赖中国的分散策略的西方公司。iPhone制造商富士康旗下的一家公司最近获批在卡纳塔克邦（Karnataka）建造一座10亿美元的工厂。

我们探讨的最后一个方面是两国政府如何取悦选民。两国经济都实现了可观的增长，但与中国和亚洲四小龙创造出的那种正规就业岗位相比，在数量上还有很大的差距。“很多年轻人失业，这是对（印度）人口红利的浪费。”印度前央行行长拉古拉姆·拉詹（Raghuram Rajan）表示。

应对措施之一是改善再分配，通常是采用新的数字化的福利制度。印尼有一个庞大的现金转移支付项目。莫迪的“印度堆栈”是一套由政府支持的数字平台，它把拥有电子身份的国民与支付系统、税收系统以及银行账户关联起来。在2022财政年度，政府通过这些叫作“直接福利转移”的系统拨付了765亿美元，超过GDP的2%，约9亿人受惠。

然而两国在政治上的做法差异巨大。佐科维领导着一个庞杂的联合政府，其中包括曾经的竞争对手以及国会十个政党中的八个。新加坡前外交官马凯硕（Kishore Mahbubani）写道，佐科维的一个“独特本领”是通过包容各方来遏制伊斯兰政党。虽然佐科维不能再次参加明年的选举，但他的多元化路线很可能会持续下去。

莫迪却反其道而行之，他利用反穆斯林的沙文主义来激励印度。皮尤研究中心（Pew）称，如今三分之二的印度教徒认为，成为印度教徒对于成为“真正的印度人”非常重要。在明年的选举中，宗教紧张局势很可能会加剧，自由主义价值观会进一步被削弱。上月，最大反对党的领袖拉胡尔·甘地（Rahul Gandhi）输掉了一场官司，被取消了议员资格。

哪种模式将带来最快的增长？两个国家面临着任人唯亲等一些共有的问题。佐科维周围都是社会关系通达的大亨；在印度，深具影响力的阿达尼集团（Adani Group）麻烦缠身，已在全国闹得沸沸扬扬。印度政府的前经济顾问阿尔温德·萨勃拉曼尼亚（Arvind Subramanian）指出，日本和韩国的财阀所经营的行业都存在对外贸易，因而不得不与国际对手竞争。而阿达尼和其他受宠爱的公司主要服务国内市场，这让它们处于保护伞之下。这样的批评可能也适用于印尼的公司。

归结起来，印度的私营部门和资本市场都更深厚，经济增速可能继续领先于印尼。风险在于政治。两国的发展模式都依赖以下几点：经济中很小一部分的快速发展、财富通过非正规经济或福利计划向下滴漏，以及政治体系能够管控好由此产生的社会压力。在印尼，政府塑造和安抚公众舆论；在印度，政府有时煽动和引导公众的愤怒。这在短期内或许还不太要紧，长远来说可能会是个严重的问题。 ■



Asia's greatest race

Which will grow faster: India or Indonesia?

Both countries are pioneering new ways to get rich in a troubled world

IF YOU ARE looking for growth opportunities among the world's 20 biggest economies, two stand out: India and Indonesia. The Asian giants, with a combined population of 1.7bn, are forecast by the IMF to be the two fastest-growing top-20 economies in 2023, and over the next five years. Both are pioneering strategies for getting richer in an era of de-globalisation, fraught geopolitics, automation and energy shifts, even as they seek a political formula that wins elections and avoids social unrest. Whether they succeed matters not just for their people and the investors betting many billions of dollars on them. It will also set an example for scores of other countries searching for new and reliable ways to develop in the 2020s and beyond.

For decades developing countries have followed a trusted formula for growing wealthier. Move workers from fields to more productive manufacturing jobs in cities, have them make goods for export, and watch the rapid formalisation of the economy. It worked in South Korea and Taiwan. In China it saw 800m people escape poverty. But today this scheme no longer works well. Many countries are rowdy democracies, not authoritarian states (as South Korea and Taiwan were when they industrialised). Protectionism challenges export-led growth. Factories use more robots.

At first glance, India and Indonesia have much in common. Both are led by charismatic leaders first elected in 2014, and both will hold elections next year. Narendra Modi, India's prime minister, and Joko Widodo (widely known as Jokowi), Indonesia's president, cut their teeth in local politics and have a reputation for getting things done. They run vast (India has 1.4bn

people and Indonesia 280m) and relatively young countries with myriad ethnicities and languages.

Both places have grown quickly: India's GDP has expanded by 71% over the past decade, and Indonesia's by 52%. Services, not manufacturing, dominate output (see chart). Both are fairly open, with trade at around 40% of GDP and annual inflows of foreign direct investment worth some 1.5% of GDP. Both are largely informal: 90% of India's workers and 60% of Indonesia's toil in the grey economy. The state is small by rich-world standards: public spending comes to just 30% of GDP in India and 18% in Indonesia.

Both countries are in the midst of ambitious infrastructure build-outs. Indonesia has built 18 ports, 21 airports and 1,700km of toll roads since Jokowi took office. India is adding 10,000km of highway each year. Yet there is still a huge amount of economic catch-up to exploit. Indonesia's gross national income per person is \$4,180 and India's is about half that: both are "lower middle-income" economies.

That is where the similarities end. To illuminate this we considered four areas in each country: the leading export sector; industrial policy; their geopolitical stance; and their strategy for pleasing voters. Start with export successes, a reflection of comparative advantage. In India the leading export sector is technology services. Thanks to its ability to crank out half a million new engineers a year, in 2021 India accounted for 15% of global IT services spending. Indonesia's advantage lies in commodities, some of which, such as nickel, are in global demand owing to the energy transition. By 2030 Indonesia will be the world's fourth-largest producer of the "green commodities" used in batteries and grids.

These industries generate chunky foreign earnings. In 2021 tech services made up about 17% of India's exports by value, and commodities (excluding fuel) accounted for 22% of Indonesia's. But these sectors generate few jobs:

even India's IT industry has only 5m workers.

Both governments want to supercharge the private sector through industrial policy. India has a more auspicious starting-point (see chart two). The MSCI India index, which covers about 85% of the market, is worth some \$830bn, about 24% of GDP. The Indonesia Index is worth just \$123bn, or 10% of GDP. India has 108 “unicorn” businesses (ie, valued at over \$1bn), more than any other country except America and China. Indonesia has produced fewer than a dozen. Mr Modi is betting on \$30bn of “production-linked incentives” to catalyse investment in 14 priority industries, including semiconductors. His pledge to achieve “net-zero” emissions of greenhouse gases by 2070 involves building solar farms, producing batteries and much more. Beyond greenery, the idea is to create jobs and cut the cost of power. India's energy-import bill is expected to drop from 4% of GDP in 2021 to 2.5% in 2032.

The Indonesian government's flagship industrial policy, “downstreaming”, is focused on natural resources. It uses sticks more than carrots. It hopes that by banning exports of selected raw materials, it will push multinationals to build refineries locally. Exports of raw nickel, for example, were prohibited in 2014. The number of nickel smelters has grown from two before the ban, to 13 in 2020 and as many as 30 by the end of this year. A ban on bauxite exports will soon take effect. Plans are afoot to shimmy higher up the value chain. Indonesia aims to make electric-car batteries with a total capacity of 140GWh in 2030—almost as much as global production in 2020. Last year Hyundai, a carmaker, started building electric cars in Indonesia.

As Sino-American tensions build, the two countries maintain different geopolitical stances. These will affect foreign investment and trade for decades. Consistent with its long-held policy of nonalignment, Indonesia wants to balance China and the West. Its sovereign-wealth fund, launched in 2021, is expected to receive up to \$3bn in investment from China, which

is also one of its largest sources of foreign direct investment. The government doesn't see this as playing countries off against each other. "Indonesia puts Indonesia first," says Nadiem Makarim, a minister.

Mr Modi's India is far more wary of China. Amid deadly border clashes with its neighbour, it has joined the Quad, a strategic grouping with America, Australia and Japan. This has implications for the economy. In 2020 India banned TikTok and dozens of other Chinese apps. Chinese tech firms, including Vivo and Xiaomi, have faced raids and investigations since. Part of Mr Modi's industrial strategy is designed to lure Western firms that are diversifying away from China. A unit of Foxconn, a Taiwanese maker of iPhones, recently received approval to build a \$1bn facility in the state of Karnataka.

Our final category concerns how the two governments keep voters happy. Both are delivering decent growth, but far too few formal jobs of the kind China and East Asian tigers managed to create. "There are a lot of unemployed youth, which is a waste of [India's] demographic dividend," says Raghuram Rajan, formerly the Indian central bank's governor.

Part of the response involves better redistribution, often using new, digitally enabled welfare states. Indonesia has an enormous cash-transfer scheme. Mr Modi's "India stack", a state-sponsored suite of digital platforms, links citizens, armed with an electronic identity, to payments and tax systems, and bank accounts. In the 2022 financial year the state handed over \$76.5bn, more than 2% of GDP, through these so-called direct-benefit transfers, reaching around 900m beneficiaries.

Yet the political differences are stark. Jokowi sits atop a sprawling coalition that includes former opponents and eight of the ten parties in parliament. Part of Jokowi's "genius" has been to stem Islamist parties through inclusion, writes Kishore Mahbubani, a Singaporean former diplomat.

Jokowi is barred from running again in next year's election, but his pluralist approach is fairly likely to endure.

Mr Modi has gone the opposite way, using anti-Muslim chauvinism to galvanise India. Two-thirds of India's Hindus now say being Hindu is very important to being "truly Indian", according to Pew, a research firm. Next year's elections are likely to see rising religious tensions and a further erosion of liberal norms. Last month Rahul Gandhi, the leader of the main opposition party, lost a court case and was disqualified from parliament.

Which model will deliver the quickest growth? The countries face some common problems, such as cronyism. Jokowi is surrounded by well-connected tycoons; in India the troubles of the Adani Group, an influential conglomerate, have been national news. Arvind Subramanian, a former economic adviser to the Indian government, points out that the zaibatsu conglomerates in Japan and the chaebol in South Korea operated in tradable sectors, forcing them to compete with international rivals. But Adani and other favourites mainly service the domestic market, leaving them sheltered. This charge may also apply to Indonesian firms.

Ultimately, with its deeper private sector and capital markets India is likely to continue to grow faster. The risk lies in its politics. Both countries' models of development rely on a narrow part of the economy racing ahead; on wealth trickling down through the informal economy or welfare schemes; and on the political system being able to manage the resulting social pressures. In Indonesia the government moulds and placates public opinion; in India it sometimes incites and directs public anger. In the short term that may not matter much. In the long run, it may be a serious problem. ■



巴勃罗巅峰

毕加索市场可能要转向

长期牛市过后，人们正在重新评估他的为人和作品

艺术家终其一生，创作出的作品很少能超过5000件。巴勃罗·毕加索于1973年4月8日去世，享年91岁，他一共创作了25,000件作品。苏富比拍卖行的艺术品数据部门梅摩指数（Mei Moses）的数据显示，从1950年到2021年，超过1500件毕加索的知名作品在美国和英国的拍卖会上售出，相比之下，第二多产的艺术家安迪·沃霍尔卖出了798件。在最近的艺术品春拍伦敦站，苏富比奉上了一件雕塑、一本插图书、一件立体派青铜铸件、一些凹版版画、几幅素描和油画，都是毕加索的作品，价格从不到5000英镑（6200美元）到1800多万英镑不等。

自1999年以来，毕加索作品的增值速度是整个20世纪艺术市场增值速度的两倍。据报道，毕加索最贵的一幅画作卖出了1.8亿美元，是由一位沙特收藏家卖给了卡塔尔一位前总理。但是，在毕加索逝世50周年之际正掀起的一位评论人士称之为“毕加索疯狂派对”（Picassopalooza）的浪潮中，交易商和拍卖行却在担心这一长期牛市可能很快要转向了。

迹象之一是毕加索对当今创作者的影响力正在减弱。“把过去的艺术家推向未来的是艺术家们，而不是其他人。”评论家本·卢克（Ben Luke）说。在播客《与.....擦肩而过》（A Brush With...）中，他采访了几十位艺术家，有老有少。他指出，其中很少有人提到毕加索是灵感来源。“马塞尔·杜尚，有。菲利普·加斯顿，有。路易丝·布尔乔亚，经常。”卢克说。毕加索不再出现在这个名单上是一个“巨大的转变”。

还有个因素可能减弱对毕加索作品的需求，那就是这位艺术家卑劣的个人行径。他对几任妻子都不忠，同时和不同的女人生儿育女。他勾引玛丽·泰蕾兹·沃尔特（Marie-Thérèse Walter），玛丽后来成了他的情妇、他的“缪斯”，当时她17岁，毕加索45岁。1932年，他画下了她做梦的样子，把

她的左颊和左眼画成勃起的阴茎。在#MeToo运动之后，所有这些都越来越难与艺术分开而论。包括巴尔蒂斯和达利在内的其他杰出艺术家的作品也已经因为艺术家私下的行为而在评论家和收藏家眼中贬值。

因此，交易商和收藏家们正焦急地观望，看6月在布鲁克林博物馆开幕的“庆祝毕加索”展览反响如何。该馆表示，展览将“涉及年轻而多元的博物馆观众提出的一些难以回避的问题，他们越来越多地关注像厌女症、男性气质、创造力和‘天才’等相互关联的议题”。展览的策展人之一则直言不讳。毕加索“得了厌女精神病”，澳大利亚喜剧演员、艺术历史学家汉娜·加兹比（Hannah Gadsby）在奈飞的一档节目中说。“我厌恶他。”她坦言。

“我们会密切关注。”另一家大型拍卖行佳士得的主管20世纪和21世纪作品的副馆长乔万娜·贝尔塔佐尼（Giovanna Bertazzoni）谈到这次展览时说。如果它很火爆，年轻一些的买家可能会反感。随着作为艺术家的毕加索和作为男人的毕加索双双失宠，他的作品可能也不再受追捧。■



Peak Pablo

The market for Picassos may be about to turn

After a long bull run, the man and the artist are being re-evaluated

ARTISTS RARELY create more than 5,000 works over a lifetime. Pablo Picasso, who died on April 8th 1973 at the age of 91, produced 25,000. Between 1950 and 2021 more than 1,500 notable Picassos were sold at auction in America and Britain, compared with 798 by the next-most-prolific artist, Andy Warhol, according to Sotheby's Mei Moses, the art-data arm of the auction house. In its recent London sales, Sotheby's offered a sculpture, an illustrated book, a cubist bronze cast, some gravure prints and several drawings and paintings, all by Picasso. Prices ranged from under £5,000 (\$6,200) to more than £18m.

Since 1999 prices of Picasso's works have grown twice as fast as the broader market for 20th-century art. The most expensive Picasso was sold for \$180m, reportedly by a Saudi collector to a former prime minister of Qatar. But in the midst of what one commentator calls the "Picassopalooza" around the 50th anniversary of the artist's death, dealers and auction houses are nervous that the long bull market may be about to turn.

One indication is Picasso's waning influence on today's creators. "It is artists, more than anyone, who propel artists of the past into the future," says Ben Luke, a critic. Having interviewed dozens of them, young and old, for a podcast, "A Brush With...", he notes that few cite Picasso as an inspiration. "Marcel Duchamp, yes. Philip Guston, yes. Louise Bourgeois, often," Mr Luke says. That Picasso no longer features on that list is a "monumental shift".

Another thing that could dampen demand for Picassos is the artist's abject

personal behaviour. He two-timed his wives and sired children with different women at once. He seduced Marie-Thérèse Walter, who would become his mistress and his muse, when she was 17. He was 45. In 1932 he painted her dreaming, depicting her left cheek and her eye as an erect penis. In the wake of #MeToo all this is becoming harder to separate from the art. The works of other prominent artists, including Balthus and Salvador Dalí, have lost value in the eyes of critics and collectors because of how they acted in private.

Dealers and collectors are thus anxiously waiting to see how “Celebration Picasso”, an exhibition which opens at the Brooklyn Museum in June, will be received. It will “engage some of the compelling questions young, diverse museum audiences increasingly raise about the interconnected issue of misogyny, masculinity, creativity and ‘genius’,” says the museum. One of the exhibition’s curators pulls no punches. Picasso “suffered from the mental illness of misogyny”, said Hannah Gadsby, an Australian comedian and art historian, in a Netflix show. “I hate him,” she confessed.

“We will be watching it very carefully,” says Giovanna Bertazzoni, vice-chairman of the 20th- and 21st-century department at Christie’s, another big auction house, of the exhibition. If it is a hit, younger buyers may be put off. With Picasso the artist and Picasso the man falling out of favour, so could his oeuvre. ■



思维地图

绘制大脑结构图的一大进步

继果蝇幼虫的大脑之后，接下来要绘制更复杂的大脑

果蝇幼虫的认知能力似乎并不值得特别关注。这种生物——果蝇形似蠕虫的早期阶段——只能够感知环境，寻找食物和躲避捕食者。它的大脑还不知道怎样移动、飞行，甚至不知道怎么正确地看东西。但是，它有限的能力仍然提供了一个有用的微缩模型，可以透过它研究更大更复杂的大脑的功能。

研究人员现在已经公布了第一张完整的果蝇幼虫大脑图谱。这种“连接组”图谱——相当于三维电路图——标记出大脑神经元和突触的位置，突触是脑细胞之间传递信息的连接点。这些回路的结构影响大脑能够做哪类计算。了解神经元如何相互连接，可以让科学家在机理结构方面更多地了解大脑的运作。

到目前为止，绘制连接组仅限于对线虫等较简单的生物，它们的大脑有数百个神经元，尚未被观察到复杂的行为。更大的大脑的一小部分——包括果蝇成虫——也已被绘制出来。不过，之前还从来没有对如此复杂的生物体绘制全脑图谱——果蝇幼虫有3016个神经元，神经元之间有约54.8万个连接。

这篇发表在《科学》杂志上的最新研究成果是十余年来努力研究的结晶，这些研究始于弗吉尼亚州的珍利亚研究园区（Janelia Research Campus），是其FlyEM项目的一部分。第一步是将微小的幼虫大脑切成数千片，并用电子显微镜（即项目名称中的EM）扫描。然后，研究人员一丝不苟地给这些图像添加标记及做分析，绘制出与功能相关的区域，如视觉或嗅觉。

果蝇幼虫的连接组图已经带来了一些洞见。例如，这种生物大脑中与学习相关的区域有更多回路，下游的神经元会再度回连到上游本已关闭的神经

元，而在大脑的其他区域里这样的回路要少得多。这表明某些信号会被重复处理。人们提出的一个解释是，这样的回路可以编码预测，生物体通过将这些预测与环境中的真实经验做比较来学习。

例如，关于树叶味道的信息进入神经元的同时，基于以前的进食经验做出的预测也进入其中。如果实际味道与预测不同，神经元可能会分泌多巴胺，这种化学物质能够重新布置回路以创建新记忆。

生物学家还有很多可以从连接组图中了解的东西。剑桥大学的神经学家玛尔塔·兹拉提克（Marta Zlatic）是这项最新研究的作者之一，她构想了一个连接组研究计划，分为三步。首先，绘制连接组图。其次，当动物执行一系列任务时，将活体大脑的活动模式成像。第三，将这两组信息结合起来，确定值得在实验室中操控或培育的大脑结构的差异。这将有助于在大脑结构不同的个体之间检验假设。

例如，为了搞清楚意向的源头，或了解果蝇是如何决定执行一项活动的，比如向前移动，研究人员会在一只果蝇移动时扫描它的大脑。然后分析连接组图中出现活动的区域。在其他果蝇的大脑中，这些区域的回路可能处于静默状态，通过比较不同个体的行为，科学家们能够确定特定的大脑区域在果蝇执行某项活动时所起的作用。兹拉提克说：“未来就是比较连接组学。”

这在今天看来是可实现的。在这只果蝇幼虫的大脑被扫描成像后的十年里，科技就已经取得了巨大的进步。电子显微镜下的纳米级超微切片现在可以在几周内完成，不再要花几年。分析也可以加快了：既然给幼虫连接组图加标记的艰苦繁琐的工作已经手动完成，可以教机器对另一个个体的大脑再做一次。

几十个小组正在推进研究。FlyEM团队的另一分支正在研究成年果蝇的连接组，其神经元的数量是幼虫的十倍，视皮层也大得多。其他小组的研究对象是斑马鱼，一种相对好驾驭些的脊椎动物。不过，目前最受关注的是小鼠。小鼠的大脑体积是果蝇的一千倍，研究人员目前正在以每次一立方

毫米的速度推进。法兰克福马克斯·普朗克大脑研究所（Max Planck Institute for Brain Research）的莫里茨·赫尔姆施塔特（Moritz Helmstaedter）主持了一个这样的项目，他说，绘制完整的小鼠连接组图是完全可实现的，不过还需要几亿美元资金。

当然，终极目标是人脑，它比小鼠的大脑还要大一千倍，复杂程度也不在一个量级。但是，何时也能拿到完整的人脑连接组图——如果真有这一天的话——还需拭目以待。 ■



Mind maps

A big advance in mapping the structure of the brain

After larval fruit-flies', more complex brains are next

THE COGNITIVE abilities of a fruit-fly larva may not seem particularly noteworthy. This creature—the fly's early, wormlike phase—is just about capable of sensing its environment, searching for food and avoiding predators. Its brain does not yet know how to walk, fly, or even properly see. And yet its limited capacity is still, in miniature, a useful model for what larger and more complex brains can do.

Researchers have now published the first complete map of the brain of such a larva. This “connectome”—the equivalent of a three-dimensional circuit diagram—charts the locations of a brain’s neurons as well as the synapses, the junctions where the brain cells pass information between each other. The structures of these circuits influence the kinds of computations a brain can do. Knowing how neurons are interconnected can give scientists a more mechanistic understanding of how the brain functions.

Until now, the production of connectomes has been limited to those of simpler organisms such as the nematode worm, whose brains have hundreds of neurons and in which complex behaviour has not yet been observed. Small portions of larger brains—including the fruit fly itself—have also been mapped. Never before, though, has the whole brain of such a complex organism—spanning some 548,000 connections between 3,016 neurons in the case of the fruit-fly larva—been mapped.

The latest work, published in *Science*, marks the culmination of over a decade’s worth of effort, started at the Janelia Research Campus in Virginia, as part of its FlyEM project. The first step involved slicing the tiny larval

brain into thousands of layers for scanning with an electron microscope (the EM of the name). Researchers then painstakingly labelled and analysed the images, mapping out areas associated with functions such as vision, for example, or olfaction.

The connectome of the fruit-fly larva has already provided insights. For example, regions of the creature's brain associated with learning had more loops in their circuitry, with downstream neurons connecting back to those close behind them, than other regions of the brain. This suggested some repeat processing of signals. One proposed explanation is that such loops encode predictions, and that the creatures learn by comparing these with real experiences in their environment.

Information about the taste of a leaf, for example, might enter a neuron at the same time as a prediction based on previous meals. If the taste differs from prediction, the neuron may secrete dopamine, a chemical capable of rewiring the circuitry to create a new memory.

Biologists have much to learn from connectomes. Marta Zlatic, a neuroscientist at the University of Cambridge and an author of the latest research, envisages a connectome study programme with three steps. First, a connectome is mapped. Second, the activity patterns in a living brain are imaged while an animal carries out a set of tasks. And third, these two sets of information are combined to pinpoint variations in brain structure worth manipulating or breeding in the lab. That would help to test hypotheses between individuals with different brain structures.

In order to understand the origins of intentionality, for example, or how a fly decides to perform an activity such as moving forward, an individual's brain would be scanned while it moved. Then, the regions that showed activity would be analysed in the connectome. Other flies could have those specific brain circuits silenced and, by comparing the behaviours of the

different individuals, scientists would be able to pinpoint the role played by specific brain regions in how a fly carries out an activity. “The future”, says Dr Zlatic, “is comparative connectomics.”

This now seems achievable. Even in the decade since this larva was imaged, technology has advanced dramatically. The nanoscale salami-slicing involved in EM can now be done in weeks, rather than years. Analysis could also be sped up: now that the painstaking work of labelling the larval connectome has already been done by hand, a machine could be taught to do it again on a different individual’s brain.

Dozens of groups are forging ahead. Another branch of the FlyEM team is tackling the adult fruit-fly connectome, which has ten times more neurons and a vastly larger visual cortex. Other groups are facing down the zebrafish, a relatively tractable vertebrate. The biggest game in the crosshairs at the moment, though, is the mouse. With a brain volume a thousand times bigger than the fruit fly’s, researchers are currently advancing one cubic millimetre at a time. Still, says Moritz Helmstaedter at the Max Planck Institute for Brain Research in Frankfurt, who leads one such project, a full mouse connectome is eminently achievable, even if it is also several hundred million dollars away.

Of course, the ultimate prize is the human brain, a thousand times bigger still and vastly more complex. But when, if ever, that can be given the full connectome treatment remains to be seen. ■



硅谷裁员

科技业下岗工人都去哪儿了？

科技行业的就业已经到达一个拐点

要了解近几个月来硅谷的调子是怎么变的，看马克·扎克伯格在2月份说了什么就够了。他宣布2023年将是个“效率年”。这种用词不大会让人心跳加速，除非你是员工，而这话是说给你听的。3月14日，扎克伯格经营的科技巨头Meta宣布将在去年11月裁员1.1万人的基础上再解雇1万人。

Meta并非个例。3月20日，另一家科技巨头亚马逊宣布将在已经解雇1.8万名白领员工的基础上再裁员9000人。根据数据供应商Crunchbase的数据，今年到目前为止，美国的科技公司已经宣布裁员11.8万人，而去年已经裁掉了14万人。

投资者为科技公司新近生发出的成本意识而欢呼。以科技股为主的纳斯达克指数较去年12月底的近期低点上涨了17%。这些公司把市场传达出的信息听得清楚明白。3月24日，商业软件公司Salesforce的首席运营官暗示，该公司将很快在1月份宣布裁员8000人之后进一步裁员。

它们还是有裁员空间的：2022年初以来的被裁员工只占美国科技行业劳动力的6%。由于科技公司2022年全年都在继续招聘，裁员才刚刚开始让整个行业的就业人数减少（见图1）。相比之下，从21世纪初互联网繁荣的顶峰到2003年底的低谷，美国科技行业的整体劳动力缩减了23%，即减少了68.5万个工作岗位。

尽管如此，近期的裁员潮波及之广之深，已经值得提出两个问题。首先，被解雇的都是谁？第二，下岗员工都去哪里了？

行业组织计算机技术行业协会（Computing Technology Industry Association）的蒂姆·赫伯特（Tim Herbert）说，到目前为止，技术岗人员基本上躲过了一劫。裁员的大斧主要落在了销售和招聘等业务部门头

上。近年来，这些人员在科技行业就业人数中的占比稳步增长，明显是机构臃肿的迹象（见表2）。

从2020年春季疫情最深重之时，到2023年初就业人数达到峰值，科技行业在这期间增加了约100万名员工。光是招这么多人就需要雇用大量的招聘人员：根据一条物色人才的经验，一个招聘人员一年可以招募25名新员工。这些招聘人员中的许多人现在可能已经变得多余。

但是在这场追求效率的行动中，技术人员也不能完全幸免。作为裁员动作的一部分，Meta将在本月重组其技术职能。把优秀的技术人才“放生”可能是其他正在焦头烂额地推进数字化转型的行业的福音。多年来，工业制成品等不够光鲜亮丽的行业一直难与科技行业争夺人才。现在它们正在四处出击。美国拖拉机制造商约翰迪尔（John Deere）一直在争抢被解雇的技术人员，以帮助自己制造更智能的农业机械。去年，该公司在得克萨斯州蓬勃发展的科技中心奥斯汀设立了办公室。越来越注重软件的汽车制造商也对技术专门人才求贤若渴。银行、医疗保险公司和零售商也是如此。

一些下岗的科技业从业者正在助力催生新一代的创业公司。今年1月，硅谷创业学校Y Combinator的申请量较上一年增长了四倍。在ChatGPT之类的“生成式”人工智能（运用复杂算法和大量数据生成从文章到艺术品的所有东西）这个热闹的领域，兴奋之情尤为强烈，连科技巨头都继续在这方面积极招聘。

乐观主义者希望，随着人工智能创业者变出各种巧妙的应用，这项技术将像之前的智能手机一样，开启一波新的创造性破坏浪潮。随着时间的推移，新的人工智能可能会进一步减少对某些岗位的需求，比如对人类营销人员的需求。但是，就像之前的其他突破一样，它们也可能创造全新的工作类别——尤其是在科技行业本身。 ■



The sack of Silicon Valley

Where have all the laid-off tech workers gone?

Employment in the technology industry has reached an inflection point

TO UNDERSTAND THE shift in tone that has taken place in Silicon Valley in recent months, look no further than Mark Zuckerberg's declaration in February that 2023 would be the "year of efficiency". It is hardly the kind of language to set the pulse racing—unless you are an employee on the receiving end of it. On March 14th Meta, the tech giant Mr Zuckerberg runs, announced it would fire 10,000 staff—on top of the 11,000 it laid off last November.

Meta is not alone. On March 20th Amazon, another tech behemoth, said it would cut a further 9,000 corporate employees, having already sacked 18,000 white-collar types. So far this year American tech firms have announced 118,000 sackings, according to Crunchbase, a data provider, adding to the 140,000 jobs cut last year.

Investors have cheered tech's new-found cost-consciousness. The technology-heavy NASDAQ index is up by 17% from its recent low point in late December. The companies are hearing the market's message loud and clear. On March 24th the chief operating officer of Salesforce, a business-software firm, hinted that the company would soon add to the 8,000 lay-offs it announced in January.

They have a way to go: firings since the start of 2022 represent only 6% of the American tech industry's workforce. Because tech companies continued to hire throughout 2022, lay-offs have only just begun to reduce total industry employment (see chart 1). By comparison, between the peak of the dotcom boom at the start of the 2000s and its nadir at the end of 2003, America's

overall tech workforce declined by 23%, or 685,000 jobs.

Still, the recent lay-offs have already been widespread and deep enough to warrant two questions. First, who is getting the chop? And second, where are the laid-off workers going?

So far techies themselves have been mostly spared, observes Tim Herbert of the Computing Technology Industry Association, a trade body. Instead, the axe has fallen mainly on business functions such as sales and recruitment. These had grown steadily as a share of technology-industry employment in recent years, a telltale sign of bloat (see chart 2).

Between the depths of the pandemic in the spring of 2020 and peak employment at the start of 2023, the tech sector added around 1m workers. Simply enlisting such numbers required hiring plenty of recruiters; as a headhunting rule of thumb, one recruiter can hire 25 new employees a year. Many of those same recruiters may now be surplus to requirements.

But the specialists are not immune to the efficiency drive. As part of its lay-offs, Meta will restructure its tech functions in April. Releasing talented tech workers back into the wild could be a boon for other sectors wrestling with digital reinvention. For years unsexy industries like industrial goods have struggled to compete with the tech industry for talent. Now they are pouncing. John Deere, an American tractor-maker, has been snapping up fired tech workers to help it make smarter farm machinery. Last year the firm opened an office in Austin, a thriving tech hub in Texas. Carmakers, increasingly focused on software, are also hungry for technologists. So are banks, health insurers and retailers.

Some of the laid-off techies are helping fuel a new generation of startups. Applications in January to Y Combinator, a startup school in Silicon Valley, were up five-fold on the previous year. Excitement is particularly strong

in the buzzy field of ChatGPT-like “generative” artificial intelligence (AI), which uses complex algorithms and oodles of data to produce everything from essays to artworks—so much so that even big tech continues to hire enthusiastically in the area.

Optimists hope that this technology will, like the smartphone before it, unlock a new wave of creative destruction, as AI entrepreneurs conjure up a variety of clever applications. The new AIs may in time mean even less need for, say, human marketers. But they could, like other breakthroughs before them, create entirely new job categories—not least in the technology industry itself. ■



进化不会上电视

为什么渐进派通常是对的而激进派是错的

《渐进》为渐进主义提供了充满激情而又令人信服的论据【《渐进》书评】

《渐进》。格雷格·伯曼、奥布里·福克斯著。牛津大学出版社；240页；29.95美元，22.99英镑。

革命者最会起口号了。布尔什维克高呼“和平！土地！面包！”毛泽东承诺要“大跃进”。切·格瓦拉声称“面对每一个不公都愤怒得发抖”。相比之下，渐进式变革的倡导者发现要定一个好的战斗口号可太难了。从来没有人群疯狂地高呼：“我们想要什么？增量改革！我们什么时候要？在预算条件允许的情况下！”

但正如格雷格·伯曼（Greg Berman）和奥布里·福克斯（Aubrey Fox）在《渐进》一书中所说的那样，渐进主义是有效的。革命者许诺天堂，但往往带来流血、排队买面包和书籍遭禁。通过对令人不满意的现状进行一系列往往不大的改良，人类变得更加繁荣。工业革命尽管叫做“革命”，却并不是一个单一的、突发的事件，而是在近一个世纪内传播的数千项累积的创新。“随着时间的推移，渐进式改革可以带来真正的变革。”作者指出。

两人都是美国刑事司法改革者，虽然其论点适用于全球，但他们关注的是自己的祖国。两人恰如其分地指出，美国政治已经被亚历山大·汉密尔顿所说的“愤怒和恶意的激情的洪流”所淹没。

在右翼这一边，特朗普和他的追随者寻求“彻底变革的终极目标”：推翻民主选举的结果。“我是你的战士，我是你的正义.....我是你实现的报应.....我将彻底消灭深层政府。”特朗普于3月4日在一次所谓的“保守派”会议上愤怒地疾呼。做总统时，他与普京走得很近，并热情地谈论了一些新纳粹分子。

与此同时，一些左翼人士认为美国已经腐烂到必须扫除旧结构的地步。

“撤资警察！”“废除 ICE[执行移民法的机构]！”作者提到了大热的学者伊布拉姆·X·肯迪（Ibram X. Kendi），他想创建一个“反种族主义部”，配备“种族主义专家”，有权否决任何未能推进他的种族公平定义的政策。他们将拥有“惩罚工具”来对付持不同意见的公职人员。这实际上会将准独裁权力交给一小群认同肯迪世界观的人。

伯曼和福克斯承认，有时必须进行彻底的变革，比如废除奴隶制。但更谨慎的改良往往更有效，因为“渐进主义者知道自己懂的多么少”。任何试图理解一个大问题的人肯定会错过关键信息。错误是不可避免的。渐进主义纠正起来比较容易。新想法可以“随着时间的推移进行测试、评估和打磨”。

作者引用了美国公共养老金制度社会保障的例子。在大萧条时期，人们提出了两种扶老扶贫的办法。一个是“激进、易于理解，并且能够动员20世纪最大的公民运动之一”。加州医生弗朗西斯·汤森（Francis Townsend）提议向每位60岁以上的美国人每月发放150美元的养老金（相当于今天的3500美元），条件是他们必须停止工作并在月底前花掉这笔钱。其想法是，通过提前退休，年长的人可以为年轻人腾出工作岗位；通过大量支出，他们将刺激经济。

这个计划是如此诱人，以至于支持它的“汤森俱乐部”之后招募了60岁以上美国人中的近五分之一。如果它被颁布，那将是一场灾难。强迫老年人退休并不会奇迹般地创造更多就业机会，据估计，汤森计划将耗费“国家一半的财富，而没有任何合理的筹资机制”。

另一个计划，用作者的话说，“制定起来耗时极长，自相矛盾，而且似乎无可救药地无法应对当下的紧迫性”。富兰克林·罗斯福总统决定，他的1935年《社会保障法》不应作为一种施舍，而是对过去劳动的奖励。工人通过工资税凑钱，他们最终获得的福利（非常粗略地）与他们一生的贡献挂钩。这使得该计划在短期内很吝啬——过了五年还没有支付第一笔福利——但从长远来看是安全的，因为养老金领取者相信自己已经挣到了自己的福利，“如果福利受到威胁，他们会怒不可遏”。

最初，社会保障比罗斯福新政的其他部分要小得多。它花了15年的时间和无休止的修修补补才呈现出今天的大致形状。1939年增加了对家属和遗孀的福利；1950年推出了帮助各州照顾残疾人的联邦拨款等等。现在它是美国最大的政府计划，并且如此受欢迎，以至于专家们将其称为政治的“第三轨”。换句话说：你要碰它，你就死了。

另一个有趣的例子是改进纽约的治安。在1980年代，一些纽约人非常害怕暴力犯罪，他们甚至为一名在火车上射杀了四名据称具有威胁性的青少年的义务警察欢呼。然而，几十年后，这座大都市已成为美国最安全的大城市之一：1990年至2009年间，凶杀率下降了82%，汽车盗窃率下降了93%。

对于这一惊人的转变，作者们并没有将其归功于某一项重大改革，而是归功于《纽约客》所说的“一千个小的理性”。大批新警官被聘用，强硬的监督委员会淘汰了坏警察。一个新的数据系统指出了犯罪热点。警察严厉打击造成无法无天气氛的轻微违法行为，例如逃票和随地小便。企业联合起来清理社区；非政府组织为处于危险中的青少年提供课后俱乐部。随着街道上的眼睛越来越多，街道也不再为犯罪分子所主宰。纽约变成了一个宜居的地方，与此同时监禁人口在减少：毒品罪犯和精神病患者的专门法庭将更多的违法者送去接受治疗，而不是将他们关起来。

伯曼和福克斯承认，渐进主义似乎很缓慢，但不大的变化比激进的变化更有可能在整个政治光谱内赢得共识，并且不太可能引起反弹并最终被逆转。它们可以更快启动，如果有效则可以继续或延长。“渐进主义要求不断改变”而远非捍卫现状，从日本汽车厂的不断改进，到美国的建设——移民家庭一个一个地到来。

革命家托洛茨基曾嘲笑渐进主义“乏味”。他帮着把俄国推入混乱，自己最终被人用冰镐刺死。 ■



The evolution will not be televised

Why gradualists are usually right and radicals are wrong

“Gradual” makes a passionate and convincing argument for incrementalism

Gradual. By Greg Berman and Aubrey Fox. Oxford University Press; 240 pages; \$29.95 and £22.99

REVOLUTIONARIES HAVE the best slogans. The Bolsheviks shouted “Peace! Land! Bread!” Mao Zedong promised a “Great Leap Forward”. Che Guevara claimed to “tremble with indignation at every injustice”. Advocates of gradual change, by contrast, find it hard to compose a good rallying cry. No crowd ever worked itself into a frenzy chanting: “What do we want? Incremental reform! When do we want it? When budgetary conditions allow!”

But as Greg Berman and Aubrey Fox argue in “Gradual”, incrementalism works. Revolutionaries promise paradise but often bring about bloodshed, bread lines and book-banning. Humanity has grown more prosperous by making a long series of often modest improvements to an unsatisfactory status quo. The Industrial Revolution, despite its name, was not a single, sudden event but thousands of cumulative innovations spread across nearly a century. “Over time, incremental reforms can add up to something truly transformative,” note the authors.

Both are American criminal-justice reformers, and although their argument applies globally they focus on their home country. Correctly, they observe that American politics has been flooded by what Alexander Hamilton called “a torrent of angry and malignant passions”.

On the right, Donald Trump and his acolytes have sought “the ultimate in radical change”: to overturn the result of a democratic election. “I am your

warrior, I am your justice...I am your retribution...I will totally obliterate the deep state," Mr Trump thundered on March 4th at a supposedly "conservative" conference. As president, he cosied up to Vladimir Putin and spoke warmly of some neo-Nazis.

Some on the left, meanwhile, deem America so rotten that old structures must be swept away. "Defund the police!" "Abolish ICE [the agency that enforces immigration laws]!" The authors refer to Ibram X. Kendi, a fashionable scholar, who wants to create a "Department of Anti-racism", to be staffed by "experts on racism" with the power to veto any policy that fails to advance his definition of racial equity. They would have "disciplinary tools" to wield against public officials who dissented. This would, in effect, hand quasi-dictatorial power to a small group of people who share Mr Kendi's world-view.

Mr Berman and Mr Fox admit that radical change has sometimes been necessary: for example, to achieve the abolition of slavery. But the more cautious sort is more often effective, because "gradualists know how little they know". Anyone trying to understand a big problem is sure to miss crucial information. Errors are inevitable. Incrementalism makes it easier to correct them. New ideas can "be tested, evaluated and honed over time".

The authors cite the example of Social Security, America's public-pension system. During the Great Depression, two approaches were proposed for helping the old and hard-up. One was "radical, easy to understand and capable of mobilising one of the largest citizen movements of the 20th century". Francis Townsend, a Californian doctor, proposed giving every American over 60 a pension of \$150 a month (\$3,500 in today's money), on condition that they stopped working and spent the cash by the end of the month. The idea was that by retiring early, older folk would free up jobs for younger ones; and by spending copiously, they would stimulate the economy.

So alluring was this plan that supportive “Townsend clubs” went on to enroll nearly one in five Americans over 60. Had it been enacted, it would have been a disaster. Forcing the old to retire would not have magically created more jobs, and the Townsend plan would have cost, by one estimate, “half the nation’s wealth without any plausible funding mechanism”.

The other plan was, in the authors’ words, “slow to develop, internally contradictory, and seemed hopelessly inadequate to the urgency of the moment”. President Franklin Roosevelt decided to frame his “Social Security” law of 1935 not as a handout, but as a reward for past labour. Workers chipped in via a payroll tax, and the benefits they eventually received were (very roughly) tied to their lifetime contributions. This made the programme stingy in the short run—the first benefits were not paid out for five years—but secure in the long run, because pensioners believed that they had earned their benefits “and would be furious if they were threatened”.

Initially, Social Security was far smaller than other bits of Roosevelt’s New Deal. It took 15 years and endless tinkering before it assumed the shape it approximately has today. Benefits to dependents and survivors were added in 1939; federal grants to help the states look after the disabled were introduced in 1950; and so on. Now it is the largest government programme in America, and so popular that pundits refer to it as the “third rail” of politics. In other words: you touch it, you die.

Another intriguing example is the pacification of New York. In the 1980s some New Yorkers were so terrified of violent crime that they applauded a vigilante who shot four allegedly menacing teenagers on a train. Yet within a few decades the metropolis had become one of the safest big cities in America: the homicide rate fell by a whopping 82% between 1990 and 2009, the rate of car thefts by 93%.

For this startling turnaround, the authors credit not one big reform but what the New Yorker called “a thousand small sanities”. Legions of new police officers were hired, and a tough oversight board weeded out the bad ones. A new data system identified crime hot spots. Cops cracked down on minor offences that created an atmosphere of lawlessness, such as fare-dodging and public urination. Businesses clubbed together to clean up neighbourhoods; NGOs offered after-school clubs for at-risk teenagers. As the number of eyes on the street grew, criminals ceased to dominate them. New York became a pleasant place to live, even as its prison population fell: specialised courts for drug offenders and the mentally ill sent more lawbreakers for treatment instead of locking them up.

Incrementalism can seem slow, Messrs Berman and Fox acknowledge, but modest changes are more likely than radical ones to earn a consensus across the political spectrum, and are less likely to provoke a backlash and wind up being reversed. They can be started sooner and, if they work, they can be continued or extended. Far from being a defence of the status quo, “incrementalism calls for ceaseless change”, from the continuous improvement of a Japanese car factory to the building of America, one immigrant family at a time.

Leon Trotsky, a revolutionary, once sneered that gradualism was “boring”. He helped plunge Russia into chaos, and was murdered with an ice pick. ■



自由交流

中国如今是冷门避风港

这个国家的金融风险是它自己的。而美国的风险很快也成为其他所有人的

金融危机破坏并重新分配财富。它们也重新分配焦虑。投资者发现自己正在为以前从未担心过的事苦恼。更糟糕的是，他们为以前想都没想过的事烦恼。一个例子是存在银行里的钱。美国的硅谷银行（SVB）崩盘让储户们重新了解了他们过去视为理所当然的申索权的性质和限制。

美国的忧虑也迅速蔓延到了其他地方。例如，新兴市场的投资者已经开始重新思考他们所投资的国家，通过“SVB色”眼镜仔细审视它们。他们想知道哪些市场最易受美国金融动荡和增长放缓的影响，哪些市场存在类似的脆弱性。例如，哪些国家正在承受顽固通胀、快速货币紧缩和债券价格骤跌的冲击？而发展中世界哪些地方的储户看起来有点心思活络？从这个角度看，有一个新兴市场看起来异常稳健。小声点问吧：中国能不能在银行业动荡时期为全球投资者提供一个避风港？

乍一看，这个问题很荒谬。就在一年前，一些重要的声音还说中国“不可投资”。任何在该国投资的人都必须担心中国与其最重要的贸易伙伴之间的新冷战。这包括未来会对中国最先进的一批企业实施严厉的金融制裁，还有令人窒息的出口管制。

不必说，中国还有土生土长的风险。信用不佳的房地产开发商仍是一个金融关切点。共产党打击不平等的运动吓坏了该国最著名的企业家和最富有的家庭，其中许多人急于将资金转移出国。近日，阿里巴巴的创始人马云在他的家乡现身，或许让人稍稍松了口气。但在一个正常的国家，投资者并不会寻求影像证据来证明该国最著名的企业家在自己祖国仍受欢迎。

中国的银行业也有自己的脆弱性。较小的地方银行（包括120多家城市商业银行和几千家村镇和农村银行）不像该系统中其余的银行那般稳健。它们难和大银行竞争储户存款，也难以抵抗地方政府要它们向华而不实的面

予工程放贷的压力。投资者也不该忘记该国应对新冠疫情的方式。其决策既固执又反复无常，既不灵活又不可预测。

然而，中国有几个宏观经济和金融上的特殊性在当前的动荡中看起来像是优势。对新冠清零政策的古怪坚持让它的经济周期与世界其他地区不再同步。因此它成了一种自然的“增长对冲”，花旗银行的余向荣、季心宇和胡渊流如是说。他们指出，中国可能是今年唯一增长快于去年的大型经济体。据本刊姊妹公司经济学人智库（EIU）称，这意味着中国和美国之间的增长差距可能会扩大到五个百分点。

这些疫情防控措施还限制了价格压力。2月份消费者价格同比仅上涨1%，这样的数字在世界上大部分地区已经属于过去时。中国是被通胀遗忘的土地。因此，其央行并未感到仓促加息的必要。事实上，它在3月还放宽了政策，将大多数银行的存款准备金率下调了0.25个百分点。

在混乱地放弃清零政策期间，债券价格确实出现了波动。但与美国、欧洲或大多数新兴经济体不同，中国目前的收益率仍低于2020年底时。此外，债券抛售并没有引发银行挤兑，反而加速了存款。在理财产品（投资于债券）上亏损的人们又纷纷把钱存入银行。花旗的经济学家估计，目前家庭存款比疫情前趋势多出15.4万亿元人民币。

中国不仅处于商业周期的不同阶段，也处于金融的恐惧和自满周期的不同阶段。硅谷银行的迅速崩溃之所以具有如此大的破坏性，一定程度在于它出乎意料。在中国，地方银行带有的危险众所周知，它们是灰犀牛，不是黑天鹅。

中国的监管官员目前态度谨慎而不强硬。他们清楚意识到地方银行面临的金融风险，但很谨慎地不去促成这些风险。如果另有一家地方银行出了问题，他们可能会表现出比之前更多的克制。当局不会想让任何事情中断才启动了几个月的经济复苏。智库MacroPolo的宋厚泽写道，中央政府“很可能竭尽全力去展现稳定的光环”，即使这需要对一些脆弱的借款方展开“悄悄的、不引人注意的纾困”。这为投资者提供了一个有吸引力的窗口

期。当局既非对银行业风险视而不见，也不急于在近期就暴露它们而引发麻烦。

即使是新冷战可能也不会削弱把中国作为风险对冲的理由。据高盛银行称，在亚太地区，中国的在岸股票已经属于对美国的经济增长或金融状况最不敏感之列。美国与中国脱钩的计划，以及中国鼓励自力更生以抵消其影响的努力，可能会让中国市场的命运进一步与美国脱离。这将削弱中国的效率，但会增加其韧性。该国作为一个增长源的吸引力将减低，而作为一个投资分散化来源的用处将增加。

中国有它自身的风险。但这一点恰恰很重要。中国的金融风险是它自己的，而美国的金融风险会很快也成为其他所有人的。具有中国特色的风险可以让投资者从具有全球特征的风险中喘一口气。 ■



Free exchange

China is now an unlikely safe haven

The country's financial risks are its own. America's quickly become everybody else's, too

FINANCIAL CRISES ruin and reallocate wealth. They also reallocate worry. Investors find themselves agonising about things they never used to fret about. Worse, they fret about things they never used to think about. One example is money in the bank. The collapse of Silicon Valley Bank (SVB) in America has made depositors newly familiar with the nature and limits of claims they previously took for granted.

America's worries have quickly spread elsewhere, too. Emerging-market investors, for example, have begun to rethink the countries in which they invest, scrutinising them through SVB-tinted spectacles. They are wondering which markets are most exposed to financial jitters and slower growth in America, and which share similar vulnerabilities. What countries, for example, are suffering from stubborn inflation, rapid monetary tightening and sharp drops in bond prices? And where in the developing world do depositors look a bit flighty? Through this lens, one emerging market looks surprisingly robust. Whisper it, but could China offer a safe haven to global investors in a time of banking turmoil?

On the face of it, the question is absurd. Only a year ago prominent voices were calling China "uninvestible". Anyone venturing their money in the country must worry about a new cold war between China and its most important trading partners. That includes the prospect of crippling financial sanctions and suffocating export controls on China's most sophisticated firms.

Needless to say, the country poses home-grown dangers as well.

Uncreditworthy property developers remain a financial concern. The Communist Party's campaign against inequality has terrified its best-known entrepreneurs and wealthiest families, many of whom are eager to move money out of the country. The appearance of Jack Ma, founder of Alibaba, in his home town recently perhaps offers some reassurance. But in a normal country investors do not crave visual proof that the nation's most celebrated entrepreneur is welcome in his homeland.

China also has banking vulnerabilities of its own. Smaller regional lenders, including more than 120 city commercial banks and thousands of rural lenders, are not as robust as the rest of the system. They struggle to compete with bigger banks for deposits and find it hard to resist pressure from local governments to lend to white elephants. Investors must also remember the country's approach to covid-19. Policymaking managed to be both obstinate and capricious, inflexible and unpredictable.

And yet China has several macroeconomic and financial peculiarities that look like strengths in the current turmoil. The eccentric commitment to the country's zero-covid policy has thrown its economic cycle out of sync with the rest of the world. It thus represents a natural "growth hedge", according to Xiangrong Yu, Xinyu Ji and Yuanliu Hu of Citigroup, a bank. China may be the only big economy that grows faster this year than last, they point out. This means the growth gap between China and America could widen to five percentage points, according to the Economist Intelligence Unit, our sister company.

These same pandemic restrictions also kept a lid on price pressures. Consumer prices rose by only 1% in February, compared with a year earlier, a number that would seem to belong to a lost era in much of the world. China is the land that inflation forgot. Thus its central bank has not felt compelled to raise interest rates in a hurry. Indeed, it eased policy in March, cutting reserve requirements by 0.25 percentage points for most banks.

Bond prices did wobble during the chaotic abandonment of the zero-covid policy. But in China, unlike in America, Europe or most emerging economies, yields remain lower now than at the end of 2020. Moreover, instead of triggering a run on the banks, the bond sell-off accelerated a run into them. People who lost money on wealth-management products, which invested in bonds, fled into deposits. The economists at Citi reckon that household deposits now exceed pre-pandemic trends by 15.4trn yuan (\$2.2trn).

China is not only at a different stage of the business cycle; it is also at a different stage in the financial cycle of fear and complacency. SVB's swift collapse was so damaging partly because it was so unexpected. In China the dangers posed by regional lenders are well understood, representing grey rhinos not black swans.

China's regulators are now in a cautious mood, rather than a hawkish one. They are aware of financial risks faced by regional banks but keen not to precipitate them. If another regional lender gets into trouble, they may show more forbearance than they have previously displayed. The authorities will not want to let anything interrupt an economic recovery that is still only a few months old. The central government "will likely do everything it can to evince an aura of stability", writes Houze Song of MacroPolo, a think-tank, even if that requires "quiet, below-the-radar bail-outs" of some vulnerable borrowers. This offers an attractive window for investors. The authorities are neither blind to banking risks nor inconveniently keen to crystallise them in the immediate future.

Even the new cold war may not undermine the case for China as a hedge. In the Asia-Pacific region, the country's onshore stocks are already among the least sensitive to American growth or financial conditions, according to Goldman Sachs, a bank. America's efforts to decouple from China and China's offsetting efforts to encourage self-reliance could untether the

market's fortunes from America still further. That will weaken China's efficiency but increase its resilience. The country will become a less attractive source of growth but a more useful source of diversification.

China has risks of its own. But that is the point. China's financial risks are its own, whereas America's quickly become everybody else's, too. Risks with Chinese characteristics could offer some respite from risks with global characteristics. ■



数字金矿

商业自动化的下一个真正的大事件

流程挖掘将帮助实现业务自动化，远早于聊天机器人的作用

运营一家大公司是件复杂的事情——常常繁琐到无趣至极。像接下一个订单然后收取付款这样看起来简单明了的操作都会有几千种可能的路径，例如如果需要做额外的信用核查、交货需要加以确认，或者要发送后续补充单据。这些繁冗的操作尽管往往有必要，但会让公司事务变得复杂，拖慢办事进度。由此造成的低效可能让企业付出惨痛的成本——一项估算认为高达年收入的20%到30%。

软件开发人员现在找到了办法来解开这团办事程序的乱麻，靠的是“流程挖掘”。虽然名字平淡乏味，但这是信息技术（IT）中发展最快的领域之一。据IT咨询公司高德纳（Gartner）估计，2022年它创造了约10亿美元的销售收入，在未来几年可能达到三倍于现在的规模。德国流程挖掘公司Celonis在几个月前融资10亿美元，估值130亿美元，成为德国最大的创业公司，书写了自50年前商业软件巨头SAP创立以来德国最亮眼的科技成功故事。

长期以来，咨询顾问们一直在努力为企业客户模拟和优化商业流程。但他们创建的抽象的模型很少能反映复杂的现实。要把现状看得更清楚，需要做两件事。公司必须能够从IT系统中提取“log文件”，巨细靡遗地显示系统的运作细节。还必须要开发算法来处理这些数据。在此基础上，“你就可以自动构建出模型，展示真正在发生的一切”，维尔·范德阿尔斯特（Wil van der Aalst）解释说。他是这一领域的先行者，现在在德国的亚琛工业大学（RWTH Aachen University）任职。这可以帮助公司明确一些事情，比如额外的信用核查是否导致了不必要的发货延误，或者交货确认的登记是否及时。

流程挖掘不是什么新鲜概念。范德阿尔斯特在1990年代就开始编写建模算

法了。但要有了Celonis这样的公司才能“把这些想法产业化”，巴斯蒂安·诺米纳赫（Bastian Nominacher）说，他在2011年与两位同学一起在慕尼黑创办了Celonis。当时他们被请去修复当地一家广播公司运转不灵的IT系统，无意中发现了流程挖掘这门生意。他们只花了三个月就开发出了第一个产品。他们没有仿效竞争对手之前的做法向商业流程主管推销它，而是瞄上了企业高层，向他们承诺可以节省大笔钱（金额会醒目地显示在软件的仪表盘上）。早期客户中有德国工程巨头西门子，Celonis通过西门子改进了产品。之后它与SAP签订协议，搭载在SAP的软件上拓展海外市场（同时拒绝了这家更大的科技公司的收购要约）。现在它雇有3000名员工。

Celonis的成功（在这个规模尚小但增长迅猛的市场里占到65%的份额）引来了竞争者。现在约有50家公司提供各式各样的挖掘服务，从检查流程在实际工作中是否如计划的那样有效，到把一项流程与其他公司的同等流程做比较。流程挖掘正越来越多地与人工智能结合，来预测瓶颈会在何时何地出现。Celonis销售一套综合性的“执行管理系统”，不断跟踪流程并设法提升其效率。高德纳的马克·凯瑞曼斯（Marc Kerremans）发现，能让企业优化自身流程的速度和效率的工具已经被一些公司用于限制其他类型的消耗，比如碳排放。

和其他炒得很火的IT系统一样，流程挖掘最后肯定会让不止一家客户失望，其老板想不通为什么花那么多钱只有那么一点收益。但如果这件事能做对，收益会很可观。当西门子在2011年开始与Celonis合作时，它在单单从订单到收款的流程中就发现了92.3万个变量。今天它已经减少了约1000万项手动干预，占总数的四分之一。 ■



A digital gold mine

The real next big thing in business automation

Process mining will help automate business long before chatbots do

RUNNING A BIG business is complicated—often mind-numbingly so. Seemingly straightforward processes such as taking an order and receiving the payment can take thousands of possible paths, for example if an extra credit-check is needed, delivery has to be confirmed or a follow-up invoice sent. Though often necessary, the rigmarole complicates life for companies and slows things down. The resulting inefficiencies can cost businesses eye-watering amounts—between 20% and 30% of annual revenue, according to one estimate.

Software-makers are now finding ways to untangle the procedural spaghetti with the help of “process mining”. Its dull name notwithstanding, it is one of the fastest-growing areas of information technology (IT). It generated around \$1bn in annual sales in 2022, reckons Gartner, an IT consultancy, and could treble in size in the next few years. Celonis, a German process-miner, recently raised \$1bn at a valuation of \$13bn, making it Germany’s biggest startup and its hottest tech success story since SAP, a business-software giant, was founded 50 years ago.

Consultants have long tried to model and optimise business processes for corporate clients. But their abstract models rarely reflected the complex reality. To get a better view, two things needed to happen. Firms had to be able to extract “log files” from IT systems, showing in minute detail how these systems operate. And algorithms had to be developed to process these data. Based on that, “you can automatically construct a model which shows you what is really happening,” explains Wil van der Aalst, a pioneer of the field now at RWTH Aachen University in Germany. That helps companies

determine if, for instance, the extra credit check leads to unnecessary shipping delays or if the confirmation of delivery was registered in a timely fashion.

The notion of process mining isn't new; Mr van der Aalst began writing modelling algorithms in the 1990s. But it took startups like Celonis to "industrialise these ideas", says Bastian Nominacher, who co-founded the firm in 2011 with two fellow students in Munich. They stumbled upon process mining when they were asked to fix the dysfunctional IT system of a local broadcaster. It took them just three months to develop their first product. Instead of marketing it to business-process executives, as rivals had done before, they targeted senior management, promising big savings (which their software displays prominently on dashboards). Early customers included Siemens, a German engineering giant, where Celonis was able to hone its products. It then expanded abroad by striking a deal to piggyback on SAP's software (while rejecting takeover offers from the bigger tech firm). Today it employs 3,000 people.

Celonis's success (and 65% share of the small but rapidly growing market) has attracted competitors. Some 50 firms now offer a range of mining services, from checking whether a process works in practice as it should on paper, to measuring how it compares with the same process at other firms. Increasingly, process mining is being combined with artificial intelligence to predict where and when bottlenecks may occur. Celonis sells a comprehensive "execution-management system" that continuously tracks processes and tries to make them more efficient. Marc Kerremans of Gartner observes that the same tools that allow companies to optimise their processes for speed and efficiency are already being used by some firms to limit other types of waste, such as carbon emissions.

As with other much-hyped IT, more than one process-mining customer will end up disappointed, its chief executive wondering why it spent so much

money for so little gain. But get it right, and the benefits can be substantial. When Siemens started working with Celonis in 2011 it counted 923,000 variants in its order-to-cash process alone. Today around 10m manual interventions, or a quarter of the total, have been eliminated. ■



可怕的武器库

美对华商业制裁可能变本加厉

中国也许会以牙还牙【深度】

让中国海关官员最先起疑心的是那位女士格外隆起的肚子，她自称怀孕仅五六个月，肚子却是大到快要临盆的样子。经过搜查，发现所谓的身孕是假的。在她假冒的“孕肚”中藏匿走私的不是毒品或武器，而是计算机芯片，总共202片。自从美国去年对华禁售某些半导体和相关设备以来，中国公司一直有元件短缺的问题。进口量急剧下降（见图表1）。居中贸易的男男女女敢想敢干，各出奇招来获取所需货品并逃避关税。

不仅小公司感受到了制裁的影响。在去年10月新规则实施前，大型国有存储芯片制造商长江存储技术公司被普遍认为是最有可能成为全球芯片制造劲旅的中国公司。然而，一夜之间，它和所有其他中国公司都被禁止购入制造最先进芯片所需的设备。分析师称，长江存储无法买到设备导致其2023年的一项商业计划无法敲定。它的一座新工厂的建设可能不得不延后。

这股冲击正在供应链中传递。长江存储无法使用进口元件建造生产线，这意味着原本用于同一生产线的中国设备的订单也只能取消。据报道，长江存储对一家本地供应商的订单已削减了70%。再过一段时间它可能就将无法交付中国客户的芯片订单。1月，该公司开始裁员，还要求前员工偿还优厚的购房补贴。一肚子不满的被裁员工说它是在拼命节省现金，其困境源自制裁。

这一切最终将拖累中国芯片产业的发展。咨询公司国际商业策略（International Business Strategies）此前估计中国公司到2030年将生产国内所需芯片的一半以上。美国制裁生效后，它将这一预测下调至33%。

这正是美国的政策制定者想要的结果。最新的制裁与过去针对中国、俄罗斯及冷战时期的苏联的措施不同。这些禁令不仅仅是要让中国无法获得先

进武器或狭义的特定技术，还要破坏产业整体。在去年9月的一次演讲中，美国国家安全顾问杰克·沙利文（Jake Sullivan）解释道，美国政府要阻碍中国发展人工智能、生物技术和清洁能源等“基础技术”，以使美国在这些领域尽可能保持优势。有人称这一计划为“沙利文主义”。

目前为止，美国打压中国产业的主要手段是通过“外国直接产品规则”（以下简称FDPR）管控出口。这些命令由美国商务部发布，不仅可用以限制销售美国制造的商品，还可限制销售使用美国知识产权在各国制造的任何商品。违反这些规则的公司如果在美国有运营业务可能被起诉，即使没有也可能受到严厉制裁。

激发了芯片走私及打乱了长江存储阵脚的FDPR规则是在去年10月发布的。该规则遵循“沙利文主义”，企图断绝对华供应用于机器学习的最先进芯片，而机器学习是一切AI技术的基础。规则还禁止美国工程师甚至是持有美国绿卡的中国公民在许多中国芯片公司工作。在北京的欧盟商会主席伍德克（Joerg Wuttke）表示，这突然升级的制裁无异于“宣布开打科技战”。

事实上，科技战早已开启。自2019年以来，美国一直用包括FDPR在内的各种武器打击中国科技公司华为。前总统特朗普曾试图迫使另一家中国公司字节跳动出售受到全球青少年追捧的应用TikTok。但美国的攻击明显在加强。国会最近在高调辩论是否禁用TikTok。商务部和财政部的官员们还在酝酿诸多制裁措施。与此同时，中国也不会眼看着自家产业备受打击而无动于衷。而正如一切冲突一样，旁观者也在被卷入战局。

战事会升级到什么程度，损失会有多严重？最起码，这场战争将迫使计算机芯片这个价值5700亿美元的市场大幅重组供应链。影响很可能蔓延至其他行业，如清洁技术、生物技术，甚至农业。这将使世界在许多产品的供应上实际割裂为截然不同且相互排斥的两大集团，令全球化带来的许多成果化为乌有。这还会损害那些被迫在这两大对手之间选边站的公司和国家。

下一波攻势很可能是加强并扩大那些新的出口限制。实施于芯片的FDPR针对两个要素：处理能力以及与其他芯片的通信速度。虽然理论上中国企业可以通过使用大量不那么尖端的芯片来绕过这两个限制，但这会使得训练大型AI模型变得非常麻烦又昂贵。但是芯片的性能总是在提升，而用于训练的算法也日益高效。这意味着制裁将逐渐失去效力，毕竟成本会下降，效能会提高。

华盛顿智库新美国安全中心（Centre for a New American Security）的比尔·德雷塞尔（Bill Drexel）表示，这类进展可能促使美国修改芯片制裁措施。它可能会转而只针对芯片的算力，这比试图找到“计算能力和互连带宽之间的最佳平衡点”来得简单，德雷塞尔指出。但这需要把限制扩大至计算力较弱的芯片。电子游戏业使用的图形处理芯片可能因此落入限制范围，这是一个快速增长的市场，去年价值400亿美元。美国芯片制造商及其中客户都会受到冲击。

美国商务部还可能通过FDPR打击其他行业。中国的生物制药业（预计到2025年销售额将超过1000亿美元）高度依赖美国知识产权。英国律所霍金路伟（Hogan Lovells）的阿贾伊·昆塔木卡拉（Ajay Kuntamukkala）指出，美国公司向研发新药和新疗法的中国机构提供大量生物材料、技术信息和实验室设备。这些交流中的一部分可能会被禁止。一个可能被盯上的目标是美国开发的软件——中国用这些软件来制造药物，再把药物出口美国。西方许多公司也向中国出口数据用以开发新疗法。这类数据的转移将来也可能受限，另一家智库CSIS的艾米莉·本森（Emily Benson）指出。

美国政府正在权衡的另一选择是扩大FDPR所限制的公司范围。这方面的测试案例是华为，尽管受到美国连串制裁，华为仍在继续运营。华为的子公司鲲鹏制造用于数据中心的服务器，同时授权CPU设计给几家中国科技公司使用。这些公司仍可从英特尔和AMD这两家美国公司购买套件，并从台积电购买芯片组。但美国有可能把这些华为的供应商加入“实体清单”，阻碍华为数据中心的扩张。

其他持有全球资产的中国大型企业集团也可能被拖入这场战争。3月初，

美国农业部宣布将成立一个工作小组来促进种子行业的公平竞争。中国农业集团中化发行的债券价值应声下跌，原因是人们担心这个新机构可能会建议限制中化的种子出口美国。对于多年来一直在海外购入技术、近些年又把自家知识产权带到美国和欧洲的中国企业来说，这样的前景令人忧惧。如果中化遭受制裁，可能重创它旗下的先正达（中化在2017年以430亿美元收购了这家瑞士农化巨头）。

沙利文关注的一些行业将难以通过FDPR打击。例如中国新生的量子计算公司，它们对美国制造的设备或知识产权的依赖程度极低。但该领域的中国研究人员确实与美国同行积极合作。美国智库兰德公司（RAND Corporation）的科学家爱德华·帕克（Edward Parker）指出，美国的量子计算专家与中国同行合著的论文数量多过与其他任何国家的同行合著的论文。因此，美国商务部的另一件管制武器“视同出口”（deemed export）意义重大：禁止向外国人披露某些类型的技术信息，即使是在美国本土内。

在企图扼杀中国某些产业时，美国还可能限制资本流动。美国人或美国公司向被疑与中国军队关系密切的公司提供资金已被列为非法。但美国的金融制裁力度还可能大大增强。财政部不太可能像对待伊朗那样完全禁止中国使用美元，除非两国关系大幅恶化。但美国当局正试图完善和拓展把美元用作国际关系武器的做法。据观察人士预计，美国财政部可能很快将禁止以美元投资中国的某些先进技术。

然而这些措施都有其弊端。例如，禁止美国人与外国人合作研究量子计算不只会损害中国的量子产业，也会伤及美国的量子产业，因为美国将无法招揽外国人才。

同理，限制美国投资于中国技术的作用也会是有限的。中美之间敌意日增，加之中国在疫情期间关闭边境近三年，已经削弱了投资流动（见图表2）。投资集团Picus Capital的高岸林（Alexander Kremer）指出，美国资金对于中国的风投行业已经没那么重要了。不管怎样，美国监管机构也将难以实施全面的金融限制。它们不大可能做到监控设在香港和开曼群岛等

离岸避风港的每支美元基金，至少在不大大增加人力物力的情况下难以做到。

而且美国公司也会受波及。中国的航空公司依赖进口飞机和零部件，其中许多是美国货。因此，美国可以通过FDPR实施全面封禁，让中国航空业陷入停顿——这种可能性令中国官员担忧。但这样的举措很可能也会让美国飞机制造巨头波音陷入危机。

再者，中国最终也会找到方法绕过美国投掷的任何新限制。假装怀孕是低级的规避方式，还有更高级的，顶点是中国在国内建立能力，取代美国监管机构限制出口的一切。华为就是个很好的例子。其电信设备和智能手机业务在美国监管部门的严厉制裁下遭受重创。但创始人任正非在最近一次演讲中表示华为将努力在其系统中去除外国知识产权。他声称，目前为止，华为已经实现了13,000个器件的国产供应替代，并重新设计了4000块电路板。最引人注目的是，华为将在4月推出自己的企业资源规划系统（以下简称ERP），这是用于全面管理该公司业务运营的软件。（直至目前华为使用的是由美国软件公司甲骨文开发的系统。）

投资银行杰富瑞的分析师表示，这个新系统是为了把美国对华为诸多束缚造成的“漏洞补上”。与该ERP系统一起开发的还有一款本土操作系统，后者帮助进一步减轻了对外国供应商的依赖。

这些替代品的开发成本很高，而且未必比原本的系统好用。但中国共产党没有气馁。在科学技术上实现“自力更生”是中国领导人习近平的首要目标之一。其政府已投入大量资金开发半导体及其他技术。有不少资金是浪费了，但并非全部。例如，中国大量使用的SerDes电路（连接芯片的重要部件）直到不久前还主要由外国公司生产，但本地制造商已相对较快地学会了制造它们，上海的私募股权公司信熹资本的贺希格图说。美国的制裁最终可能反而推动了它意图阻遏的东西：中国战略产业的发展。

同时，美国限制越严厉，世界各地的企业越畏缩。许多商界人士和一些外国政府抱怨称，美国正在改写全球化的规则，代价庞大，得益寥寥。西方

企业已经被迫把自己的中国业务视作独立封闭的实体，与自己设在其他地方的研究部门之间的联系越来越少。面对未来可能有更多制裁的威胁，高管们都在推迟大规模投资和招聘的决定。中国科技公司在西方国家的投资和扩张计划也可能延后，它们都在静观TikTok的命运。

美国行动太快，有时顾不上先说服盟友形成统一战线。例如去年10月发布的FDPR就是在获得荷兰、韩国和日本的支持前宣布的。而这些国家生产大量先进芯片和芯片制造设备，假如它们不配合美国的新规，围堵中国的意图就会失败。

这项新规则宣布之后，美国官员还是得到了荷兰和日本政府的支持，它们勉强答应了采取类似的措施，尽管这会让荷兰芯片制造设备商阿斯麦（ASML）和几家日本大公司很痛苦。据报道，韩国公司获得了一年的豁免，但最终也还是要配合。新美国安全中心的萨姆·豪尔（Sam Howell）指出，韩国生产的内存芯片约有一半出口到中国。三星和SK海力士（SK Hynix）这两家韩国大型芯片制造商已在中国投资数十亿美元建设工厂。如果不配合，它们将受到美国的惩罚，但如果配合，又可能受到中国的惩罚。豪尔表示，美国的庞大制裁计划面临许多这样的障碍。

中国迄今没有做出激烈的报复动作。中国领导人乐于看到苹果这样的美国大公司在中国扩展业务。在三年来首次中国之行中，苹果的首席执行官库克试图缓解人们对中美经济脱钩的担忧。3月25日，他在北京向听众表示，过去30年中美之间的“共生”关系推动了两国共同发展。

不过，据说中国商务部正考虑禁止出口一些用于太阳能电池板的先进硅晶片，这将伤害许多美国公司。（对于中国出口商的冲击也将是巨大的。）研究公司荣鼎（Rhodium）的瑞瓦·古戎（Reva Goujon）说，也许更可能成为报复目标的是生物技术，因为许多美国公司在药品原料和医疗器械方面对中国有着“令人不安的依赖”。例如，炭疽病的抗体中用到一些成分只在中国生产。美国宣布的对华制裁越多，冤冤相报的风险就越大。

批评美国的做法的人说，这种方式不仅有损美国自家企业的利益，还在阻

碍将能惠及全人类的技术发展。这肯定会令受影响的行业里的公司成本上升。制裁行动还可能让美国呈现一副霸道形象。帕克指出，阻止中国人参与高水平量子科学的研究也许会拖慢中国的量子计算发展，但也会侵蚀美国式的开放价值观。“我彻底震惊了，”一位中国经济学家在谈到10月实施的FDPR时说，“这违背了我曾被告知的一切：自由贸易、基于规则的秩序、开放竞争。”■



A daunting arsenal

America's commercial sanctions on China could get much worse

And China could retaliate in kind

THE CHINESE custom official's suspicions were first aroused by the size of the woman's stomach. She said she was only five to six months pregnant, yet her belly protruded as if she were close to term. When she was searched, her baby bump turned out to be fake. Inside an improvised pouch she was smuggling not drugs or weapons, but computer chips—202 of them. Since America imposed a ban on sales of certain semiconductors and related equipment to Chinese entities last year, firms in China have been running short. Imports have plunged (see chart 1). Entrepreneurial middlemen (and women) have been coming up with all manner of schemes to obtain the desired goods, and to avoid customs duties to boot.

It is not just small operators who are feeling the effects of the sanctions. Before the new rules were imposed in October, Yangtze Memory Technologies Corp (YMTC), a big state-owned maker of memory chips, was widely seen as the Chinese firm with the best chance of becoming a global force in chipmaking. Overnight, however, it and all other Chinese firms were barred from buying the equipment they needed to make the most advanced chips. YMTC's inability to procure this gear, in turn, has stopped it from finalising a business plan for 2023, analysts say. It may have to delay the construction of a new production facility.

The impact is reverberating through supply chains. YMTC cannot build production lines with foreign components, which means it is having to cancel orders for Chinese equipment, too, that would have gone into the same lines. It has reportedly cut orders from one local firm by 70%. It may in time be unable to fulfil orders for chips from Chinese customers. In January

it began laying off workers and asked former staff to repay generous housing subsidies. Disgruntled former employees claim it is desperately trying to save cash and that its troubles stem from the sanctions.

The ultimate effect of all this will be to set back China's chip industry. International Business Strategies, a consultancy, had previously estimated that Chinese firms would be making more than half of the chips their country needed by 2030. After the American sanctions came into effect, it lowered that forecast to 33%.

This is just what America's policymakers want. The latest sanctions are different from past measures against China, Russia and, during the cold war, the Soviet Union. They seek to deny China access not just to advanced weapons or narrowly defined technologies, but to undermine whole industries. In a speech in September Jake Sullivan, America's national security adviser, explained that the government wanted to hobble China's capabilities in "foundational technologies" such as artificial intelligence, biotech and clean energy, to allow America to maintain as much of an edge as possible in these areas. Some call this plan the "Sullivan doctrine".

So far, America's main technique for hobbling Chinese industry has been export controls using "foreign direct product rules" (FDPRs). These orders, issued by the Department of Commerce, can be used to restrict the sale not just of goods made in America but also of any item made anywhere using American intellectual property. Firms that break the rules risk prosecution if they do business in America and crippling sanctions even if they do not.

The FDPR that has spurred chip-smuggling and upended YMTC was issued in October. In keeping with the Sullivan doctrine, it attempts to cut China off from the most advanced chips involved in the machine learning that underpins all AI. It also bars American engineers, and even Chinese nationals with American green cards, from working at many Chinese chip

companies. This abrupt escalation, says Joerg Wuttke of the European Union Chamber of Commerce in Beijing, was tantamount to “a declaration of tech war”.

In fact, the war had already begun. America has been cudgelling Huawei, a Chinese tech firm, with various weapons, including an FDPR, since 2019. Donald Trump, the previous president, attempted to force ByteDance, another Chinese firm, to sell TikTok, an app adored by teens around the world. But America’s assault is clearly intensifying. Congress has been loudly debating a ban on TikTok. The mandarins of the commerce department and the Treasury have many more potential sanctions up their sleeves. China, meanwhile, will not sit idly by as its industries are pummelled. And, as in any conflict, bystanders are being pulled into the fight.

How far will the battle escalate and how severe will the damage be? At the very least, the fighting will force a drastic reorganisation of supply chains in the \$570bn market for computer chips. It may well spill into other industries such as clean technology, biotech and even agriculture. It will in effect split the world into two distinct and mutually exclusive blocs for many products, and thus undo many of the gains brought about by globalisation. And it will harm the companies and countries that are forced to choose between the two rivals.

The next salvo is likely to be a strengthening and widening of the new export rules. The FDPRs on chips focus on two factors: processing power and the speed at which they communicate with other chips. Although in theory Chinese firms could get around these twin restrictions by using lots of less sophisticated chips, that would make it very cumbersome and expensive to train large AI models. But the performance of chips is always improving, and algorithms used for training are becoming more efficient. This means that the sanctions will gradually lose their potency, as more can be done with

less.

Such advances may prompt America to modify its sanctions on chips, says Bill Drexel of the Centre for a New American Security (CNAS), a think-tank in Washington. It might choose to focus purely on the computational power of chips. This is a simpler approach than trying to find a “sweet spot between computing power and interconnect bandwidth”, says Mr Drexel. But it would entail broadening the restrictions to less powerful chips. That could ensnare the graphics-processing units used in the video-games industry, a rapidly growing market worth \$40bn last year. Both American chipmakers and their Chinese customers would suffer.

The commerce department might also target other industries with FDPRs. Chinese biopharmaceuticals, an industry with projected sales of more than \$100bn by 2025, are highly dependent on American intellectual property. American firms supply lots of biological materials, technical information and lab equipment to Chinese facilities which produce new medicines and therapies, notes Ajay Kuntamukkala of Hogan Lovells, a law firm. Some of these exchanges could be banned. One possible target is American-developed software that Chinese companies use to make medicines that are then exported back to America. Many companies in the West also export data to China in order to develop new treatments. In future, such transfers of data could also be restricted, notes Emily Benson at CSIS, another think-tank.

Another option the American government is weighing is an expansion of FDPRs on companies. The test case for this is Huawei, which continues to operate despite an array of American sanctions. One of its subsidiaries, Kunpeng, makes servers used in data centres and licenses its designs for central processing units (CPUs) to several Chinese tech firms. Those groups are still able to buy kit from Intel and AMD, two American companies, and chipsets from TSMC, a Taiwanese chipmaker. But America could add these

Huawei suppliers to the “entity list” of blacklisted firms, impeding the expansion of Huawei’s data centres.

Other big Chinese conglomerates with global holdings could also get dragged into the fight. In early March America’s Department of Agriculture announced it would form a working group to promote fair competition in the seed industry. The value of bonds issued by Sinochem, a Chinese agro-industrial group, fell on the announcement, owing to fears that the new body could recommend restrictions on its seeds. This is a frightening prospect for China Inc, which has spent years acquiring technologies overseas and, more recently, bringing intellectual property to America and Europe. Sanctions against Sinochem could devastate the operations of Syngenta, a Swiss agribusiness giant that it bought in 2017 for \$43bn.

Some industries in Mr Sullivan’s sights will be hard to injure with FDPRs. China’s nascent quantum-computing firms, for instance, rely very little on American-made equipment or intellectual property. But Chinese researchers in the field do collaborate energetically with their American counterparts. American quantum-computing specialists write more papers with Chinese ones than with people from any other foreign country, notes Edward Parker, a scientist at the RAND Corporation, an American think-tank. Hence the significance of another of the commerce department’s munitions: “deemed export” controls, which prohibit the disclosure of certain types of technical information to foreign nationals, even on American soil.

America may also place limits on capital flows in its attempt to stifle certain Chinese industries. It is already illegal for American people or companies to provide funding to firms suspected of close ties to China’s armed forces. But American financial sanctions could get much fiercer. The Treasury is unlikely to try to cut China off from the use of the dollar altogether, as it has Iran, for example—at least unless relations deteriorate much more. But

American authorities are trying to refine and develop the use of the dollar as a weapon in international relations. Observers expect the Treasury may soon try to ban the use of dollars to invest in some advanced technologies in China.

All these measures, however, have drawbacks. Barring Americans from collaborating with foreigners in research on quantum computing, for instance, would set back the American industry as well as the Chinese one, by preventing it from recruiting talented foreigners.

By the same token, restricting American investment in Chinese technology would have only a limited effect. The growing hostility between China and America and the closing of China's borders for nearly three years during the pandemic have already crimped the flow of investment (see chart 2). American money is no longer that important to China's venture-capital industry, says Alexander Kremer of Picus Capital, an investment group. Anyway, American regulators would struggle to enforce sweeping financial restrictions. Monitoring every dollar fund based in Hong Kong and in offshore havens such as the Cayman Islands is probably beyond them, at least without a massive increase in staff and resources.

And then there are the repercussions for American firms. China's airlines are reliant on imported planes and parts, many of them American. America could therefore bring aviation in China to a standstill with a sweeping FDPR—a prospect that alarms Chinese officials. But such a move would probably also provoke a crisis at Boeing, a giant American aircraft-maker.

What is more, China will also eventually find ways around whatever new restrictions America lobs at it. The phoney baby bump is a crude form of evasion, but there are more sophisticated ones, culminating in the development of a domestic capacity to replace whatever America's regulators have withheld. Huawei is a good example. Its telecoms-

equipment and smartphone divisions have been dealt savage blows by its regulatory pounding. But a recent speech by its founder, Ren Zhengfei, described the company's attempt to push foreign IP from its systems. So far, Mr Ren claims, it has secured domestic supplies of 13,000 components and redesigned 4,000 circuit boards. Most strikingly, in April it will launch its own enterprise-resource-planning (ERP) system, the software that underpins operations across the corporation. (Until now it has used one developed by Oracle, an American software firm.)

The new system is meant to “plug all the holes” created by the many American strictures on Huawei, say analysts at Jefferies, an investment bank. The ERP system was developed alongside a home-grown operating system that has helped further diminish ties with foreign suppliers.

These substitutes are expensive to develop and may not prove as good as the systems they replace. But China's Communist Party is undaunted. “Self-reliance” in science and technology is one of the top priorities of Xi Jinping, China's leader. His government has poured funding into semiconductor development, among other technologies. Much of the money has been wasted—but not all. For example, China uses lots of SerDes circuits, vital components that connect chips, and that were mainly produced by foreign firms until recently. But local manufacturers have learned to make them relatively quickly, says Hexigetu of Sincere Capital, a private-equity firm based in Shanghai. American sanctions may end up spurring the very thing they are intended to impede: the development of strategic Chinese industries.

Meanwhile, the fiercer America's restrictions become, the more businesses around the world wince. Many businessmen and some foreign governments complain that America is rewriting the rules of globalisation at great cost and to little benefit. Western corporations have been forced to think about their operations in China more like stand-alone, ring-fenced entities with

fewer and fewer links to their research departments elsewhere. The looming threat of future sanctions means executives are putting off big decisions on investments and hiring. Chinese tech firms, too, are likely to delay investment and expansion in Western countries while they wait to see what happens to TikTok.

America is moving so quickly that it has not always managed to persuade its allies to form a united front. The FDPRs issued in October, for instance, were announced before it had secured the support of the Netherlands, South Korea and Japan. Yet these countries make lots of advanced chips and chipmaking equipment. If they do not go along with America's new rules, the attempt to blockade China will fail.

After the announcement American officials did elicit reluctant agreement from the Dutch and Japanese governments to adopt similar measures, even though they will be painful for ASML, a Dutch manufacturer of chipmaking equipment, and several big Japanese firms. South Korean firms have been granted a one-year reprieve but will eventually have to comply, according to reports. South Korea exports about half of its memory chips to China, notes Sam Howell at CNAS. Samsung and SK Hynix, two big South Korean chipmakers, have invested billions of dollars in manufacturing facilities in China. They risk penalties from America if they do not fall into line, and from China if they do. America's vast sanctions programme faces many such hurdles, Ms Howell notes.

China has so far refrained from dramatic retaliation. Its leaders are happy to see big American firms such as Apple expanding in their country. On his first trip to China in three years, Apple's chief executive, Tim Cook, sought to allay fears of an economic decoupling between America and China. He told an audience in Beijing on March 25th that the "symbiotic" relationship between the two countries over the past 30 years has helped them both grow.

China's commerce ministry, however, is said to be mulling a ban on exports of some advanced silicon wafers used in solar panels, which would hurt many American firms. (It would also be devastating to Chinese exporters.) Perhaps a likelier target is biotech, since lots of American companies have an "uncomfortable dependency" on China for pharmaceutical inputs and medical devices, says Reva Goujon of Rhodium, a research firm. Some of the ingredients used in antibodies for anthrax, for instance, are produced only in China. The more sanctions America announces the greater the risk of a tit-for-tat cycle.

Critics of America's approach say that it is not just harming its own companies, but also hindering the development of technologies that will benefit all humanity. It will certainly raise costs for companies in the affected industries. The sanctions drive also risks making America look like a bully. Preventing Chinese nationals from participating in high-level quantum-science research might slow the development of quantum computing in China, notes Mr Parker, but it would also erode the notion of American openness. "I was totally shocked," says a Chinese economist of the FDPRs imposed in October, "It goes against everything I was told: free trade, a rules-based order, open competition." ■



掌控机器

科技巨头争夺AI霸权

科技巨头全力投入人工智能，招数各异【深度】

这次视频通话有什么收获？施洋（Jared Spataro）只需点击几下就能找到答案。微软的这位办公软件负责人在视频会议服务Teams上拉出一个侧边栏。接下来是30秒的停顿——等待公司某个数据中心里的AI模型分析此次访谈记录。然后就弹出了一份对笔者的提问和施洋的回答的准确摘要。施洋难掩兴奋。“这可不是你老爸那个时代的AI。”他喜笑颜开地说。

微软不是只对Teams这一个产品植入了机器智能。3月16日，该公司宣布包括Word和Excel在内的几乎所有生产率软件都将享受同样待遇。往前几天，谷歌的母公司Alphabet为其Gmail和Sheets等生产率产品推出了类似的升级。

在过去一个月左右的时间里，美国的科技巨头纷纷宣布做出此类升级。微软部分持股的创业公司OpenAI创建了热门AI聊天机器人ChatGPT，该公司近期发布了超级强大的新AI——GPT-4。电子商务巨头亚马逊的云计算部门亚马逊云科技（AWS）表示将扩大与另一家AI创业公司Hugging Face的合作。据报道，苹果正在包括虚拟助手Siri在内的所有产品中测试新的AI。Meta的老板马克·扎克伯格说他想用AI“增强”他的社交网络。在生产率工具之外，谷歌于3月21日推出了自己的AI聊天机器人Bard以抗衡ChatGPT。

这一连串动作是新一轮AI模型浪潮的结果，这些模型正在迅速从实验室走向现实世界。事实上，由于进展太快，3月29日，1000多位科技界专家名士联名签署了一封公开信，呼吁未来六个月暂停开发比GPT-4更先进的模型。无论相关工作是否真的会暂停，科技巨头都不敢心存侥幸。五大巨头都声称高度专注于AI发展。每家公司的实际做法各不相同。但有两点已经明确。AI竞赛正在升温。而甚至在赢家浮现之前，这场竞赛就已经在改变

科技巨头们部署这项技术的方式。

AI对科技巨头来说并不新鲜。2014年，亚马逊的创始人杰夫·贝索斯就问过他的团队计划如何将AI嵌入产品。两年后，Alphabet的老板桑达尔·皮查伊（Sundar Pichai）开始将他的公司描述为“以AI为先的公司”。AI技术是亚马逊销售和配送产品、谷歌提供在线搜索、苹果驱动Siri智能助理、微软帮助客户管理数据和Meta提供广告服务的基础。

尽管如此，像新发布的GPT-4这样的“生成式”AI模型似乎是一个转折点。ChatGPT于去年11月发布，具备像人一样生成各种内容的能力，能制定旅行计划和写诗等等。自那时起，生成式AI模型的潜能变得清晰起来。赋予此类AI内容生成能力的是“大语言模型”。这些模型分析互联网上的内容，并根据用户的请求，预测一个句子中的下一个词，一幅画中的下一笔和一段曲调的下一个音符。许多技术专家认为这些模型标志着一次“平台转移”。从这个角度来看，AI将变成一个技术层，在其之上可以构建各种软件。很多人把它和互联网、智能手机和云计算的出现相比较。

科技巨头拥有在AI时代蓬勃发展所需的一切——数据、算力和数十亿用户。它们也回想起从柯达到黑莓等曾经的科技巨擘的命运，这些公司错过了早前的平台转移，结果陷入破产或无足轻重的境地。五巨头的应对之策是大举投资。2022年，在科技股引领的股市暴跌期间，五巨头投入了2230亿美元的研发资金，而在2019年是1090亿美元（见图表1）。这还不包括1610亿美元的资本支出，这个数字也在三年内翻了一番。这些钱加起来相当于它们去年总销售额的26%，而2015年为16%。

这些资金并非全部都投向了尖端技术。其中一大部分花在了仓库、办公楼和数据中心等平平无奇的项目上。但总还是有一部分最终流向了五巨头对未来的大押注。今天，它们首选的赌注是AI。这些公司对此毫不避讳。扎克伯格最近表示，AI是他的公司最大的投资类别。Alphabet计划在4月发布的下一次季度财报中首次披露其AI投资的规模。

为了弄清楚五巨头如何押注AI以及所下的赌注有多大，本刊分析了它们在

投资、收购、职位发布、专利、研究论文，以及其员工在领英上公布的个人资料等数据。分析显示，规模可观的资源正被投入到AI技术中。根据研究公司PitchBook的数据，自2019年以来，五巨头的并购和投资总和中约有五分之一涉及AI公司，比重显著超过另外两个近年的科技热点：加密货币、区块链等去中心化“Web3”项目（占2%）；虚拟现实元宇宙（占6%）。根据另一家研究公司PredictLeads的数据，五巨头招聘的岗位中约十分之一要求AI技能。其员工的领英资料也显示差不多同样比例的人数在AI部门工作。

然而，这些平均数据掩盖了五巨头之间的巨大差异。根据我们的衡量标准，微软和Alphabet似乎处于领先，Meta紧随其后。同样有趣的是五巨头各自决定把侧重点放在哪里。

来看它们的股权投资，先从那些并非直接收购的交易开始。在过去四年里，五巨头共入股了200多家公司。对AI公司的投资正在加速。自2022年初以来，五巨头加起来大概每个月对AI公司做一笔投资，是前三年的三倍。

微软在这方面领跑。它的交易中有三分之一涉及AI相关公司，是亚马逊和Alphabet（其风险投资部门之一Gradient Ventures专门投资AI创业公司，自2019年以来已投资近200家）的两倍，是Meta的六倍多，更是远超没有此类投资的苹果。微软最大的赌注是OpenAI，其技术支持着微软新的工作效率功能，并驱动着增强版的Bing搜索引擎。据报道，微软向OpenAI投入了110亿美元，按照这家创业公司最新传闻的290亿美元估值，微软将持有OpenAI38%的股份。微软其他值得注意的投资包括为数据中心开发AI技术的公司D-Matrix，以及使用算法简化实验室工作和其他研发项目的Noble.AI。

微软也热衷于整体收购AI创业公司，其近四分之一的收购目标都在AI领域，例如为医疗保健开发语音识别的Nuance。Meta的水平与之类似，它更喜欢整体收购而不是零碎的投资。与股权投资一样，AI在Alphabet收购中所占份额自2019年以来一直落后于微软（见图表2）。但已有的这些再

加上它的股权投资正在撑起一个令人生畏的AI大厦，其支柱之一是谷歌于2014年收购的DeepMind，一家位于伦敦的AI实验室。DeepMind在AI领域取得了一些重大进步，例如预测蛋白质形状的系统AlphaFold。了解蛋白质形状是个困扰科学家多年的难题，对药物发现至关重要。

最专注收购AI公司的是苹果。其近一半的收购目标与AI有关。这些目标的业务范围广泛，从创作音乐的AI.Music到使用AI评估贷款申请人信用的Credit Kudos等。美国银行（Bank of America）的瓦斯米·莫汉（Wasmi Mohan）指出，苹果的收购历来规模较小，但往往会迅速整合到产品中。

与投资一样，五巨头的AI人才招聘也在增加（见图表3）。与过去三年相比，如今谷歌、Meta和微软发布的职位更有可能要求具备AI专业知识。自2019年以来，Alphabet招聘的职位中有23%与AI相关（见图表4）。Meta位居第二，占8%。目前，这两个数字分别为27%和18%。根据领英的数据，四分之一的Alphabet员工在他们的个人资料中提到了AI技能，与Meta的比重相似，略高于微软（苹果和亚马逊远远落后）。高管猎头公司Stanton Chase的格雷格·塞尔克（Greg Selker）说，尽管五巨头最近纷纷裁员，但对AI人才的需求依然旺盛。

这些AI研究人员可没闲着。追踪AI研究的Zeta Alpha统计了发表论文（至少有一位作者是某家公司的员工）的数量。2020年至2022年间，Alphabet发表了约9000篇AI论文，超过任何其他企业或学术机构。微软共发表了大约8000篇，Meta有4000篇左右。

与其他科技巨头相比，Meta尤其以对自家研发没那么守口如瓶出名。它的AI软件库PyTorch已经对公众开放了一段时间。自2月以来，研究人员可以自由使用它的大语言模型LLaMA，有关该模型训练和偏差的细节也已公之于众。Meta开放研究计划的负责人乔艾尔·皮诺（Joelle Pineau）表示，这一切都有助于吸引顶尖人才（他们跳槽到私营部门的条件往往是要能不断与外界分享研究成果）。

如果根据Meta的收入和员工人数（远少于Alphabet或微软）调整其研究成

果数据，并且只考虑引用次数最多的论文，扎克伯格的公司就升到了研究排行榜的头名。而且，多伦多大学的阿杰·埃格拉瓦（Ajay Agrawal）指出，除了吸引顶尖人才外，开放还有两个好处。低成本AI可以让创作者更经济实惠地制作文本和视频等内容，为Meta的社交网络吸引更多眼球。它也可能打击Alphabet、亚马逊和微软的业务，这三家公司都在试图通过自己的云平台销售AI模型。

因此，此轮AI热潮正在科技界实力最强劲的几家公司中全力推进。而它们在AI上的押注已经开始得到回报——它们提高了自身运营效率（在微软的财务部门，每年审批的约9000万份支付单据中有七八成通过AI自动完成，现在还可以请生成式AI聊天机器人标记出看起来可疑的账单留待人工核对），并得以加快步伐将AI技术融入产品，看起来以比许多早期的技术突破融入得都更快。

在ChatGPT引起全球关注后不过四个月，微软和谷歌就推出了面貌一新的必应、Bard以及AI辅助的生产率程序。Alphabet和Meta提供了一种工具，可以根据广告主的促销或揽客等目标生成广告活动方案。微软正在向其Azure云平台的客户提供OpenAI的技术。得益于与Cohere和Anthropic等模型开发商的合作，AWS的用户可以访问30多种大语言模型。谷歌也在以首年免费提供价值25万美元的计算能力来吸引模型构建者和其他AI公司使用其云服务，这比它向非AI创业公司提供的条件要慷慨。也许用不了多久，AI.Music和Credit Kudos就会出现在苹果的音乐流媒体服务和金融产品中，或者亚马逊的聊天机器人就会向用户推荐直击其心坎的商品。

如果平台转移的论点是正确的，那么五巨头可能会被新来者颠覆，就像它们颠覆了昔日的科技巨擘那样。它们在AI技术上倾注大量资源，反映出它们迫切想要避免这种命运。无论它们能否成功，有一点是肯定的：AI革命不过才刚刚拉开序幕。 ■



Mastering the machine

Big tech and the pursuit of AI dominance

The tech giants are going all in on artificial intelligence. Each is doing it its own way

WHAT HAS been achieved on this video call? It takes Jared Spataro just a few clicks to find out. Microsoft's head of productivity software pulls up a sidebar in Teams, a video-conferencing service. A 30-second pause ensues as an artificial-intelligence (AI) model somewhere in one of the firm's data centres analyses a recording of the meeting so far. An accurate summary of your correspondent's questions and Mr Spataro's answers then pops up. Mr Spataro can barely contain his excitement. "This is not your daddy's AI," he beams.

Teams is not the only product into which Microsoft is implanting machine intelligence. On March 16th the company announced that almost all its productivity software, including Word and Excel, were getting the same treatment. Days earlier, Alphabet, Google's parent company, unveiled a similar upgrade for its productivity products, such as Gmail and Sheets.

Announcements like these have come thick and fast from America's tech titans in the past month or so. OpenAI, the startup part-owned by Microsoft that created ChatGPT, a hit AI conversationalist, released GPT-4, a new super-powerful AI. Amazon Web Services (AWS), the e-commerce giant's cloud-computing arm, has said it will expand a partnership with Hugging Face, another AI startup. Apple is reportedly testing new AIs across its products, including Siri, its virtual assistant. Mark Zuckerberg, boss of Meta, said he wants to "turbocharge" his social networks with AI. Adding to its productivity tools, on March 21st Google launched its own AI chatbot to rival ChatGPT, called Bard.

The flurry of activity is the result of a new wave of AI models, which are rapidly making their way from the lab to the real world. Progress is so rapid, in fact, that on March 29th an open letter signed by more than 1,000 tech luminaries called for a six-month pause in work on models more advanced than GPT-4. Whether or not such a moratorium is put in place, big tech is taking no chances. All five giants claim to be laser-focused on AI. What that means for each in practice differs. But two things are already clear. The race for AI is heating up. And even before a winner emerges, the contest is changing the way that big tech deploys the technology.

AI is not new to tech's titans. Amazon's founder, Jeff Bezos, quizzed his teams in 2014 on how they planned to embed it into products. Two years later Sundar Pichai, Alphabet's boss, started to describe his firm as an "AI-first company". The technology underpins how Amazon sells and delivers its products, Google finds stuff on the internet, Apple imparts smarts on Siri, Microsoft helps clients manage data and Meta serves up adverts.

The new GPT-4-like "generative" AI models nevertheless seem a turning point. Their promise became clear in November with the release of ChatGPT, with its human-like ability to generate everything from travel plans to poems. What makes such AIs generative is "large language models". These analyse content on the internet and, in response to a request from a user, predict the next word, brushstroke or note in a sentence, image or tune. Many technologists believe they mark a "platform shift". AI will, on this view, become a layer of technology on top of which all manner of software can be built. Comparisons abound to the advent of the internet, the smartphone and cloud computing.

The tech giants have all they need—data, computing power, billions of users—to thrive in the age of AI. They also recall the fate of one-time Goliaths, from Kodak to BlackBerry, that missed earlier platform shifts, only to sink into bankruptcy or irrelevance. Their response is a deluge of

investments. In 2022, amid a tech-led stockmarket rout, the big five poured \$223bn into research and development (R&D), up from \$109bn in 2019 (see chart 1). That was on top of \$161bn in capital spending, a figure that also doubled in three years. All told, this was equal to 26% of their combined sales last year, up from 16% in 2015.

Not all of this went into cutting-edge technologies; a chunk was spent on prosaic fare, such as warehouses, office buildings and data centres. But a slug of such spending always ends up in the tech firms' big bets on the future. Today, the wager of choice is AI. And the companies aren't shy about it. Mr Zuckerberg recently said AI was his firm's biggest investment category. In its next quarterly earnings report in April, Alphabet plans to reveal the size of its AI investment for the first time.

To tease out exactly how the companies are betting on AI, and how big these bets are, The Economist has analysed data on their investments, acquisitions, job postings, patents, research papers and employees' LinkedIn profiles. The examination reveals serious resources being put into the technology. According to data from PitchBook, a research firm, around a fifth of the companies' combined acquisitions and investments since 2019 involved AI firms—considerably more than the share targeting cryptocurrencies, blockchains and other decentralised “Web3” endeavours (2%), or the virtual-reality metaverse (6%), two other recent tech fads. According to numbers from PredictLeads, another research firm, about a tenth of big tech's job listings require AI skills. Roughly the same share of big tech employees' LinkedIn profiles say that they work in the field.

These averages conceal big differences between the five tech giants, however. On our measures, Microsoft and Alphabet appear to be racing ahead, with Meta snapping at their heels. As interesting is where the five are deciding to focus their efforts.

Consider their equity investments, starting with those that aren't outright takeovers. In the past four years big tech has taken stakes in 200-odd firms in all. The investments in AI companies are accelerating. Since the start of 2022, the big five have together made roughly one investment a month in AI specialists, three times the rate of the preceding three years.

Microsoft leads the way. One in three of its deals has involved AI-related firms. That is twice the share at Amazon and Alphabet (one of whose venture-capital arms, Gradient Ventures, invests exclusively in AI startups and has backed almost 200 since 2019). It is more than six times that of Meta, and infinitely more than Apple, which has made no such investments. Microsoft's biggest bet is on OpenAI, whose technology lies behind the giant's new productivity features and powers a souped-up version of its Bing search engine. The \$11bn that Microsoft has reportedly put into OpenAI would, at the startup's latest rumoured valuation of \$29bn, give the software giant a stake of 38%. Microsoft's other notable investments include D-Matrix, a firm that makes AI technology for data centres, and Noble.AI, which uses algorithms to streamline lab work and other R&D projects.

Microsoft is also a keen acquirer of whole AI startups; nearly a quarter of its acquisition targets, such as Nuance, which develops speech recognition for health care, work in the area. That is a similar share to Meta, which prefers takeovers to piecemeal investments. As with equity stakes, AI's share of Alphabet acquisitions have lagged behind Microsoft's since 2019 (see chart 2). But these, plus its equity stakes, are shoring up a formidable AI edifice, one of whose pillars is DeepMind, a London-based AI lab that Google bought in 2014. DeepMind has been behind some big advances in the field, such as AlphaFold, a system to predict the shape of proteins, a task that has stumped scientists for years and is critical to drug discovery.

The most single-minded AI acquirer is Apple. Nearly half its buy-out targets are AI-related. They range from AI.Music, which composes new tunes, to

Credit Kudos, which uses AI to assess the creditworthiness of loan applicants. Apple's acquisitions have historically been small, notes Wasmi Mohan of Bank of America, but tend to be quickly folded into products.

As with investments, big tech's AI hiring, too, is growing (see chart 3). Jobs listed by Google, Meta and Microsoft today are likelier to require AI expertise than in the past three years. Since 2019, 23% of Alphabet's listings have been AI-related. Meta came second, at 8%. Today the figures are 27% and 18%, respectively. According to data from LinkedIn, one in four Alphabet employees mention AI skills on their profile—similar to Meta and a touch ahead of Microsoft (Apple and Amazon lag far behind). Greg Selker of Stanton Chase, an executive-search firm, observes that demand for AI talent remains red-hot, despite big tech's recent lay-offs.

The AI boffins aren't twiddling their thumbs. Zeta Alpha, a firm which tracks AI research, looks at the number of published papers in which at least one of the authors works for a given company. Between 2020 and 2022, Alphabet published about 9,000 AI papers, more than any other corporate or academic institution. Microsoft racked up around 8,000 and Meta 4,000 or so.

Meta, in particular, is gaining a reputation for being less tight-lipped about its work than fellow tech giants. Its AI-software library, called PyTorch, has been available to anyone for a while; since February researchers can freely use its large language model, LLaMA, the details of whose training and biases are also public. All this, says Joelle Pineau, who heads Meta's open-research programme, helps it attract the brightest minds (who often make their move to the private sector conditional on a continued ability to share the fruits of their labours with the world).

If you adjust Meta's research output for its revenues and headcount, which are much smaller than Alphabet's or Microsoft's, and only consider the

most-cited papers, Mr Zuckerberg's firm tops the research league-table. And, points out Ajay Agrawal of the University of Toronto, openness brings two benefits besides luring the best brains. Low-cost AI can make it cheaper for creators to make content, including texts and videos, that draw more eyes to Meta's social networks. And it could dent the business of Alphabet, Amazon and Microsoft, which are all trying to sell AI models through their cloud platforms.

The AI frenzy is, then, in full swing among tech's mightiest firms. And their AI bets are already beginning to pay off: by making their own operations more efficient (Microsoft's finance department, which uses AI to automate 70-80% of its 90m-odd annual invoice approvals, now asks a generative-AI chatbot to flag dodgy-looking bills for a human to inspect); and by finding their way into products at a pace that seems faster than for many earlier technological breakthroughs.

Barely four months after ChatGPT captured the world's imagination, Microsoft and Google have introduced the new-look Bing, Bard and their AI-assisted productivity programs. Alphabet and Meta offer a tool that generates ad campaigns based on advertisers' objectives, such as boosting sales or winning more customers. Microsoft is making OpenAI's technology available to customers of its Azure cloud platform. Thanks to partnerships with model-makers such as Cohere and Anthropic, AWS users can tap more than 30 large language models. Google, too, is wooing model-builders and other AI firms to its cloud with \$250,000-worth of free computing power in the first year, a more generous bargain than it offers to non-AI startups. It may not be long before AI.Music and Credit Kudos appear in Apple's music-streaming service and financial offering, or an Amazon chatbot recommends purchases uncannily matched to shoppers' desires.

If the platform-shift thesis is right, the tech giants could yet be upset by newcomers, rather as they upset big tech of yore. The mass of resources

they are ploughing into the technology reflects a desire to avoid that fate. Whether or not they succeed, one thing is certain: these are just the modest beginnings of the AI revolution. ■



熊彼特

透过芭比娃娃看近岸外包

供应链既不是全球性的，也不是地方性的，而是兼而有之

你想笑就笑吧，反正笔者还真的挺期待将于7月上映的首部真人版《芭比》电影。该片由格蕾塔·葛韦格（Greta Gerwig）执导，《伯德小姐》（Lady Bird）和《小妇人》（Little Women）就出自她手，这两部影片中的人物都极富个性。《芭比》的预告片是对《2001太空漫游》（2001: A Space Odyssey）的恶搞，暗含的意思是，不管是喜爱还是厌恶芭比，人们对于她的意义都心领神会。

这也是一个商业大转向的故事。如果这部电影票房大卖，美泰公司（Mattel）可能会逆风翻盘。美泰是全球最大的玩具制造商之一，它的“玩具箱”里有芭比、风火轮（Hot Wheels）和费雪（Fisher-Price）等品牌。五年前，该公司阵脚大乱，四年内走了三个首席执行官，握在手中几十年的为迪士尼生产玩偶的授权被竞争对手孩之宝（Hasbro）夺走。在自2018年以来担任首席执行官的伊农·克瑞兹（Ynon Kreiz）领导下，该公司的成本基础、资产负债表、制造足迹和士气都有所改善。去年，它赢回了迪士尼的合同，员工们欢欣鼓舞。一部风风光光的芭比大电影将会锦上添花。

因此，上个月笔者以肯尼（Ken）那样的轻快脚步，前往墨西哥北部的蒙特雷（Monterrey），见证美泰如何将其北美制造业务整合在一家墨西哥工厂之中，这是它在全球最大的工厂。他希望芭比在成为银幕明星的同时，也能成为贸易领域一个热门新趋势的象征：近岸外包。色彩鲜艳的玩具在流水线上排开，遗憾的是一个芭比也看不到。唯一展出的是芭比梦幻屋的一个道具，这个好莱坞式豪宅是该厂的旗舰产品之一。事实上，芭比娃娃根本不在墨西哥制造。她的生产仍然是在印度尼西亚和中国（第一个金发娃娃是1959年在日本制造的）。

这让芭比完全成了另一件事情的象征：当今供应链的悖论。除了将部分生

产搬到离本国更近的地方，美泰还在亚洲维持着全球制造业务。在需求越来越难以预测、环境脆弱、地缘政治不稳定的商业环境下，这是跨国制造商面临的新现实。它们需要同时做到全球化和本地化，即使这增加了它们的供应链的复杂性。

不管美国政客们可能想让你相信什么，“近岸外包”的首要理据并不是要让供应链与中国脱钩。正如美泰的供应链主管罗伯托·伊萨亚斯（Roberto Isaias）所言，近岸外包是为了提供灵活性。在某些情况下，缩短供应链是合理的，可以更好地响应消费者需求的变化。在其他情况下，最好还是优先考虑低成本生产，无论工厂离得多远。

要理解美泰双管齐下的战略，先来看墨西哥的利与弊。有利的一面是，墨西哥毗邻全球最大的市场。它与美国和加拿大签订了自由贸易协定，这让商品和服务的跨境流动更加便利。它的劳动力成本与东南亚相比已变得更有竞争力（中国劳动力价格上涨已有多年）。墨西哥的工人可能不像亚洲工人那样目标导向，但他们往往更有协作精神。伊萨亚斯（他本人就是墨西哥人）说，墨西哥人对待友善的雇主和同事就像对待家人一样，他们会提出各种点子，以提高事情运转的效率。中美竞争加剧给所有亚洲供应链带来了风险因素，而墨西哥基本上不受此影响。

不过墨西哥也带来了一些经营风险。尽管美泰和规模更大的丹麦竞争对手乐高已在蒙特雷地区耕耘多年，但那里的玩具业尚未形成一个低层级供应商的生态系统，能与太平洋彼岸的竞争对手相抗衡。例如，美泰的蒙特雷工厂使用的塑料树脂是通过铁路从美国和加拿大运来的。用于注入热塑料的玩具模具来自中国。亚洲的基础设施也比墨西哥的更为稳固。在蒙特雷，美泰公司对电力和水的供应没什么怨言，尽管它们并不是始终都可靠。但是蒙特雷科技大学（Monterrey Technology Institute）的罗伯托·杜兰-费尔南德斯（Roberto Durán-Fernández）说，最近汽车制造商如特斯拉对蒙特雷所在的新莱昂州（Nuevo León）大笔投资，可能会加剧各种基础设施的压力，包括道路和住房。

美泰的芭比供应链体现了这些权衡。她的梦幻屋有三层楼高，又重又贵，

父母们基本在圣诞节时才会花大价钱买这种商品。在墨西哥北部生产意味着它可以在48小时内运送到美国的亚马逊、塔吉特、沃尔玛和其他零售商那里，这样美泰就可以等到圣诞节前相对较晚的时候衡量需求的强度。靠近市场也降低了运输相关的成本和排放。

芭比娃娃则不同。她只有11.5英寸（29厘米）高，以苗条著称，因此从亚洲批量运输到美洲相当便宜。对这种娃娃的需求是相对可预测的，因此跨太平洋运输时间长构成的市场风险较小。她的做工精细复杂，头发梳得很整齐，衣着也很考究——这得益于亚洲工厂一代又一代人建立起的手工制作传统。如果特定款式的娃娃需求激增，美泰可以让中国的分包商快速生产，同时自己也提高产能。

因此，对美泰来说，近岸外包仍是一项未完成的工作。该公司正努力发展本土工具供应商，以减少对中国的依赖。要想成为一个近岸外包强国，墨西哥也需要这么做。人们希望，随着时间的推移，从汽车制造到玩具制造的各个行业将在全国范围内发展出充分整合的供应商网络，以减少边境附近的过度拥挤。至于芭比，最佳的供应链策略可能是在成本保持合理的情况下，尽可能在最大的市场附近生产，以便能快速响应消费者的需求。只不过首席执行官克瑞兹不再将他们视为消费者。他认为他们是粉丝。■



Schumpeter

What Barbie tells you about near-shoring

Supply chains are neither global nor local. They are both

CHUCKLE IF YOU will but Schumpeter is looking forward to the first live-action “Barbie” film, due out in July. It is directed by Greta Gerwig, maker of “Lady Bird” and “Little Women”, two movies with strong characters. Its trailer is a parody of “2001: A Space Odyssey”, which suggests that, love Barbie or loathe her, she will be treated with a knowing wink.

It is a business turnaround story, too. If the film is a hit, it could crown a comeback for Mattel, one of the world’s biggest toymakers, with brands like Barbie, Hot Wheels and Fisher-Price in its toy box. Five years ago it was in a funk, having lost three CEOs in four years, and a decades-old licence to produce dolls for Disney to its rival, Hasbro. Under Ynon Kreiz, its CEO since 2018, its cost base, balance-sheet, manufacturing footprint and morale have all improved. Last year, to the joy of staff, it won back the Disney contract. A Barbie red-carpet blockbuster would put icing on the cake.

So it was with a Ken-like spring in his step that your columnist travelled to Monterrey, in northern Mexico, last month to witness the way Mattel has consolidated its North American manufacturing operations into a single Mexican factory, its biggest in the world. He was hoping that Barbie, as well as becoming a star of the silver screen, could also become emblematic of a hot new trend in trade: near-shoring. Among the brightly coloured toys on the assembly line, there was sadly not a Barbie in sight. The only one on display was a prop in the Barbie Dreamhouse, a Tinseltown-like mansion that is one of the plant’s flagship products. In fact, Barbie is not made in Mexico at all. She is still made in Indonesia and China (the first blonde doll was made in Japan in 1959).

That makes Barbie emblematic of something else entirely: the paradox of today's supply chains. As well as bringing some production closer to home, Mattel is maintaining global manufacturing operations in Asia. In a business landscape where demand is increasingly hard to forecast, the environment is fragile and the geopolitics unstable, this is the new reality for multinational manufacturers. They need to be global and local at the same time, even if this adds to the complexity of their supply chains.

Despite what American politicians might have you believe, the overriding rationale for near-shoring is not to decouple supply chains from China. As Roberto Isaias, Mattel's supply-chain chief, puts it, it is to provide flexibility. In some cases, it makes sense to shorten supply chains, in order to be more responsive to changes in consumer demand. In others, it is better to prioritise low-cost production, however far away the factories.

To understand Mattel's two-pronged strategy, consider Mexico's pros and cons. On the plus side, it adjoins the world's biggest market. It has a free-trade agreement with America and Canada, which eases the cross-border flow of goods and services. The cost of labour has become more competitive with South-East Asia (Chinese labour has been pricier for years). Its workers may not be as target-oriented as their Asian counterparts, but they tend to be more collaborative. Mexicans treat benign employers and colleagues like family, pitching in ideas to make things flow more efficiently, reports Mr Isaias (himself a Mexican). Mexico is also more or less immune to the rising Sino-American rivalry, which introduces an element of risk into all Asian supply chains.

Yet Mexico, too, presents some business risks. Though Mattel and Lego, its bigger Danish rival, have been in the Monterrey area for years, the toy industry has yet to nurture an ecosystem of lower-tier suppliers to rival that across the Pacific. The plastic resins used at Mattel's Monterrey factory, for example, are transported by rail from America and Canada. The toy moulds

into which the hot plastics are poured come from China. Asian infrastructure also remains more solid than Mexico's. In Monterrey Mattel has no complaints about electricity and water supply, the reliability of which can be patchy. But Roberto Durán-Fernández of the Monterrey Technology Institute, a university, says that the recent flood of investments by carmakers such as Tesla to Nuevo León, Monterrey's home state, could exacerbate the strain on all manner of infrastructure, including roads and housing.

Mattel's Barbie supply chain illustrates these trade-offs. Her Dreamhouse is three storeys high, heavy and expensive—the sort of item that parents splash out for mostly at Christmas-time. Making it in northern Mexico means it can be shipped within 48 hours to Amazon, Target, Walmart and other retailers in America, enabling Mattel to wait until relatively late in the run-up to Christmas to gauge the strength of demand. The proximity to its market also reduces transport-related costs and emissions.

Barbie, the doll, is different. She is just 11.5 inches (29cm) tall and famously svelte. That makes her fairly cheap to ship in bulk from Asia to America. Demand for the dolls is relatively predictable, so the long trans-Pacific transport time poses less of a market risk. And she is intricately made, with well-coiffed locks and tailored garments—the beneficiary of a tradition of handiwork built up over generations in Asian factories. If demand spikes for particular dolls, Mattel can have Chinese subcontractors make them quickly while it ramps up its own production capacity.

For Mattel, then, near-shoring is still a work in progress. It is trying to develop local tooling suppliers to reduce the dependence on China. To become a near-shoring powerhouse, Mexico needs that, too. Over time, the hope is that industries from carmaking to toymaking will develop fully integrated supplier networks across the country, in order to reduce overcrowding near the border. As for Barbie, the optimal supply-chain

strategy is probably to manufacture her as close to her biggest markets as possible, provided costs are kept reasonable, in order to respond quickly to consumer demand. Though Mr Kreiz, the CEO, no longer thinks of them as consumers. He thinks of them as fans. ■



经济学人视频

全球“假货流行病” - 2

假货盛行是一场“无受害者的犯罪”吗？



The Economist Film

The counterfeit epidemic - 2

Is the counterfeit business a “victimless crime” against the real?



弄假成真

《擂台之王》是一本讲述摔角剧场总监的生动传记

但亚伯拉罕·里斯曼夸大了这项娱乐盛事在现代美国的代表性

《擂台之王》，亚伯拉罕·里斯曼著。Atria Books出版社，464页；29.99美元。

在伍迪·艾伦1986年的电影《汉娜姐妹》（Hannah and Her Sisters）中，马克斯·冯·西多（Max von Sydow）饰演的一位坏脾气的艺术家一边不停地转换电视频道，一边咕哝道：“你能想象看摔角比赛的人都是什么样的思维水平吗？”看起来，这位艺术家犯了傲慢自大者常犯的认知错误。他似乎很清楚职业摔角是假打——也就是说比赛的胜负是预先设定好的——却以为摔角迷们不知道这一点。

在现实中，正如亚伯拉罕·里斯曼在《擂台之王》（Ringmaster）中所展示的，许多忠实粉丝都是“聪明人”而非“大傻子”。这本深入细致但发挥过头的传记写的是世界摔角娱乐公司（WWE）的最大股东文斯·麦克马洪（Vince McMahon）的故事，此人把摔角运动打造成了一个娱乐盛事。许多观众都知道比赛是有剧本的——它更像一出肥皂剧而不是传统的体育比赛。但他们还是爱看——要么是不在乎这种假模假式，要么正是为了看剧本怎么演，后者的可能性还更大。体育艺人们演绎的故事情节既简单又曲折——由人物的欲望或委屈不甘推动，但一波三折如同没完没了的机场小说。粉丝们保持着“一副深信不疑的样子，以免对自己的英雄主人公太失礼”。

这些粉丝以几千万计，遍布世界各地。去年，麦克马洪创建的上市公司WWE实现营收13亿美元。浩克·霍根（Hulk Hogan）和巨人安德雷（Andre the Giant，如图）等昔日的摔角手有时也涉足演艺业；再近一些的，比如约翰·塞纳（John Cena）和“巨石”强森（Dwayne “The Rock” Johnson），都是从摔角起步，后来成了真正的电影明星。而特朗普的事

业与职业摔角交缠在一起至今已有30多年——上世纪80年代末，他在大西洋城的自家赌场打出广告，宣称它是第四届和第五届摔角狂热大赛（WrestleMania）的主办地，而这两届比赛实际上是在当地的其他场所举行的。

特朗普的影子时时在书中出没。本书实际上讲述了两个故事，其中一个相较另一个不那么站得住脚。第一个写得更好的故事说的是麦克马洪本人，以及他从北卡罗来纳州偏远贫困的乡野小镇崛起的故事。像其他一些成功的商人——确实也就和特朗普一样——他也号称自己是白手起家。而实际上，他的父亲老文斯和祖父杰斯·麦克马洪（Jess McMahon）都是摔角运动的早期推动者，当时这项运动的组织还很松散，各个地区各自为政，相互间也没有竞争。一个亲戚说老文斯是“你会想要结识的最有爱心的人”，深受他手下摔角手的敬重和爱戴，而他的儿子在人们口中是个冷酷无情之人。

他还很精明，雄心勃勃，并且洞察了松散零落的摔角组织的低效。前一辈的摔角运动推动者担心电视转播会毁掉现场观赛市场，而他积极接纳电视和名人。自1985年开始，每年的摔角狂热大赛成为付费观看的赛事。历届赛事中出场的不仅有浩克·霍根和T先生（Mr T）等著名摔角手，还有格洛丽亚·斯泰纳姆（Gloria Steinem）、杰拉尔丁·费拉罗（Geraldine Ferraro）、穆罕默德·阿里（Muhammad Ali）和安迪·沃霍尔（Andy Warhol）等人，其中前两人是预先录制好了短片。在麦克马洪的经营下，摔角变得很像美式橄榄球——它越发精彩，且不知何故，在电视上看比在现场看体验更真实。

“我们在麦克马洪创造的世界里生活了四分之一个世纪，”本书的最后一章这样开头，“不只是摔角迷们，我们所有人都是。”这段话概括了本书那另一个不太站得住脚的故事，即摔角运动的表演和麦克马洪的无情以某种方式定义了整个当代美国，而不是仅仅作为它的一个面相。毫无疑问，这种论点在支持特朗普的美国右翼以及极左翼这两个群体那里都会有市场，但原因正相反：特朗普的支持者发自肺腑地认同麦克马洪的做派，而极左翼则认为它揭示了美国根本上的犬儒主义以及道德沦丧。

但若读者不是本来就持同样的观点，可能不大会被说服。在麦克马洪和特朗普之前就不乏残酷无情的商人和不诚实的政客。他们也并非只在美国如鱼得水。大多数美国人不看摔角比赛，正如大多数人没有投票给特朗普。而如果人们觉得第45任总统或者摔角比赛让他们倒胃口，他们可以投票给其他人——或者换个频道。





Fake it to make it

“Ringmaster” is a colourful biography of a wrestling impresario

But Abraham Riesman overstates the spectacle’s place in modern America

Ringmaster. By Abraham Riesman. Atria Books; 464 pages; \$29.99

PART-WAY THROUGH “Hannah and Her Sisters”, Woody Allen’s film of 1986, a dyspeptic artist played by Max von Sydow has been flicking through the television channels and grumbles: “Can you imagine the level of a mind that watches wrestling?” Apparently the character labours under a common snooty misconception. He seems to grasp that professional wrestling is fake—meaning the outcomes of the matches are predetermined—but assumes its fans do not.

In reality, as Abraham Riesman explains in “Ringmaster”, his thorough but overwritten biography of Vince McMahon—the majority owner of World Wrestling Entertainment (WWE) and the man who turned wrestling into an entertainment behemoth—many devoted fans are “smarts” rather than “marks”. They know they are watching a scripted event more akin to a soap opera than a traditional sport. But they love it anyway, either despite its phoniness or, more likely, because of it. They are seeing athletic entertainers acting out storylines at once simple, driven by lust or grievance, and tortuous, with as many twists as an endless airplane novel. They maintain “the pose of belief so as not to be rude to their heroes”.

Those fans number in the tens of millions and are spread all over the world. Last year WWE, the publicly traded company that Mr McMahon built, had revenues of \$1.3bn. Wrestlers of the past, such as Hulk Hogan and Andre the Giant (pictured), sometimes dabbled in acting; more recent ones, such as John Cena and Dwayne “The Rock” Johnson, used their starts in wrestling

to become genuine film stars. Donald Trump's career, meanwhile, has been intertwined with professional wrestling for more than three decades—ever since, in the late 1980s, one of his casinos in Atlantic City was billed as the host of WrestleManias 4 and 5, jamborees that were actually held at other local venues.

Mr Trump's spectre haunts this book, which really tells two stories, one more tenuous than the other. The first and better tale is about Mr McMahon himself, and his rise from rural and small-town poverty in North Carolina. Like some other successful businessmen—indeed, like Mr Trump—he passes himself off as self-made. In fact his father and grandfather, respectively Vince McMahon senior and Jess McMahon, were wrestling promoters in the sport's early ramshackle days, when it comprised a set of regional fiefdoms that did not compete with each other. But whereas Vince senior was, according to a relative, “the most loving man you'd ever want to know”, and held in great esteem and affection by the wrestlers in his stable, his son is said to be cold and ruthless.

He is also shrewd and ambitious, and was able to see that wrestling's fragmented structure was inefficient. An earlier generation of promoters feared television would kill the market for in-person wrestling; Mr McMahon embraced TV and celebrity. WrestleManias—annual pay-per-view events running since 1985—featured not just famous wrestlers such as Hulk Hogan and Mr T, but also appearances by Gloria Steinem, Geraldine Ferraro, Muhammad Ali and Andy Warhol (the first two in recorded clips). Under Mr McMahon, wrestling became, much like American football, better and somehow more authentically experienced on television than live.

“We have lived for a quarter of a century in the world Mr McMahon made,” begins the book's final chapter. “Not just wrestling fans—all of us.” Those sentences encapsulate its more tenuous story, which is that wrestling's fakery and Mr McMahon's ruthlessness somehow define contemporary

America, rather than simply being an aspect of it. Doubtless this thesis will find favour on both America's Trumpian right and the far left, albeit for opposite reasons: the Trumpsters wholeheartedly embracing McMahonism, the left-wingers believing it reveals America's fundamental cynicism and moral bankruptcy.

But readers who do not already agree with the author are unlikely to be persuaded. Cut-throat businessmen and dishonest politicians predate Messrs McMahon and Trump. They do not thrive only in America. Most Americans do not watch wrestling, just as most did not vote for Mr Trump. And if people find either the 45th president or wrestling distasteful, they can vote for someone else—or change the channel. ■

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风雨欲来

随着电子游戏的发展，它们正在吃掉媒体

游戏业给其他行业和各国政府的启示

华纳兄弟在2月发行了《哈利·波特》新作，两周入账8.5亿美元。这让它成为华纳历史上第二成功的哈利·波特系列作品。不过这部名为《霍格沃茨之遗》（Hogwarts Legacy）的作品并不是一部电影，而是一款电子游戏。

华纳的这个爆款是游戏胜过传统媒体的一个例子，无论是作为一门生意，还是一种娱乐方式。预计今年消费者将在游戏上花费1850亿美元，是他们在电影院消费的五倍，比他们将在奈飞等流媒体上的消费多70%。游戏曾经是孩子们的爱好，现在已经走向成人。如今三四十岁的主机游戏玩家比十几二十来岁的玩家人数更多。

但随着游戏发展成熟，它已经不仅仅是在和其他媒体竞争了。它就像一个贪婪的吃豆人，要把都它们都吞掉。《哈利·波特》之类的IP固然可能在游戏形式中取得成功，但系列游戏本身已经成为其他媒体中最受欢迎的IP类型。苹果公司的电影《俄罗斯方块》（Tetris）在3月底上映，这是好莱坞在观众厌倦漫画中的英雄之时从游戏中挖掘创意的最新（或许也是最奇怪的）案例。业余创作者也在做同样的事。在YouTube上，游戏视频是除音乐外内容最多的类别。

与此同时，越来越多的观众正在通过游戏消费旧媒体。长寿剧集《行尸走肉》的最新一季在Facebook上以互动游戏的形式播出。爱莉安娜·格兰德（Ariana Grande）等音乐人在游戏《堡垒之夜》（Fortnite）中举办演唱会。健身视频让位给健身游戏。甚至连社交网络也部分转移到了游戏疆域。像Roblox之类的平台为孩子们提供了一个游戏场所——同时也是和朋友们闲逛消遣、聊天和购物的地方。如果说现在存在像元宇宙这样的东西，那么它就存在于游戏里。

等着看更多增长吧。智能手机把一个强大的游戏机装进了人们的口袋，解

锁了通勤路上和讲堂后排的游戏时间。下一个推动力可能来自智能电视和流媒体，它们不需要专用硬件就能将高保真游戏带到客厅。

新的商业模式是另一个增长源头。游戏业近来的繁荣是由免费游戏推动的，它们先把用户吸引住，然后通过广告和游戏内购买来盈利。新一轮扩张来自游戏库订阅，它已经显示出增加消费、加速人们发现新内容的迹象，类似有线电视套餐当年对电视业的影响。这些新的发行机制和商业模式将给消费者提供更多的选择——所以监管机构应该允许微软以690亿美元收购大型游戏开发商动视暴雪，这样它的游戏就可以在微软旗下的流媒体和订阅服务中出现。

所有这些给其他行业带来了启示——简单地说就是，如果你在做媒体，你就得做游戏。苹果和奈飞正急着用游戏补充自己的流媒体业务。其他公司已经在这么做了。索尼影业将在今年8月发行一部改编自索尼游戏的电影《GT赛车》（*Gran Turismo*），其中的歌曲由索尼音乐的艺人演唱。忽视游戏的媒体公司可能会落得上世纪50年代那些对电视热潮无动于衷的公司的结局。

各国政府也应当予以关注。到目前为止，它们主要担心的是游戏是否会腐蚀年轻人的头脑（几乎可以肯定不会，尤其是如果玩游戏会让他们少用社交媒体的话）。随着游戏行业的发展，更大的问题逐渐显现。电影和电视是20世纪流行文化的引擎，由好莱坞主导。新媒体的竞争则更加开放。西方政府开始意识到TikTok这个世界上最热门的社交媒体应用是由中国人持有的会带来什么。接下来它们可能会思量，中国还制作了去年最热卖的三款手机游戏中的两款，这又意味着什么。

当电子游戏还仅仅是电子玩具时，这可能并不重要。但随着游戏不断扩展而渗透到其他形式中，谁主导游戏，谁就将在各种形式的传播中发挥影响力，这一点日渐清晰。在任何意义上，媒体的未来都在游戏里。■



Storm forming

As video games grow, they are eating the media

The games business has lessons for other industries and for governments

WARNER BROS released a new Harry Potter title last month and took \$850m in two weeks. That made it the second-most-successful Potter launch in the film studio's history. But "Hogwarts Legacy", the title in question, was no movie: it was a video game.

Warner's hit is an example of how gaming is besting older media, both as a business and as a way for people to entertain themselves. Consumers are forecast to spend \$185bn on games this year, five times what they will spend at the cinema and 70% more than they will allocate to streamers like Netflix. Once a children's hobby, gaming has grown up. Console players in their 30s and 40s now outnumber those in their teens and 20s.

Yet as gaming matures, it is not just rivalling other media. Rather like a ravenous Pac-Man, it is gobbling them up. While such intellectual property as Harry Potter may be finding success in game form, game franchises have themselves become the most in-demand kind of IP in other media. Apple's "Tetris" movie, due out later this month, is the latest (and perhaps oddest) instance of Hollywood mining games for ideas as audiences tire of comic-book heroes. Amateur creators are doing the same. After music, gaming clips are the biggest content category on YouTube.

At the same time, audiences are increasingly consuming old media through games. The latest season of "The Walking Dead", a long-running television drama, took the form of an interactive game on Facebook. Musicians such as Ariana Grande perform concerts in "Fortnite". The fitness video is giving way to the fitness game. Even social networking is partly migrating to the

gaming arena. Platforms like Roblox provide children with a place to play—but also to hang out, chat and shop. In so far as anything resembling a metaverse yet exists, it exists in games.

Expect more growth. Smartphones put a powerful console in people's pockets and unlocked hours of playtime on the commute and at the back of the lecture hall. The next boost may come from smart TVs and streaming, which bring high-fidelity games to living rooms without the need for dedicated hardware.

New business models are another source of growth. Gaming's latest boom was propelled by free-to-play games, which suck users in before monetising them with ads and in-game purchases. A new phase of expansion is coming from game-library subscriptions, which already show signs of increasing consumption and accelerating discovery, much as the cable bundle did in television. These new distribution mechanisms and business models promise more choice for consumers—which is why regulators should allow Microsoft's \$69bn acquisition of Activision Blizzard, a big gamemaker whose titles Microsoft would make available for streaming and subscription.

All this holds lessons for other industries—chiefly that, if you are in media, you need to be in gaming. Apple and Netflix are scrambling to complement their streaming offerings with games. Others are already there. In August Sony Pictures will release “Gran Turismo”, a film based on a Sony game which features songs by artists from Sony Music. Media firms that ignore gaming risk being like those that decided in the 1950s to sit out the TV craze.

Governments should also pay attention. Their main concern so far has been whether games rot young minds (almost certainly not, especially if playing diverts them from social media). As gaming grows, bigger questions loom. Film and television, the engines of popular culture in the 20th century, are

dominated by Hollywood. The contest in new media is more open. Western governments are waking up to the implications of the world's hottest social-media app, TikTok, being Chinese-owned. Next they might consider what it means that China also made two of last year's three highest-grossing mobile games.

When video games were just electronic toys, this might not have mattered. But as games expand and spill into other formats, it is becoming clear that whoever dominates gaming is going to wield clout in every form of communication. In every sense, the future of the media is in play. ■



未完成交易

阿根廷正在浪费中国提供给它的巨大机会

中国问它的南美伙伴：牛肉在哪儿呢？

它们本应是绝配，就像一块牛排和一杯马尔贝克葡萄酒。阿根廷有肥沃的土地和熟练的农民。中国有14亿张嘴要养活。双边贸易应该很火爆。但阿根廷的政策太过反复无常，结果中国常常在问：牛肉在哪儿呢？

有时这就是原话。2018年，中国向阿根廷牛肉开放了自己的市场。一开始交易繁荣。但在2021年，阿根廷突然给自己下了一道牛肉出口禁令。“中国人简直不敢相信。”智库中国-阿根廷观察站（China-Argentina Observatory）的帕特里西奥·朱斯托（Patricio Giusto）回忆道。

这背后令人费解的缘由是这样的。当时阿根廷国内肉类价格上涨，让喜欢烧烤的阿根廷人很不高兴。总统费尔南德斯认为，如果他不再让外国人大口饕餮阿根廷牛肉，就能把更多牛肉留给国人。这项禁令对抑制通胀没起什么作用——同比通胀率目前接近100%，主要缘于政府疯狂印钞。但这项出口禁令伤害了阿根廷农民，也激怒了他们的中国客户。

更聪明的双边关系会带来巨大的好处。阿根廷迫切需要资金，中国财力雄厚。中国渴求矿产，阿根廷矿藏丰富。但由敏感易怒的左翼庇隆主义者组成的阿根廷现任政府并没有利用这些经济机会，而是更注重和中国的政治和外交关系，而这又让美国警觉。更务实的做法应是寻求与两个大国都友好相处，同时充分利用阿根廷和中国在经济上的互补。阿根廷将于10月举行的下一次大选可能就会让这样一个政府上台。

近几十年，阿根廷和中国的经济关系发展迅速。双边贸易额从2001年的23亿美元增加到去年的260亿美元。中国宣布了几个大型投资项目。根据华盛顿智库“美洲对话”（Inter-American Dialogue）的数据，2007年至2021年间，中国的商业银行在拉丁美洲发放的62笔贷款中有一半以上流向了阿根廷（见图表）。其中大部分发生在2015年之后。中国最大的商业银行中

国工商银行的一家分行就耸立在布宜诺斯艾利斯的总统府附近。

但近来进展已停滞不前。但凡阿根廷有相对优势之处，费尔南德斯政府就削弱它。对牛肉出口的全面禁令已经解除，但对牛小排等七种受欢迎的牛肉部位的禁令还在。农作物被征收沉重的出口税，从葵花籽油的7%到大豆的高达33%。这阻碍了投资，让阿根廷损失了一大笔钱。智库Fada的戴维·米亚佐（David Miazzo）估计，假如它采取的政策稍微明智些，就可以在十年内每年增加250亿美元的谷物和油籽出口，相当于今天GDP的5%。但费尔南德斯政府急需短期现金，而一船一船的粮食无可隐藏，很容易就成为了征税目标。

登上新闻头条的中国投资项目经常陷入麻烦。一年前，中国宣布了一项价值80亿美元的交易，将在布宜诺斯艾利斯附近建造一座核电站。它很想展现一番自己的华龙一号核电技术，到目前为止该技术还只在中国本土发电。它还希望将阿根廷锁定在核项目所需的那种长期关系中。

问题是阿根廷负担不起项目价格——据前能源官员朱利安·加达诺（Julian Gadano）估计，加上利息可能高达130亿美元。根据咨询公司Econviews的数据，阿根廷的净外汇储备总共才25亿美元。阿根廷欠国际货币基金组织的债务比任何其他国家都多，它正在奋力抓住另一根救命稻草。在已经多次重新谈判核项目后，阿根廷恳求中国贷款方从提供85%的融资改为提供全额融资。加达诺预测这个项目“不会发生了”。

2014年，在德基什内尔（现任副总统）任总统期间，阿根廷从中国三大国有银行借款47亿美元，用于在她的票仓圣克鲁斯建造两座水电大坝。目前为此支付的利息消耗了政府预算的一大块，而两座大坝尚未开始发电。去年，中国公司原本看起来很有机会赢得一份合同，建造一条从全球最大的页岩油气储藏之一的瓦卡穆尔塔（Vaca Muerta）输送天然气到布宜诺斯艾利斯的管道，但在一番争吵后放弃了竞标。2020年，中国石油巨头中石化在与工会发生口角后撤出了阿根廷。

价格管制削弱了能源投资的积极性。阿根廷的家庭几乎不支付任何电费，

而且大量浪费电力。停电很常见。

胡胡伊省省长杰拉尔多·莫拉莱斯 (Gerardo Morales) 表示，无论从事何种业务，“中国公司面对的问题和所有想在阿根廷投资的公司是一样的”。除了高通胀，投资者还面对货币管制，导致难以将利润汇回国内。多种汇率制度（美元兑换至少有十几种）造成了混乱和扭曲。出口商必须按官方汇率进行美元结汇，大约仅为美元价值的一半。政府在充斥贪腐的过程中分配打了折扣的硬通货。特殊汇率被用于摇滚音乐会（“酷玩乐队”汇率）和流媒体服务（“奈飞”汇率）等。中国公司发现自己很难在一个政策走向如梅西脚下的足球般变幻莫测的国家开展业务。

阿根廷似乎更有兴趣做中国的盟友而非供应商。德基什内尔最近赞美中国是“最成功的资本主义制度”。中国大陆强调台湾与阿根廷声称拥有主权的英国领土福克兰群岛之间的相似性。（它没有提及的一个相似点是，福克兰岛人和台湾岛人一样，都不渴望被他们更大的邻居统治。）

阿根廷近期与中国的许多合作项目更多是政治象征，缺乏经济实质。其中一些已经激怒了美国。去年，费尔南德斯宣布阿根廷将加入中国的全球基础设施计划“一带一路”倡议。相关协议不包括新的金融承诺。中国在巴塔哥尼亚 (Patagonia) 建造了一个天文台，声称这纯粹出于科学目的——极南的纬度使它能够观测到从中国无法观测到的宇宙景观。其他人怀疑该设施从事间谍活动，因为与一座类似的欧洲天文台不同，中国这个天文台不对外开放，工作人员都是军人。去年9月，位于阿根廷最南端的火地岛省的省长宣布设立一个船舶后勤基地，说该省可以作为中国通往南极洲的“门户”。

费尔南德斯政府可能低估了美国近来对中国的敌意以及阻止中国在其半球立足的决心。任何看起来像是中国在该地区的军事活动的事物都肯定会激怒任何美国政府。尽管阿根廷不同于被美国视为敌人的古巴或委内瑞拉的那种独裁统治，但华盛顿一些急性子说它正在朝着那个方向走。2月28日，美国议员玛丽亚·埃尔维拉·萨拉查 (María Elvira Salazar) 称阿根廷已经和中国达成协议，将在阿根廷建造中国战机。她称之为“与魔鬼的契

约，可能会导致难以想象的大规模后果”。阿根廷政府表示并没有这样的一个计划。

尽管庇隆主义者对华盛顿政府怀有戒心，但他们并不想疏远它，尤其是因为国际货币基金组织的支持有赖美国的善意。他们已经开始放弃美国人反对最为强烈的那些和中国的交易。阿根廷现在说它将用自己的钱在火地岛建设海事基地，这也就意味着不太可能建成了。阿根廷购买中国战斗机的计划在去年12月取消，它现在可能会转而购买老式美国喷气机，如果它能弄到钱的话。

对阿根廷中央政府感到失望的中国投资者中有一些转而直接和省级政府打起了交道。胡胡伊省省长莫拉莱斯已经多次访华。胡胡伊干旱的土壤基本不适合耕种，却有充足的阳光和矿藏。建在南美高原上的考查里

（Cauchari）太阳能园区使用了中国的资金和技术，发电量足够16万户家庭使用。附近一个投资8.52亿美元的中阿锂项目预计将于今年开始生产这种用于电动汽车电池的金属。莫拉莱斯说，阿根廷“在一个渴望食物和能源的世界里.....拥有巨大的机遇”。如果它取消资本管制并且只有一种汇率，它将收获“大得多的投资流量”。

10月的大选很可能会带来一个实施更明智的经济政策的政府，这应该有助于阿根廷与中国的商贸关系。它也可能不像庇隆主义者那样愿意去助推中国在西半球的野心。“我们是民主政体，相信人权。我们不[认同中国]对世界的看法主张。”反对派的一名高级成员说。但在经济上，“他们需要我们拥有的东西，我们应该利用这一点，[通过出口]矿产和食品。”朱斯托认同这种策略。他指出，治理得更好的阿根廷邻国乌拉圭和美国维持着很好的关系，和中国也不错。它出口牛肉，政策稳定可预测。

如果阿根廷选出了一个对中国的战略目标更不友好、和美国走得更近的政府，中国的共产党政府可能要抱怨了。但如果这让阿根廷的经济政策变得不那么古怪荒诞，中国的投资者可能会默默地欢迎它。 ■



Deals not done

Argentina is wasting the vast opportunities China offers it

China is asking its South American partner: where's the beef?

THEY SHOULD be a perfect match, like a steak and a glass of Malbec. Argentina has fertile land and skilled farmers. China has 1.4bn mouths to feed. Bilateral trade should be sizzling. But Argentine policy is so erratic that China is often left asking: where's the beef?

Sometimes, literally. In 2018 China opened its market to Argentine beef. At first, trade boomed. However, in 2021 Argentina slapped a beef-export ban on itself. "The Chinese couldn't believe it," recalls Patricio Giusto of the China-Argentina Observatory, a think-tank.

The convoluted logic went like this. Domestic meat prices were rising, upsetting barbecue-loving Argentines. President Alberto Fernández reasoned that if he stopped foreigners from wolfing Argentine beef, there would be more for domestic consumers. The ban did little to curb inflation, which is now nearly 100% year on year and mostly caused by the government's frenzied money-printing. But the export ban gored Argentine farmers and infuriated their Chinese customers.

Cleverer engagement would yield huge benefits. Argentina desperately needs capital; China has deep pockets. China craves minerals; Argentina has mountains of them. Rather than exploit those economic opportunities, Argentina's current government of prickly left-leaning Peronists has given priority to political and diplomatic ties with China, which alarms the United States. A more pragmatic one would seek to get along well with both big powers, while taking full advantage of the way the Argentine and Chinese economies complement each other. Argentina's next national election, due

in October, may bring such a government to power.

In recent decades the economic relationship between Argentina and China has burgeoned. Bilateral trade has increased from \$2.3bn in 2001 to \$26bn last year. Several big Chinese investment projects have been announced. More than half of the 62 loans doled out by Chinese commercial banks in Latin America between 2007 and 2021 have gone to Argentina, according to the Inter-American Dialogue, a think-tank in Washington (see chart). Most of this has taken place since 2015. A branch of ICBC, China's biggest commercial bank, dominates the skyline near the presidential palace in Buenos Aires.

Lately, though, progress has stalled. Wherever Argentina has a comparative advantage, the Fernández government erodes it. The total ban on beef exports has gone, but bans remain on seven popular cuts of beef, such as short ribs. Crops are whacked with export taxes ranging from 7% (for sunflower oil) to a crushing 33% for soya. This discourages investment and costs Argentina a fortune. If it had halfway sensible policies it could add \$25bn a year to grain and oilseed exports within a decade, estimates David Miazzo of Fada, a think-tank. That is equivalent to 5% of today's GDP. But the government is desperate for short-term cash, and shiploads of grain are hard to hide and easy to tax.

Chinese investments that generate headlines often run into trouble. A year ago China announced an \$8bn deal to build a nuclear power plant near Buenos Aires. It was eager to show off its Hualong One nuclear technology, which so far produces power only in China itself. It also hoped to lock Argentina into the kind of long-term relationship that nuclear projects require.

The problem is that Argentina cannot afford the price tag (which with interest could add up to \$13bn, estimates Julian Gadano, a former energy

official). Its net foreign reserves are a mere \$2.5bn, according to Econviews, a consultancy. Argentina owes more than any other country to the IMF, and is trying to secure another lifeline. Having renegotiated the nuclear project several times, Argentina is begging Chinese lenders to cover 100% of the cost, up from 85%. The project “is not going to happen”, predicts Mr Gadano.

In 2014, during the presidency of Cristina Fernández de Kirchner (who is now the country’s vice-president), Argentina borrowed \$4.7bn from three Chinese state-owned banks to build two hydroelectric dams in Santa Cruz, Ms Fernández’s political stronghold. Interest payments are now a big drain on the budget, and the dams have yet to produce any electricity. Last year Chinese firms seemed well placed to win a contract to build a pipeline to Buenos Aires for gas from Vaca Muerta, one of the world’s largest deposits of shale gas and oil. But after some wrangling, they abandoned the bidding. In 2020 Sinopec, a Chinese oil giant, pulled out of Argentina after squabbles with labour unions.

The incentive to invest in energy is dulled by price controls. Households pay hardly anything for electricity and waste it copiously. Power cuts are common.

Regardless of their line of business, “Chinese firms have the same problems as all companies that want to invest in Argentina,” says Gerardo Morales, the governor of Jujuy province. In addition to high inflation investors must contend with currency controls, which make it hard to repatriate profits. A system of multiple exchange rates (there are at least a dozen for the dollar) causes confusion and distortion. Exporters must surrender their dollars at the official rate, which is roughly half what they are worth. The government allocates cut-price hard currency in a process riddled with graft. Special rates apply to such things as rock concerts (the “Coldplay” rate) and streaming services (the “Netflix” rate). Chinese firms find it hard to operate in a country where policy changes direction as often and unpredictably as a

football at Lionel Messi's feet.

Argentina seems more interested in being China's ally than its supplier. Vice-President Fernández (no relation to her nominal boss) recently gushed that China was the "most successful capitalist system". China plays up similarities between Taiwan and the Falkland islands, a British territory that Argentina claims. (One parallel it does not mention is that the Falkland islanders, like the Taiwanese, have no desire to be ruled by their bigger neighbour.)

Many of Argentina's recent ventures with China are long on political symbolism and short on economic substance. Some of these have irked the United States. Last year Mr Fernández announced that Argentina would join the Belt and Road Initiative, a Chinese global infrastructure scheme. The agreement included no new financial commitments. China has built a space observatory in Patagonia, which it claims is purely for scientific purposes—the far-southern latitude gives it a view of the cosmos unavailable from China. Others suspect it is spying; unlike a similar European observatory, China's is closed to outsiders and staffed by military folk. In September the governor of Tierra del Fuego, on the tip of Argentina, offered his province as "the gateway" for China to Antarctica, with a logistics base for ships.

The Fernández administration may have underestimated how hostile the United States has recently become towards China, and how determined it is to prevent China from gaining a foothold in its hemisphere. Anything that looks like Chinese military activity in the region is sure to infuriate any American administration. Although Argentina is not like the dictatorships in Cuba or Venezuela, which the United States regards as foes, some hotheads in Washington suggest it is heading that way. On February 28th María Elvira Salazar, an American legislator, claimed that Argentina had struck a deal with China to build Chinese warplanes in Argentina. She called

it “a pact with the devil that could have consequences of biblical proportions”. The Argentine government said there was no such plan.

Although the Peronists are suspicious of the government in Washington, they do not want to alienate it, not least because support from the IMF depends on American goodwill. They have begun to walk back from the deals with China to which the United States most objects. Argentina now says it will build the maritime base in Tierra del Fuego with its own money, which means it is unlikely to happen. An Argentine plan to buy Chinese fighter jets was cancelled in December; Argentina may now buy vintage American jets instead, if it can find the money.

Frustrated with Argentina’s central government, some Chinese investors are dealing directly with provincial governments. Governor Morales in Jujuy has made multiple trips to China. Jujuy’s arid soil is little use for farming, but it has sunshine and minerals. A solar park at Cauchari, built high on an altiplano (plateau) with Chinese money and technology, yields enough electricity for 160,000 homes. A nearby \$852m Sino-Argentine lithium project is expected to start producing the metal, used in electric-car batteries, this year. Mr Morales says Argentina has “great opportunities...in a world hungry for food and energy”. It would receive “far greater investment flows” if it scrapped capital controls and had only one exchange rate.

The election in October is expected to bring in a government with saner economic policies, which ought to help Argentina’s commercial relations with China. It may also be less willing than the Peronists are to promote China’s ambitions in the western hemisphere. “We are democratic and believe in human rights. We don’t [share the Chinese] vision of the world,” says a senior member of the opposition. But economically, “they need what we have, and we should take advantage of that, [by exporting] minerals and food.” Mr Giusto agrees. Uruguay, Argentina’s better-governed neighbour, maintains excellent relations with the United States and good ones with

China, he notes. It exports beef and behaves predictably.

China's communist regime may grumble if Argentina elects a government that is less friendly to its strategic aims and closer to the United States. But if that makes Argentina's economic policy less wacky, Chinese investors may quietly welcome it. ■



梧桐

为何市场永无真正安全时

在试图避免危机时，官员们可能已种下了下一次危机的种子

抵押品往往枯燥乏味。为资产估值并据此发放信贷，这是按揭银行家和回购交易员操心的事情。交易员们每天通过超短期国债回购协议安排数万亿美元的资金。这种活动被称为“金融管道”，确有其道理：它至关重要，但又很无趣。而且就像普通的水暖管道一样，只有出了问题的时候你才会听到它的声响。

眼下就是这样子。3月16日，瑞士央行以瑞信（Credit Suisse）的抵押品为担保，向其提供540亿美元贷款，但事实证明，此举并不足以拯救这家有167年历史的机构。3月19日，美联储宣布将重启与英国、加拿大、欧元区、日本和瑞士的每日美元互换安排。这些经济体的央行现在可以用本国货币作担保，以固定汇率从美联储短期借入美元，然后贷给本地的金融公司。

在正常时期，一些风险较小、被认为价值不太会大幅波动的资产支撑着大量的市场活动。政府债券和房地产就是典型的抵押品。大宗商品、企业信用和股票的风险更高，但有时也会用于抵押。这两种类型的抵押品都是许多金融危机的根源。

安全感是风险最终冒头的原因。人们越是认为这些资产安全，贷款人就越愿意接受它们作抵押来发放信贷。有时这些资产本身是安全的，但以它们作抵押的借贷（以及这些资金的使用）却不安全。

安全和风险之间的这种矛盾可能会引发金融恐慌。在其他时候，问题就只是判断错误。硅谷银行（SVB）的操作本质上就是其银行家认为某些资产是可靠的——长期按揭和美国长期国债——然后基于这些资产做加杠杆押注。该公司的管理层相信，它能够以这些可靠资产为抵押而安全地借钱——也就是储户存在该银行的钱。随后这些资产价格迅速下跌，最终导致

了该银行倒闭。

在2007至2009年全球金融危机期间，正是因为市场认为美国抵押贷款市场的安全性无懈可击，才导致了抵押贷款的爆炸式增长。最后发生崩盘时，甚至都不需要抵押贷款支持的证券真正出现违约。仅仅是违约概率的变化，就提高了信用违约掉期的价值，卖出这些产品的公司的负债也随之上升，足以让大量出售掉期产品的机构陷入困境。在1990年代初的日本，作为国内银行首选抵押品的土地价格暴跌，引发一系列慢性金融危机，持续了超过十年。

危机不仅揭示了哪些抵押品被误认为是安全的。它们也带来了颠覆抵押品运作方式的创新。1866年，伦敦批发银行奥弗伦格尼（Overend, Gurney & Company）倒闭。面对由此引发的市场恐慌，本刊前总编白芝浩（Walter Bagehot）推广了一种主张：以稳健的抵押品为担保，央行应当成为私营金融机构的最后贷款人。美联储最近重新启动的每日互换额度就是在金融危机期间推出的，并在新冠疫情初期重新开放。

美联储在硅谷银行破产后推出的“银行定期融资计划”（Bank Term Funding Programme），是当前金融动荡期间抵押品政策的首项创新。该计划的慷慨程度既新奇又令人震惊。一份2016年发行的30年期美国国债目前的市场价值比票面要低四分之一左右，但如果一家机构把它用作抵押品，美联储会按票面价值对其估值。在该计划推行的第一周，各银行就借入了近120亿美元，另外还从美联储常规的贴现窗口借入了创纪录的1530亿美元。银行现在通过该窗口借入资金，无需对抵押品价值进行惯常的折减。

该计划可能会改变过去150年来形成的对抵押品的理解。如果投资者预期该机制将像互换额度那样成为应对恐慌的常备工具之一，那么长期债券将得到一个新的、极有价值的后盾。这意味着，当利率下降、债券升值时，金融机构将从中获益；当利率上升，债券价值大跌时，美联储又会出手相救。政策制定者想要消除突然崩溃的风险，并使金融体系更加安全，但从长远来看，其效果可能恰恰相反。 ■



Buttonwood

Why markets can never be made truly safe

In seeking to prevent a crisis, officials may have planted the seeds of the next one

COLLATERAL IS USUALLY a boring affair. Valuing assets and extending credit against them is the preoccupation of the mortgage banker and the repo trader, who arranges trillions of dollars a day in repurchase agreements for very short-term government bonds. This activity is called financial plumbing for a reason: it is crucial but unsexy. And like ordinary plumbing, you hear about it only when something has gone wrong.

Now is one of those times. On March 16th the Swiss National Bank extended \$54bn to Credit Suisse, backed by the bank's collateral, in a move that turned out to be insufficient to save the 167-year-old institution. On March 19th America's Federal Reserve announced it would reactivate daily dollar swap lines with Britain, Canada, the euro area, Japan and Switzerland. The central banks of these economies can now borrow dollars from the Fed at a fixed exchange rate for short periods, backed by their own currencies, and lend them on to local financial firms.

In normal times assets that are exposed to little risk, and thought unlikely to swing much in value, underpin lots of market activity. Government bonds and property are typical examples of collateral. Commodities, corporate credit and stocks are riskier but also sometimes employed. Both sorts of collateral are at the root of many financial crises.

The perception of safety is the reason why risks eventually emerge. The safer assets are thought to be, the more comfortable a lender is extending credit against them. Sometimes the assets are themselves safe, but the lending they enable (and the use of the money) is not.

This tension between safety and risk can prompt financial panics. At other times, the problem is simple misjudgment. The activities of Silicon Valley Bank (SVB) were in essence a leveraged bet on assets its bankers believed to be solid: long-dated mortgage and Treasury bonds. The firm's management believed it could safely borrow money—namely, that owed to depositors in the bank—against these reliable assets. The subsequent rapid drop in price of the assets was ultimately the cause of the bank's downfall.

During the global financial crisis of 2007-09, the belief in the unimpeachable safety of the American mortgage market led to an explosion in collateralised lending. The blow-up did not even require actual defaults in mortgage-backed securities. The mere shift in the probability of default raised the value of credit-default swaps, and the liabilities of firms that sold the products, which was sufficient to sink institutions that had sold enormous volumes of the swaps. In Japan in the early 1990s a collapse in land prices, the preferred collateral of domestic banks, led to a slow-burning series of financial crises that lasted for longer than a decade.

Crises do not only reveal where collateral has been wrongly judged to be safe. They are also the source of innovations that upend how collateral works. In response to the panic of 1866, caused by the collapse of Overend, Gurney & Company, a wholesale bank in London, Walter Bagehot, a former editor of this newspaper, popularised the idea of central banks operating as lenders of last resort to private financial institutions, against sound collateral. The daily swap lines recently reactivated by the Fed were introduced in the financial crisis and reopened in the early period of covid-19.

The Fed's "Bank Term Funding Programme", introduced after the collapse of SVB, is the first innovation in collateral policy during the present financial wobble. The programme's generosity is both new and shocking. A 30-year Treasury bond issued in 2016 is worth around a quarter less than its face

value in the market today, but is valued at face value by the Fed if an institution pledges it as collateral. In the programme's first week, banks borrowed nearly \$12bn, as well as a record \$153bn from the central bank's ordinary discount window, at which banks can now borrow without the usual haircut on their collateral.

The programme could change the understanding of collateral that has built up over the past 150 years. If investors expect the facility to become part of the regular panic-fighting toolkit, as swap lines have, then long-maturity bonds would enjoy a new and very valuable backstop. This would mean that financial institutions benefit when interest rates fall and their bonds rise in value; and when rates rise and the bonds slump in value, the Fed comes to the rescue. In an attempt to remove the risk of sudden collapses, and make the financial system safer, policymakers may in the long run have done just the opposite. ■



关键时刻

德国终于开始着手解决其经济中长久存在的弱点

朔尔茨能扭转局面吗？

“我们正处于一个剧变的时代。”3月6日，德国总理奥拉夫·朔尔茨（Olaf Scholz）站在勃兰登堡（Brandenburg）的梅泽贝格宫（Schloss Meseberg）前表示。这是一座巴洛克风格的城堡，为期两天的内阁会议正在这里举行。之所以这么说，并不仅仅因为俄乌战争，朔尔茨解释道，还有应对环境危机所需做出的转型。他承诺会让德国高速转变为一个焕然一新、气候中和的经济体。但他能做到这一切吗？

这种“新德国速度”已经成了朔尔茨的口头禅。“我们的弱点早在环境危机到来之前就很严重了。”位于慕尼黑的经济政策智库Ifo的负责人克莱门斯·菲斯特（Clemens Fuest）表示。俄罗斯入侵乌克兰让德国一些问题暴露出来，比如依赖俄罗斯的廉价能源、军事上没有自卫能力，以及经济上与威权国家联系紧密存在隐患——在这一点上，中国可能与俄罗斯一样会带来风险。去年，中国连续第七年成为德国最大的贸易伙伴，进出口总额超过2980亿欧元（3200亿美元），比2021年增长约21%。德国依赖从中国进口很多关键矿产，包括稀土，这是电池和半导体中必不可少的原材料。化工巨头巴斯夫（BASF）正投资100亿欧元在中国南方新建一个工厂。欧洲最大的汽车制造商大众汽车40%的销量来自中国。

一年前俄罗斯入侵乌克兰让德国很多弱点暴露于聚光灯下。而现在来看，其弱点远不止那些。德国在脱碳、经济数字化，以及应对人口结构问题和技术工人严重短缺这几方面的行动也过于迟缓。技术工人严重短缺对德国中小企业中的中型企业的影尤其明显。

这一切是否意味着德国的整个商业模式已经崩溃？大多数经济学家并不这么认为，尽管仍需要深层次的结构性改革。“德国经济比预想的更有韧性。”游说团体德国工业联合会（Federation of German Industries）的克

劳斯·金特·多伊奇（Klaus Günter Deutsch）表示。去年，由于能源成本急剧上涨，造纸、陶瓷和其他能源密集型产品的制造商都受到影响，德国最大行业之一的化工业受到的冲击尤其大，从而引发了大规模去工业化的传言。德国蓝筹股指数DAX在去年前九个月下跌了27%，几乎是英国富时100指数和美国标普500指数跌幅的两倍。一些专家曾预测德国经济将在2023年陷入深度衰退。

随着春天的到来，经济前景比先前乐观。得益于暖冬，德国完全没有像许多人担心的那样需要定量配给天然气。根据政府预测，德国今年应该能避免经济衰退。

对去工业化的恐慌也没之前那么严重了。虽然能源密集型企业的产量与2022年1月时相比下降了13%（见图表1），但整体工业产出保持平稳。这表明供应链在重组，而不是在大规模去工业化。例如，巴斯夫正在重组其复杂的生产布局，去除低利润产品。钢铁制造商已经这么做了。“近几十年来，德国市场对普通钢材的需求大幅下降。我们现在把重点放在只有极少数厂家能生产的特种钢材上。”大型钢铁制造商蒂森克虏伯（ThyssenKrupp）的马库斯·格罗尔穆斯（Markus Grolms）表示。

美国印第安纳州的圣母大学（Notre Dame University）的经济学家吕迪格·巴赫曼（Rüdiger Bachmann）预测，德国的工业格局会发生永久性的改变。相当少一部分能源密集而工艺流程相对简单的工业企业（比如氨、锌或铝的制造商）会迁往国外。但其他生产流程更复杂的企业很可能会填补空位。

然而，即使能源密集型企业减少了，德国若要按照原计划在2045年前成为气候中和经济体，就仍然需要大量的绿色能源。德国在脱碳方面的行动相对滞后。2020年，其人均年碳排放量为九吨，比法国、意大利或西班牙高出大约50%（见图表2）。对于一个常常以应对气候变化的领导者自居，并在用可再生能源取代化石燃料的“能源转型”（Energiewende）战略上投入了数十亿美元的国家来说，实现净零排放还有很长的路要走。

今年1月，朔尔茨在达沃斯也谈到了实现气候目标的“新德国速度”。他表示，近期出台的一项法律不仅要求优先发展电力和氢能网络，也要优先发展风能和太阳能。在此新规之下，电网项目的审批速度平均比以前快了两年。今年，朔尔茨政府的陆上风力发电场招标量增加了一倍多。这位总理雄心勃勃的目标是每天新安装四到五个风力涡轮机，一直到2030年代。朔尔茨承诺，到2030年，德国有足足80%的电力都将产自可再生能源。这是个艰巨的任务。

业务数字化是德国另一个行动过于迟缓、过于官僚主义的领域。在企业的数字技术整合方面，它在欧盟成员国中仅大致处于中游水平。其公共行政管理还可悲地停留在模拟化时代。它在应对新冠疫情时主要还是用的传真机。2017年颁布的一项联邦法律规定近600项公共服务都应能在网上办理，而去年许多州和市都没能在规定的最后期限前达标。

在某些领域，特别是在私营部门，还是取得了一些进展。根据政府的千兆战略，到2025年，至少50%的德国家庭和企业会连接到光纤网络；到2030年，应该会实现家庭光纤网络全覆盖。中小企业正在取得进展，尤其是工程和机械行业的企业。但拥抱数字经济所需的企业文化转型需要时间。41岁的马蒂亚斯·克内希特（Matthias Knecht）是柏林一家专做公对公支付的创业公司Billie的联合创始人，他表示，公司是否乐意积极采纳新技术往往取决于CEO的年龄。

最后一个被忽视的挑战是如何接替即将退休的员工。德国劳动年龄人口约占总人口的64%，与美国相似。但其中最多的是60岁上下的人。公司现在就已经难以填补岗位空缺（见图表3）。智库就业研究所（Institute for Employment Research）预测，如果没有更多移民或者政策上的变化，到2035年，劳动年龄人口将会在现有4600万人的基础上减少700万。但还有一定潜力可挖：可以给年长员工和兼职人员更多激励，让他们增加工作时长。

至于技术工人的短缺，企业的核心应对策略之一是对劳动力进行再培训。“我们计划了一个培训项目，让每名工人接受至少12个全工作日的培训，

主要是因为要学习新的制造技术。”位于科隆的福特欧洲公司的勒妮·沃尔夫（René Wolf）表示。提高薪酬倒是有利于把工人吸引到最好、最高效的公司，但德国却以限制薪资为荣。

朔尔茨已经承诺要在军事和外交政策上带来“时代转折”（Zeitenwende，意为划时代的转折点），它在经济政策上同样需要这样的转折。考虑到前几届政府留下的未竟之业，这是一项艰巨的任务。朔尔茨必须让他的联合政府停止争吵。他还需要做成一件可能更艰巨的事情：让他的德国同胞对未来有盼头。 ■



Crunch time

Germany is at last tackling its long-standing economic weaknesses

Can Olaf Scholz turn things around?

“WE ARE AT a time of great upheaval,” said Olaf Scholz on March 6th, standing in front of Schloss Meseberg, a baroque castle in Brandenburg where his cabinet was holding a two-day pow-wow. This is not only because of Russia’s war against Ukraine, explained the German chancellor, but because of the transformation required by the environmental crisis. He promised to turn Germany at high speed into a gleaming, climate-neutral economy. But can he pull it all off?

This “new German speed” has become Mr Scholz’s mantra. “We already had massive weaknesses before the crisis,” says Clemens Fuest, head of Ifo, a Munich-based economic-policy think-tank. The invasion of Ukraine exposed Germany’s dependence on cheap Russian energy, its inability to defend itself militarily and the pitfalls of close economic ties with autocracies—those with China potentially as risky as the ones with Russia. Last year China was again Germany’s top trading partner, for the seventh consecutive year, with combined exports and imports of more than €298bn (\$320bn), up by around 21% from 2021. Germany depends on China for the import of rare earths that are indispensable in batteries and semiconductors as well as other critical minerals. BASF, a chemicals giant, is investing €10bn in a new factory in southern China. Volkswagen, Europe’s biggest carmaker, relies on China for 40%, by volume, of its sales.

The economy’s vulnerabilities go well beyond those that have been brought into sharp focus by the Russian invasion a year ago. Germany has also been too slow in decarbonising and digitising its economy and in confronting its demographic problems and the acute shortage of skilled workers that affects

especially the midsized companies of the Mittelstand.

Does all this mean that Germany's entire business model is broken? Most economists do not think so, though deep structural change is needed. "The economy was more resilient than expected," says Klaus Günter Deutsch of the Federation of German Industries, a lobby group. Last year there was talk of large-scale deindustrialisation because of the spiralling cost of energy that affected in particular the chemicals industry, one of Germany's biggest, but also makers of paper, ceramics and other energy-intensive goods. The DAX, the index of German blue-chips, dropped by 27% in the first nine months of last year, almost twice the fall in Britain's FTSE 100 or America's S&P 500. Some pundits predicted a deep recession for Germany in 2023.

As spring approaches, the outlook is rosier. Helped by a mild winter, Germany never came close to needing gas rationing, as many people had feared. According to government forecasts, Germany is now likely to dodge a recession this year.

The panic about deindustrialisation has also abated. Energy-intensive production has declined by 13% compared with January 2022 (see chart 1), but overall industrial output has held up. That points to a rejigging of supply chains rather than a wholesale process of deindustrialisation. BASF is restructuring its complex production profile to shed low-margin products, for instance. Steel-makers have already done so. "Demand for commodity steel in the German market has decreased significantly in recent decades. We focus on highly specialised steel products that very few can produce," says Markus Grolms of ThyssenKrupp, a big steel-maker.

Rüdiger Bachmann, an economist at Notre Dame University in Indiana, predicts that the geography of German production will shift permanently. A fairly small percentage of industrial companies that use energy-intensive and relatively simple processes, such as the makers of ammonia, zinc or

aluminium, will relocate abroad. But others that use more complex production processes are likely to take their place.

Yet even with fewer energy-intensive businesses Germany will need plenty of green energy if it wants to become a climate-neutral economy, as planned by 2045. Its efforts to decarbonise are lagging. Its annual carbon footprint, of nine tonnes per person in 2020, is roughly 50% higher than that of France, Italy or Spain (see chart 2). For a place that likes to think of itself as a climate leader and that has spent billions on its Energiewende, a strategy to replace fossil fuels with renewables, it is a long way to net-zero emissions.

In January Mr Scholz also spoke, in Davos, of the “new German speed” in reaching climate goals. A recent law mandates the prioritisation of expanding wind and solar power, as well as electricity and hydrogen networks, he said. Under this new regime, approvals for electricity grids are being granted, on average, two years faster than before. This year the Scholz government has more than doubled the volume of calls for tender for onshore wind farms. The chancellor’s ambitious goal is to erect four or five new wind turbines every day until the 2030s. By 2030 fully 80% of German electricity production will come from renewables, promises Mr Scholz. It is a tall order.

The digitisation of businesses is another area where Germany has been too slow and too bureaucratic. It ranks only around average among EU members on businesses’ integration of digital technologies. Its public administration is woefully analogue. It dealt with the pandemic mostly by using the fax machine. Many states and municipalities missed a deadline last year, set by a federal law in 2017, to make almost 600 public services available online.

There is progress in some areas, especially in the private sector. According to the government’s Gigabit strategy, at least 50% of German households and businesses are to be connected to the optical-fibre network by 2025

and all households should be connected by 2030. Mittelstand companies are making progress, in particular those in the engineering and machinery industries. But the cultural shift needed to embrace the digital economy takes time. Firms' readiness to embrace technology often depends on the age of the CEO, says Matthias Knecht, the 41-year-old co-founder of Billie, a startup in Berlin that specialises in business-to-business payments.

The final neglected challenge is the replacement of retiring workers. Germany's working-age population is around 64% of the overall population, similar to America's. But the largest cohorts are in their late 50s and early 60s. Firms are already struggling to fill vacancies (see chart 3). The Institute for Employment Research, a think-tank, predicts that without more immigration or policy changes, the labour market will lose 7m workers by 2035, from 46m now. But there is some potential in giving older workers and those working part-time more incentives to add hours.

Retraining the workforce is a central element of businesses' strategies to tackle this shortage of skilled workers. "We are planning a training programme of at least 12 full working days per worker, mostly because of new manufacturing techniques," says René Wolf, of Ford Europe in Cologne. Higher pay would help to draw workers to the best and most productive firms, but Germany prides itself on wage restraint.

Germany needs an economic-policy *Zeitenwende* (an epochal turning-point) as much as it requires the one Mr Scholz has promised in its military and foreign policy. That is a huge task, given the backlog left by previous governments. Mr Scholz must get his coalition government to stop squabbling. And he needs to achieve something possibly even harder: to get his fellow Germans excited about the future. ■



社交媒体

TikTok如何打击社交媒体

无论是否被禁，该应用都已迫使其竞争对手采取不那么赚钱的模式

TikTok大限将至了吗？3月23日，在本期《经济学人》付印后，该社交媒体应用的首席执行官周受资接受了美国国会质询。TikTok的一亿多美国用户担心其政府出于安全考虑，准备禁用这个中资社交媒体平台。这些用户的担忧与硅谷的狂喜形成了鲜明对比，那里的美国本土社交媒体公司都乐得摆脱这个大受欢迎的竞争对手。国会山对TikTok每抱怨一次，Meta、Pinterest、Snap等公司的股价就会有一波上涨。

TikTok命运未卜，但有一点已经很清楚，那就是这个应用已经永久性地改变了社交媒体，而且这种改变会让老牌社交应用的日子不那么好过。在不到六年的时间里，TikTok让世界摆脱了老式的社交网络，转而沉迷于算法推荐的短视频。用户欲罢不能。这给各大平台带来的麻烦是，这种新模式不像旧模式那么能赚钱，而且可能会一直如此。

这一变化速度惊人。TikTok在2017年进入美国，现在它的用户数量只少于寥寥几个社交媒体应用，而这些应用的成立时长是TikTok的两倍多（见图表1）。在年轻受众中，TikTok碾压了竞争对手。18至24岁的美国人每天用TikTok的时间为一个小时，是花在Instagram和Snapchat上的两倍、Facebook的五倍多。如今年轻人用Facebook主要是为了和祖父母交流（见图表2）。

TikTok的成功促使其竞争对手重塑自我。拥有Facebook和Instagram的Meta已将这两个应用的主要信息流变成了按算法排序的“发现引擎”，并推出了Reels，一个绑定在Facebook和Instagram上的TikTok克隆版。推出类似产品的还有Pinterest（Watch）、Snapchat（Spotlight）、YouTube（Shorts），甚至奈飞（Fast Laughs）。3月8日，Spotify宣布改版，这是受TikTok启发的最新动作，现在这款音乐流媒体应用的主页上会

展示短视频，可以通过向上滑动来跳过。（TikTok的中国版抖音在其本土市场也产生了类似的影响，腾讯等数字巨头越来越多地将短视频作为产品的核心。）

结果就是短视频占领了社交媒体。经纪公司盛博估计，美国人平均每天花在社交媒体上的时间为64分钟，其中有40分钟是在看短视频，就在三年前还只是28分钟。然而，这种转变也带来了一个问题。尽管用户似乎看短视频看个没完，但事实证明这种模式的盈利能力不如原来的信息流。

平均而言，美国用户每用TikTok一小时，该应用只能获得0.31美元的收入，分别是Facebook的三分之一和Instagram的五分之一（见图表3）。据研究公司Insider Intelligence估计，今年TikTok将从每名美国用户身上赚取约67美元，而Instagram能赚到200美元以上。这不是TikTok一家的问题。Meta的首席执行官马克·扎克伯格3月告诉投资者：“目前，Reels的表现效率远低于Feed，因此Reels增长得越快……就会分走越多Feed的使用时间，我们实际上就是在赔钱。”

对收入差距最让人宽慰的解释是TikTok、Reels和其他短视频平台还不成熟。Insider Intelligence的贾思敏·恩伯格（Jasmine Enberg）表示：“TikTok在社交媒体广告领域仍处在蹒跚学步的阶段。”她指出，该应用在2019年才引入广告。社交媒体平台往往会在吸引新用户时保持较低的广告量，广告主也需要时间来适应新产品。“如果拿不出任何历史业绩，就别想挥舞一下魔杖就宣称你的新广告服务是‘优质’的，所以广告业务是最后才开始启动的。”广告技术公司Skai的米歇尔·厄文（Michelle Urwin）说。

Meta指出自己以前也是这样。Instagram的Stories功能花了一段时间才吸引到广告主签约，但现在已经成了一大收入来源。Meta正在更积极地用Reels创收，并预计它能在今年年底左右停止亏损。但Meta承认，Reels要做到像原来的信息流那样盈利还需要很长时间。“我们很清楚我们是花了几年时间才缩小了Stories和Feed广告之间的差距。”Meta的首席财务官苏珊·李（Susan Li，音译）在2月的财报电话会议上表示，“我们预计Reels需要更长的时间。”

有些人猜想这个差距会不会永远也无法弥合。在把用户时间变现方面，即使是成熟的视频应用也赶不上老式的社交网络。据盛博估计，已有18年历史的YouTube每名用户每小时带来的收入还不到Facebook或Instagram的一半。短视频在中国比西方早几年兴起，去年短视频广告的价格仅为本土电子商务应用广告的15%左右。

一方面，视频中的广告量不可避免地要少于文本和图像信息流中的。观看一段五分钟的YouTube视频，可能会看到三条广告；浏览Instagram五分钟，能看到几十条。与查看朋友的更新相比，观看视频似乎也让消费者处于更被动的状态，从而降低了他们点击广告去购买的可能性。大型营销机构Tinuiti称，Instagram Reels上1000次视频广告展示的价格大约是Instagram上1000次信息流广告展示的一半，这意味着广告主认为Reels广告产生点击的可能性更低。

视频广告的拍卖竞争没有静态广告激烈，因为许多广告主尚未制作视频格式的广告。大广告主看重视频广告（而且在TikTok上录得创纪录的参与度，其产品视频带着#TikTokmademebuyit的标签疯传）。但处于长尾部分的小企业发现制作视频广告很难，而正是这条长尾让社交网络赚了数十亿美元。Meta表示，在该公司1000万左右的广告主中，只有刚过四成投放Reels广告。有了人工智能，让余下的六成来制作视频广告可能会更容易。根据一位高管的设想，在不久的将来，小型零售商使用语音指令就可以定制视频广告。但在那一刻到来之前，一半的长尾都被砍掉了。

短视频应用也因定位不够精准而受阻。对受众来说，TikTok及其众多模仿者的一部分吸引力源自用户只需观看视频，觉得无聊时滑动屏幕即可。算法利用这一点来了解用户喜欢什么类型的视频，进而可能喜欢什么样的广告，但这种猜测并不能替代上一代社交网络收集到的具体个人数据，后者会说服用户填写一份冗长的个人资料，从教育到婚姻状况无所不包。结果是，许多广告主仍将短视频视作投放品牌广告的地方，用定位宽泛的广告提高人们对其产品的总体认知，而不是老派社交网络擅长的那种高度个性化（也更有价值）的直效广告。

至少在这方面，TikTok的模仿者比TikTok本尊更有优势。Meta在15年里积累了大量数据，那会儿还没有什么反对在整个网络上追踪用户活动的规则。有了这些数据，Meta对许多观看其视频的用户就有很多了解，并可以对其余用户做出有理有据的猜测。如果一个新的未知用户与一个已知有钱有娃、大学毕业的女性群体观看的视频相同，那么这个新用户很可能具有相同的个人背景。TikTok表示，它已就直效广告做了大量投资，包括用于衡量这类广告的效果的新工具。但它仍需大力追赶。“Meta正在利用他们的历史经验。”盛博的马克·施穆里克（Mark Shmulik）说。

在这个更复杂的新广告环境中，社交应用不会是唯一的输家。“投放广告都是关乎次优选择是什么。”广告咨询公司Madison and Wall的布莱恩·维泽（Brian Wieser）说。大多数广告主为在某个平台上投放广告分配预算，而“预算就是预算”，不管广告投放情况如何。如果整个社交媒体圈的广告效果全面下降，那么这对卖广告位的平台和买广告位的广告主来说都是坏消息。■



Social media

How TikTok broke social media

Whether or not it is banned, the app has forced its rivals to adopt a less lucrative model

IS TIKTOK'S TIME up? As the social-media app's chief executive, Shou Zi Chew, was getting ready for a grilling before Congress on March 23rd, after The Economist went to press, TikTok's 100m-plus users in America were fretting that their government was preparing to ban the Chinese-owned platform because of security fears. Their anguish contrasts with utter glee in Silicon Valley, where home-grown social-media firms would love to be rid of their popular rival. With every grumble from Capitol Hill, the share prices of Meta, Pinterest, Snap and others edge higher.

TikTok's fate hangs in the balance. But what is already clear is that the app has changed social media for good—and in a way that will make life harder for incumbent social apps. In less than six years TikTok has weaned the world off old-fashioned social-networking and got it hooked on algorithmically selected short videos. Users love it. The trouble for the platforms is that the new model makes less money than the old one, and may always do so.

The speed of the change is astonishing. Since entering America in 2017, TikTok has picked up more users than all but a handful of social-media apps, which have been around more than twice as long (see chart 1). Among young audiences, it crushes the competition. Americans aged 18-24 spend an hour a day on TikTok, twice as long as they spend on Instagram and Snapchat, and more than five times as long as they spend on Facebook, which these days is mainly a medium for communicating with the grandparents (see chart 2).

TikTok's success has prompted its rivals to reinvent themselves. Meta, which owns Facebook and Instagram, has turned both apps' main feeds into algorithmically sorted "discovery engines" and launched Reels, a TikTok clone bolted onto Facebook and Instagram. Similar lookalike products have been created by Pinterest (Watch), Snapchat (Spotlight), YouTube (Shorts), and even Netflix (Fast Laughs). The latest TikTok-inspired makeover, announced on March 8th, was by Spotify, a music-streaming app whose homepage now features video clips that can be skipped by swiping up. (TikTok's Chinese sister app, Douyin, is having a similar effect in its home market, where digital giants like Tencent are increasingly putting short videos at the centre of their offerings.)

The result is that short-form video has taken over social media. Of the 64 minutes that the average American spends viewing such services each day, 40 minutes are spent watching video clips, up from 28 minutes just three years ago, estimates Bernstein, a broker. However, this transformation comes with a snag. Although users have a seemingly endless appetite for short video, the format is proving less profitable than the old news feed.

TikTok monetises its American audience at a rate of just \$0.31 for every hour the typical user spends on the app, a third the rate of Facebook and a fifth the rate of Instagram (see chart 3). This year it will make about \$67 from each of its American users, while Instagram will make more than \$200, estimates Insider Intelligence, a research firm. And it is not just a TikTok problem. Mark Zuckerberg, Meta's chief executive, told investors last month that "Currently, the monetisation efficiency of Reels is much less than Feed, so the more that Reels grows...it takes some time away from Feed and we actually lose money."

The most comforting explanation for the earnings gap is that TikTok, Reels and the other short-video platforms are immature. "TikTok is still a toddler in the social-media ad landscape," says Jasmine Enberg of Insider

Intelligence, who points out that the app introduced ads only in 2019. Platforms tend to keep their ad load low while getting new users on board, and advertisers take time to warm to new products. “You can’t really wave a magic wand and declare that your new ads are ‘premium’ without any performance history to back it up, so they start at the end of the line,” says Michelle Urwin of Skai, an ad-tech firm.

Meta points out that it has been here before. Instagram’s Stories feature took a while to get advertisers signed up but is now a big earner. Meta is monetising Reels more aggressively and expects it to stop losing money around the end of this year. But the firm acknowledges that it will be a long time before Reels is as profitable as the old news feed. “We know it took us several years to bring the gap close between Stories and Feed ads,” Susan Li, Meta’s chief financial officer, said on an earnings call in February. “And we expect that this will take longer for Reels.”

Some wonder if the gap will in fact ever be closed. Even mature video-apps cannot keep up with the old social networks when it comes to monetising their users’ time. YouTube, which has been around for 18 years, makes less than half as much money per user-hour as Facebook or Instagram, estimates Bernstein. In China, where short-form video took off a few years before it did in the West, short-video ads last year monetised at only about 15% the rate of ads on local e-commerce apps.

For one thing, the ad load in video is inescapably lower than on a news feed of text and images. Watch a five-minute YouTube clip and you might see three ads; scroll Instagram for five minutes and you could see dozens. Watching video also seems to put consumers in a more passive mood than scrolling a feed of friends’ updates, making them less likely to click through to buy. Booking 1,000 impressions for a video ad on Instagram Reels costs about half as much as 1,000 impressions for an ad on Instagram’s news feed, reports Tinuiti, a big marketing agency, implying that advertisers see Reels

ads as less likely to generate clicks.

Auctions for video ads are less competitive than those for static ones, because many advertisers have yet to create ads in video format. Big advertisers prize video ads (and report record engagement on TikTok, where products have gone viral with the hashtag #TikTokmademebuyit). But the long tail of small businesses from which social networks have made their billions find video spots tricky to produce. Just over 40% of Meta's 10m or so advertisers use Reels ads, the company says. Getting the remaining 60% to create video commercials may be made easier by artificial intelligence. One senior executive imagines a near future in which a small retailer can create a bespoke video ad using only voice commands. Until that moment arrives, half the long tail is lopped off.

Short-video apps are also hampered by weaker targeting. For audiences, part of the appeal of TikTok and its many imitators is that users need do no more than watch, and swipe when they get bored. The algorithm uses this to learn what kinds of videos—and therefore ads—they like. But this guesswork is no substitute for the hard personal data harvested by the previous generation of social networks, which persuaded users to fill in a lengthy profile including everything from their education to their marital status. The upshot is that many advertisers still treat short-form video as a place for loosely targeted so-called brand advertising, to raise general awareness of their product, rather than the hyper-personalised (and more valuable) direct-response ads that old-school social networks specialise in.

Here, at least, TikTok's imitators have an advantage over TikTok itself. Using a trove of data built up over a decade and a half, when there were few rules against tracking users' activity across the wider web, Meta already knows a lot about many of the users watching its videos and can make well-informed guesses about the rest. If a new, unknown user watches the same videos as a group who are known to be rich female graduates with children, say, it is a

good bet that the new user has the same profile. TikTok says it has made big investments in its direct-response ads, including new tools for measuring their effectiveness. But it still has catching up to do. “Meta are leveraging their history,” says Mark Shmulik of Bernstein.

Social apps will not be the only losers in this new, trickier ad environment. “All advertising is about what the next-best alternative is,” says Brian Wieser of Madison and Wall, an advertising consultancy. Most advertisers allocate a budget to spend on ads on a particular platform, he says, and “the budget is the budget”, regardless of how far it goes. If social-media advertising becomes less effective across the board, it will be bad news not just for the platforms that sell those ads, but for the advertisers that buy them. ■



经济学人视频

全球“假货流行病” - 1

全球假货市场价值超过5000亿美元，并且还在不断上升，鞋类约占其中的20%。



The Economist Film

The counterfeit epidemic - 1

Footwear accounts for about 20% of the value of all counterfeit goods is a global market worth over 500 billion dollars and rising.



美国社会

《贫困：美国制造》：一篇向痼疾开刀的檄文

但马修·德斯蒙德给出的更多是愤怒，而非务实的解决方案【《贫困：美国制造》书评】

《贫困：美国制造》。马修·德斯蒙德著。皇冠出版集团，304页，28美元。艾伦·莱恩出版社，25英镑。

作为历史上最富有的国家，美国依然存在的贫困之普遍十分刺眼。算上政府援助，在疫情前夕每八个美国成年人中就有一个被列为贫困——比例比前几十年要小，但仍占人口的很大一部分。时不时地，从平平无奇的日常新闻和统计数据中会突然冒出一篇关于这个问题的辩论文章，惹得人们心生羞愧，在极少数情况下甚至也会触发改变。

1962年，社会活动家迈克尔·哈灵顿（Michael Harrington）出版了《另一个美国》（The Other America），揭示了隐形穷人的存在。根据他对政府收入数据的解读，这些人当中包含多达一半的老年人。人们认为这本书促使总统林登·约翰逊在两三年后在全国范围内“向贫困宣战”。在《法律的色彩》（The Colour of Law，2017年出版）一书中，理查德·罗斯斯坦（Richard Rothstein）梳理回顾了具偏倚性的政府项目，它们拒绝向非裔美国人提供抵押贷款，这助长了城市种族隔离，时至今日仍然阻碍着一些人的机会。这本书让“redlining”（将某些顾客排除出贷款对象范围）一词普及开来。

马修·德斯蒙德（Matthew Desmond）在2016年出版的关于美国住房无保障的研究《扫地出门》（Evicted）是另一本影响很大的书。这本书让这位普林斯顿大学的社会学家赢得了普利策奖，并成为上个十年最具影响力的社会学著作之一。他的后续作品《贫困：美国制造》探究了持续存在的贫困问题及其成因。尽管他以动人的笔调描述了贫穷带来的心理创伤，但这本书缺乏令其前作不同凡响的那种人类学研究和深度分析。不过它也自有其用处：展示了一种无视渐进性成果、将虔诚置于现实政策之上的态度

有何缺陷。

德斯蒙德认为，贫穷并不复杂，而是很简单。他写道，贫困在美国这么普遍，是因为许多美国人就喜欢事情是这个样子。这个国家的公民在有意无意地合谋剥削穷人。他们打压工会，享受着以微薄工资生产出来的商品和服务，把同胞困在贫民窟，让税法向利于富裕阶层的方向倾斜。作者说，要想让这种道德弊病得到宽宥，就应该发起一个“贫困废除主义”新计划。

许多关于美国贫困问题的优秀著作都是批评资本主义，间或做一番道德说教。美国的儿童贫困率居高不下，这的确是一种道德失败。但在这本书中，构成论据的主要就是道德上的确定性和正义感。

德斯蒙德奋力贬低对细微差别的区分。他指出，“饥饿的人不过想要面包”，而作为对策，“富人召集了一个专家小组。复杂是有权有势者的避难所。”他对政策的分析就算有也很粗略，还有点相互矛盾，而且基本上对其他的解释不屑一顾。他只用了一个简短的段落来驳斥“城市贫困是去工业化的结果”这一著名论点（还主要是抱怨“去工业化”这个名词丑陋不堪）。

德斯蒙德宿命论地认为，花在扶贫项目上的万亿计美元收效甚微。“这方面并没有切实的改善，”他写道，“只有漫长的停滞。”他声称，提高低收入劳动者工资的计划——好让人们有钱买食物和其他必需品——实际上只是补贴了剥削工人的企业和贫民窟的恶霸房东。事实上，他所不齿的那类专家小组（包括哥伦比亚大学的一个）的分析表明，这种福利支出使千百万人摆脱了贫困（目前对贫困的界定是一个四口之家每年生活费略低于三万美元）。有这类保障体系兜底的贫困儿童在之后的人生中也有所受益。

尽管德斯蒙德批评扶贫支出，但他的主要解决方案之一却是大幅增加这项支出，确保每个人的收入都足够让他们维持在贫困线之上。据他估算，在2020年，这将在已有福利支出的基础上增加约1770亿美元（他没有具体说明这部分费用是否要重复发生）。他谴责那些可能对这种努力心存疑虑的人：“我们怎么负担得起？这是个多么罪恶的问题。能问出这种问题是多

么自私和不诚实啊，就好像答案不是摆在眼前的一样。”至于可能出现的意想不到的后果，比如工作积极性可能会下降，也不值得认真讨论。

《扫地出门》之所以引人入胜，部分原因是它运用了对密尔沃基贫民窟持续多年的研究。《贫困：美国制造》并不像《扫地出门》那样建立在案例研究的基础上（尽管重复利用了一些较早期的材料）。德斯蒙德仍然是一位才华横溢的作家，行文凝练、优雅，如挽歌。“贫穷通常是物质匮乏叠加慢性疼痛叠加抑郁叠加成瘾。”他解释道。“贫穷不是一条线。它是各种社会弊病打成的一个死结。”然而，在其他段落中，这种文风却误入歧途。他的结束语是：“对于这个问题，我们不需要比它智高一筹，而是需要对它恨之入骨”——并没像作者可能想要的那样震撼人心。

这本书最强有力的章节是对租房问题的重新审视，它向读者展现了有的人别无选择，只能住在糟糕透顶的旧公寓里，却要被迫支付高得令人发指的租金，还展示了联邦政府竟为本就富裕的人提供购房补贴，令人瞠目。德斯蒙德说的没错，美国分化成富裕的孤岛和贫困聚集的深渊，这样的隔离伤害了穷人。但比起技术官僚式的解决方案，自我鞭笞更让他感兴趣。“也许超过了一定的收入水平，我们都是种族隔离主义者。”他若有所思地写道。

悲观会搅扰人的判断力。作者断言“如今美国提供的工资在工业化国家中处于下游”，以及美国创造了一个“严重偏袒上层阶级的福利国家”。往好了说，这两种说法对数据的解读非常值得商榷。德斯蒙德对美国从20世纪40年代末到70年代末的“辉煌三十年”十分推崇——他认为“事情并不是从来都这么糟糕”，因为在从前，工会势力处于鼎盛期——但这与哈灵顿在他书中描述的促使约翰逊在全国范围内发起“战争”的极度贫困不相一致。

德斯蒙德将自己描绘成反“资本主义宣传”的战士，这种宣传将穷人丑化成什么都不配享有的人，并否认资本主义制度“本质上就是工人试图得到尽可能多的东西，而所有者试图尽可能少地付出”。但是，观念和利益的较量不必是零和博弈。许多工业化国家就兼具充满活力的市场经济和低贫困率，是因为它们的再分配做得稍微多一些，也稍微明智一些。

作者希望读者成为“贫困废除主义者”。举例来说，这意味着只购买加入工会的劳动者所生产的啤酒或糖果。这样的建议或许是有价值的，但实用性不如扩大儿童税收抵免等技术官僚式的政策。2021年，这样一个项目开展了全国试验，结果显示儿童贫困率下降了近一半（试验结束时数字再次上升）。这是令人振奋的成就，德斯蒙德对此却没有细究。

贫穷是一种祸害。唤起羞耻心是将之公诸于众的一个方法，揭露贫穷带来的苦痛也不无裨益。但如果美国人能认识并认可过去取得的进步，未来的困苦才更有可能得到纾解。 ■



American society

“Poverty, By America” is a fierce polemic on an enduring problem

But Matthew Desmond offers more outrage than real-world solutions

Poverty, By America. By Matthew Desmond. Crown; 304 pages; \$28. Allen Lane; £25

FOR THE richest country in history, poverty in America remains jarringly widespread. Taking government assistance into account, one in eight American adults was classified as poor on the eve of the pandemic: a smaller share than in previous decades but still a big slice of the population. Every now and then, a polemic on the subject cuts through the routine news and statistics to induce shame, or even, in rare cases, spur change.

In 1962 the social activist Michael Harrington published “The Other America”, an exposé of the invisible poor who—on his reading of government income figures—included as many as half of senior citizens. The book was credited with helping to inspire the national “War on Poverty” that President Lyndon Johnson launched a couple of years later. In “The Colour of Law” (2017), Richard Rothstein chronicled the prejudiced governmental programmes that denied mortgages to African-Americans and contributed to urban segregation, which still blights opportunity today. The book popularised the term “redlining”.

Published in 2016, Matthew Desmond’s study of housing insecurity in America, “Evicted”, was another book with a big impact. It won a Pulitzer prize for its author, a sociologist at Princeton University, and became one of the most influential works of social science of its decade. His follow-up, “Poverty, By America”, is about the persistent problem of poverty and its causes. Though he writes movingly about the psychological scars of poverty,

this book lacks the anthropological research and in-depth analysis that distinguished its predecessor. In its own way, though, it is useful: it shows the shortcomings of an approach that dismisses incremental gains and prioritises piety over real-world policies.

Poverty, Mr Desmond argues, is not complicated but simple. There is so much of it in America, he writes, because many Americans like it that way. Wittingly or otherwise, the country's citizens conspire to exploit the poor. They crush unions, enjoy goods and services produced on paltry wages, trap their compatriots in slums and slant the tax code for the benefit of the better-off. Absolution for this moral sickness, the author says, should come through a new project of "poverty abolitionism".

Many fine books on American poverty criticise capitalism and go in for intermittent moralising. It is indeed a moral failing that America continues to have a high rate of child poverty. But in this book, moral certainty and righteousness are the main substance of the argument.

Mr Desmond actively disparages nuance. "Hungry people want bread," he notes. In response, "the rich convene a panel of experts. Complexity is the refuge of the powerful." His policy analysis, when he gets to it, is cursory, somewhat contradictory and largely unconcerned with alternative explanations. He dismisses the prominent thesis that urban poverty is a result of deindustrialisation in a single short paragraph (which mostly gripes about the ugliness of that term).

The trillions spent on anti-poverty initiatives have achieved little, Mr Desmond argues fatalistically. "There is no real improvement here," he writes, "just a long stasis." Programmes that top up the wages of low-income workers—so providing money for food and other essentials—wind up subsidising exploitative firms and slumlords, he alleges. In fact, analysis by the sort of expert panel he dislikes, including one at Columbia University,

shows that this kind of welfare spending has kept millions out of poverty (currently defined, for a family of four, as living on just under \$30,000 a year). Poor children caught by such safety-net schemes experience gains later in life, too.

Despite his critique of anti-poverty spending, one of Mr Desmond's main solutions is to boost it considerably, by ensuring everyone is paid enough to stay above the poverty line. In the year 2020, he calculates, that would have taken roughly \$177bn on top of existing welfare spending (he does not specify whether that cost would recur). He denounces those who might query this endeavour: "How can we afford it? What a sinful question. What a selfish, dishonest question, one asked as if the answer wasn't staring us in the face." Possible unintended consequences, such as the risk of disincentivising work, are also unworthy of serious discussion.

"Evicted" was gripping in part because it drew on years of research in the slums of Milwaukee. "Poverty, By America" does not build on case studies in the same way (though some of the earlier material is recycled). Mr Desmond remains a talented writer, and his prose can be crisp, elegant and elegiac. "Poverty is often material scarcity piled on chronic pain piled on depression piled on addiction," he explains. "Poverty isn't a line. It's a tight knot of social maladies." In other passages, though, the style is botched. His peroration—"We don't need to outsmart this problem. We need to out-hate it"—is less stirring than it seems meant to be.

The book is strongest when it revisits the problem of rental housing, showing how those with little choice but to live in dreadful flats are obliged to pay scandalous rents—as well as the egregious way the federal government subsidises home ownership for the already wealthy. Mr Desmond is right to say that the poor are harmed by America's segregation into islands of affluence and pits of concentrated poverty. But technocratic solutions for this interest him less than self-flagellation. "Maybe above a

certain income level, we are all segregationists,” he muses.

Pessimism addles judgment. The assertions that “the United States now offers some of the lowest wages in the industrialised world”, and that America has created a “welfare state that heavily favours the upper class”, are both, at best, deeply questionable readings of the data. Mr Desmond’s reverence for the American trente glorieuses from the late 1940s to the late 1970s—his view that “things weren’t always this bad”, because, in the olden days, the unions were riding high—is inconsistent with the dire poverty Harrington depicted in his book, and which set off Johnson’s nationwide “war”.

Mr Desmond portrays himself as a warrior against the “propaganda of capitalism”, which caricatures the poor as undeserving and denies that the capitalist system “is inherently about workers trying to get as much, and owners trying to give as little, as possible”. Yet the contest of ideas and interests need not be zero-sum. Many industrialised countries manage to have both vibrant market economies and low poverty rates because they redistribute a bit more, and a bit more intelligently.

The author wants readers to become “poverty abolitionists”. That means, for instance, only buying beer or sweets that are made with unionised labour. Such recommendations may be worthy, but they are less practical than technocratic policies such as expanding tax credits for children. In 2021 a nationwide trial of that programme saw the child-poverty rate drop by almost half (it rose again when the trial ended). It was a heartening success on which Mr Desmond does not dwell.

Poverty is a blight. Shame is one way to publicise it; exposing the suffering it involves is salutary. But the hardship is more likely to be relieved in future if Americans recognise the progress made in the past. ■



【首文】三角洲之国

孟加拉国骄人的增长模式行不通了？

发展的超级明星面对恶性政治和腐败日益泛滥

没有几个国家像孟加拉国那样成功让它的唱衰者乖乖闭嘴。1971年在第三次印巴战争的战火中诞生的孟加拉国被基辛格无情地嘲讽为“废物”。过去世人普遍认为它注定将是个失败的国家。它贫困潦倒，拥挤不堪，管理不善，飓风肆虐，蜿蜒流淌的大河忽而泛滥忽而枯竭。然而，孟加拉国在2021年庆祝了自己作为世俗民主国家的五十周年，已经成为朴素社会发展的典范，其经济成就在南亚令人瞩目。

在国内活动家的积极努力下，孟加拉国长期采取进步的社会政策。妇女和女童尤其受益良多，与印度（更不用说巴基斯坦）相比，她们的受教育程度更高，就业机会更好，生育的孩子更少、更健康。有了这样的进步，又成功从劳动力成本上涨的中国那里承接了制衣业，经济得以加速发展。在新冠疫情暴发前的十年里，孟加拉国的年增长率为7%，与中国的8%相差不远。按市场价格计算，其人均GDP约为2500美元，高于印度。到2026年，它将能脱离联合国的最不发达国家名单。该国立志到2031年成为中等偏上收入国家的雄心应该是有可能实现的。

然而，这样的前景如今蒙上了阴影。与许多发展中国家一样，受进口成本上升、资本变稀缺和国际收支平衡压力等问题的困扰，孟加拉国被迫在1月从国际货币基金组织（IMF）获得一笔47亿美元贷款。虽然远不像深陷危机的巴基斯坦或斯里兰卡那样拮据，但它理应做得更好。

要保持进步，孟加拉国将需要在经济上更上层楼。然而，其困境却暴露出结构性和政治上的弱点，它们指向另一个方向：严峻的衰败风险。

孟加拉国过度依赖制衣业，服装占到其总货物出口的85%。这部分出口可能很快就要失去因其最不发达国家地位而享有的优惠贸易条件，与此同时来自柬埔寨等生产成本更低的国家的竞争却在加剧。而孟加拉国发展制药

和电子等更高附加值产业的多元化努力不尽人意。阻碍这些产业发展的因素包括贪污、官僚作风、难以获得信贷，以及持续的人才外流。它们都有一个共同的原因：在2009年以后担任总理的谢赫·哈西娜（Sheikh Hasina）的腐败又想掌控一切的政府。

她试图把孟加拉国变成她遇刺身亡的父亲、首任总统谢赫·穆吉布·拉赫曼（Sheikh Mujibur Rahman）所构想的一党制国家，这一努力几乎渗透到该国所有经济领域。获得工作、许可证和政府合同都要经过执政的人民联盟（Awami League）之手。许多国内银行几乎就是不加掩饰的空壳机构，专向有关系的人提供贷款。过去几年，孟加拉国的外国直接投资开始减少；营商环境评级目前在南亚垫底。处境艰难的哈西娜反对者走上街头抗议，将于明年初举行的大选越来越可能出现暴力事件。

这位75岁的总理对强权政府的追求并不是非理性的。孟加拉国经历了许多动荡，包括29次未遂军事政变。尽管如此，在一个有着深厚的多元主义和辩论传统的社会里，她已经把威权主义实施到了极限。要建立更持久的执政文化，必须要迈出的一步是放松她的政党的控制力，甚至可以说，这也是为了维护她的家族遗产，甚至家族安全。恢复独立的制度也是必不可少的，它将成为孟加拉国未来增长的基础——与迄今为止取得的成绩相比，未来增长的难度很可能更大。

西方政府不愿施加压力。它们觉得自己对哈西娜并没有多少影响力，又对中国在孟加拉国不断增长的投资感到警惕。然而，它们的影响力比自己以为的要大。从商业机会到子女教育，该国的精英分子十分珍视与西方的联系；而且今天的孟加拉国也比过去更加依赖外资。

这事关重大。随着气候变暖，孟加拉国面临的环境威胁正在赶超它的发展步伐。世界银行表示，如果气温比工业化前水平上升 1.5°C ，到2050年，该国可能会出现1300万气候移民，三分之一的农业产出将化为乌有。这样的灾难会让一个极其敏感的地区陷入不稳定。甚至可能让基辛格看起来很有先见之明。如果要缓解这种风险，孟加拉国就不能陷入压制性一党政治的泥淖。它需要更快富裕起来。 ■



Delta force

Is Bangladesh's admired growth model coming unstuck?

A development superstar faces malign politics and rising corruption

FEW COUNTRIES have confounded their doomsayers as satisfactorily as Bangladesh. The “basket case”, in Henry Kissinger’s noxious phrase, that emerged in 1971 from the ravages of the third India-Pakistan war was widely considered a failed state in the making. It was poor, overcrowded, badly run and prey to violent cyclones and the vicissitudes of the great rivers meandering across it. Yet Bangladesh celebrated its first half-century in 2021 as a secular democracy, a model of frugal social development and South Asia’s standout economic performer.

Thanks to the dynamism of its activists, the country has long embraced progressive social policies. They have brought advances in particular for women and girls, who are more educated, likelier to be employed and have fewer and healthier children than their counterparts in India (let alone Pakistan). On the back of such progress, and a garments industry that was a winner from China’s rising labour costs, economic growth picked up. In the ten years before covid-19 struck, Bangladesh grew at an annual rate of 7%, not far off China’s 8%. Its GDP per head at market prices, of about \$2,500, is higher than India’s. In 2026 it is due to be promoted from the UN’s ranks of least developed countries. Its ambition to be an upper-middle-income country by 2031 should be plausible.

However, those prospects are now clouded. Beset by conditions that afflict many developing countries, including rising import costs, scarcer capital and balance-of-payments pressures, Bangladesh was forced in January to secure a \$4.7bn loan from the IMF. It is not nearly as straitened as crisis-ridden Pakistan or Sri Lanka, but it ought to be held to a higher standard.

To maintain its progress Bangladesh will require a step-up in its economic performance. Yet its troubles have exposed structural and political weaknesses that point in the other direction: to a serious risk of deterioration.

Bangladesh is over-reliant on garments, which make up about 85% of its total goods exports. They may soon lose the preferential trade terms associated with Bangladesh's least-developed status, even as competition from lower-cost producers such as Cambodia is rising. And Bangladesh's efforts to diversify into higher-value-added industries, such as pharmaceuticals and electronics, are unimpressive. They are hampered by graft, red tape, difficulties in obtaining credit and a relentless brain drain, all of which have a common cause: the corrupt and controlling regime of Sheikh Hasina, the prime minister since 2009.

Almost every area of the economy is touched by her bid to turn Bangladesh into the one-party state envisaged by her assassinated father, Sheikh Mujibur Rahman, the country's first president. Access to jobs, permits and government contracts runs through the ruling Awami League. Many domestic banks are thinly disguised shell operations, designed to funnel loans to the well-connected. Foreign direct investment has begun to flag in the past few years; the country's ratings for doing business are the worst in South Asia. In an election due early next year, violence is looking increasingly likely as Sheikh Hasina's beleaguered opponents take to the streets.

The 75-year-old prime minister's commitment to strong government is not irrational. Bangladesh has suffered spasms of instability, including 29 attempted military coups. Still, she has taken authoritarianism to its limit in a society with deep traditions of pluralism and debate. Easing her party's grip is the necessary next step towards building a more durable governing culture and, it might be added, to securing her family's legacy and perhaps

its safety. It is also essential to restoring the independent institutions that will be the foundation for the country's future growth—which is likely to be harder to generate than its growth so far.

Western governments are reluctant to apply pressure. They doubt they have much influence with Sheikh Hasina and are wary of China's growing investments in Bangladesh. Yet they have more sway than they know. Members of the country's elite prize their links with the West, from business opportunities to educating their children; and Bangladesh relies more on foreign capital than in the past.

The stakes are high. As the climate warms, the environmental threats to Bangladesh are outpacing its progress. Assuming a temperature rise of 1.5°C above pre-industrial levels, the country could see 13m climate migrants and a third of its agricultural output wiped out by 2050, says the World Bank. Such a disaster could destabilise an acutely sensitive region. It could even make Mr Kissinger look prescient. If it is to mitigate that risk, Bangladesh cannot afford to become mired in oppressive one-party politics. It needs to get richer quicker. ■



吼声渐近

政策制定者面对两个噩梦：顽固通胀和市场动荡

美联储与两难困境搏斗，其他国家很快也将感同身受

在担任美联储理事后的首次公开发言中，伯南克以一句简单的老话来解释一个复杂话题。当时有人问，央行应否运用货币政策来冷却过热的市场，例如通过加息戳破房地产泡沫。他的回答是，美联储应该“用合适的工具做事”。他认为美联储应该依靠监管和贷款权力来管控金融事务，而把利率这项工具留给经济目标，比如稳定价格。

20年后，伯南克的信条正面临反方向的严峻考验——要作为框架来应对疲惫烦躁而非过热的市场。一边是硅谷银行挤兑引发危机，美联储正忙于灭火。另一边，官员们要面对过去一年用尽解数都没能抑制的顽固通胀。稳定金融系统需要美联储支持，控制价格压力则需要紧缩政策，两者矛盾至极。但是，美联储正试图利用两套不同的工具来同时完成这两个目标。这是个不太可能的任务。而未来几个月，其他央行将别无选择，只能效仿。

3月22日，美联储为期两天的议息会议结束，主席鲍威尔阐述了美联储全面救助金融系统背后的逻辑。“个别银行的问题不解决，可能破坏人们对那些状况良好的银行的信心。”他说。但他也坚称，美联储可以而且也会把通胀拉下来。他表示：“价格不稳定，这经济对任何人都不好。”美联储说到做到，选择加息25个基点。

这次会议召开前，对于官员们是否会连续第九次加息，众说纷纭。2月的数据显示，通胀仍然高得令人不安，同比上涨6%，是美联储目标的三倍，继续紧缩似乎已成定局。但随着硅谷银行倒闭，恐慌情绪蔓延，一些重量级人物呼吁暂停紧缩，调查一下经济受到了什么影响。或者正如前波士顿联储主席埃里克·罗森格伦（Eric Rosengren）所说：“在经历地震带来的巨大冲击后，你该立马恢复正常生活吗？”

最终，美联储还是没被吓退。过去一年，美联储已加息近五个百分点，是

四十年来最大幅度的紧缩。光看数字，这一次加息25个基点显得微不足道。但这在显示美联储的决心上意义重大。它表明鲍威尔及其同事深信可以利用货币政策工具，特别是利率，来解决通胀问题，即使紧缩正对金融稳定构成风险。

美联储甘愿选择这一立场，因为它有一系列替代工具可用于应对市场混乱。在过去几周，美联储与政府其他部门协同行动，迅速保障银行系统的资产和负债。在资产方面，美联储让陷入困境的银行更易获得流动资金，银行能以所持政府债券为抵押从美联储获得与抵押品面值相当的贷款，即使市场定价低得多。这使得银行不必实现相关损失——在2022年底总计达6200亿美元，足以抹去美国银行系统近三分之一的股权资本。

至于负债，监管机构联邦存款保险公司（Federal Deposit Insurance Corporation）承诺兑付硅谷银行和另一家遭挤兑的银行Signature Bank的大量未受保存款。财政部长耶伦曾暗示，假如储户逃离更小的银行，政府将提供类似的救助，不过她在3月22日表示，拜登政府没打算提供全面担保（这需要国会批准）。尽管如此，即使法律规定存款保险的赔付上限为25万美元，但所传递的信息似乎是，账户无论存款数额大小都是安全的。目前，保险加上美联储的贷款已经帮助平息了事态：美国银行股KBW指数在暴跌去四分之一后已有所回稳。

美联储既要打击通胀又要稳定金融，这一噩梦般的平衡动作看起来与此前的两次危机截然不同。在2007年至2009年的全球金融崩盘以及2020年新冠疫情导致经济突然停滞时，美联储和其他央行都竭尽所能重振经济和支撑金融系统。在那两次危机中，金融和经济风险都迅速消减。这可能也让人更怀疑美联储能否一心二用——既抑制通胀又缓解市场压力。

不过，在美联储的观察人士看来，这种来回拉扯的动作并没有那么奇怪。1984年美国一家大型银行倒闭，1987年股市崩盘，1998年一家对冲基金爆仓——这些事件爆发后，美联储都暂时停止加息或小幅降息，但不久又恢复紧缩。花旗银行的经济学家认为，这些经验才更适用于当前的情况，而不是2008年或2020年的经验。虽然市场定价已考虑到美联储可能于今年

年底前降息0.5个百分点，但花旗银行的观点是，只要通胀保持在高位，美联储就可能会一直坚持紧缩政策，让投资者大吃一惊。事实上，美联储发出的信号正是这样。在3月22日宣布加息的同时，美联储公布了一份经济预期摘要。联邦公开市场委员会（Federal Open Market Committee）的中位数成员主张今年再加息25个基点，明年才开始降息。

不过，虽说货币政策工具和金融稳定工具理论上泾渭分明，在现实中两者的界限看起来可能会不甚清晰。以美联储的资产负债表为例。作为抑制通胀的努力之一，美联储去年开始量化紧缩，每月从资产负债表移出固定数量的到期债券，减少银行系统内的流动性。从去年5月到今年3月初，美联储资产瘦身约6000亿美元。然后，在硅谷银行破产后的几天内，其资产又增加了3000亿——这是通过贴现窗口和其他紧急操作向银行提供信贷的副产品。货币专家看到一条明显的分界线：量化紧缩是美联储资产负债表的一个持久变化，而紧急信贷将在状况恢复正常后消失。但鉴于资产负债表政策发挥作用的主要渠道之一是作为信号传递美联储的意图，这里显然有带来混淆的可能。

金融稳定和货币政策之间的反馈线路也同样模糊。大多数呼吁暂停加息的人并非简单粗暴地主张美联储要拯救陷入困境的投资者。相反，这里有更复杂的原因：银行业的乱局和市场的动荡本身就等同于加息。包含债券收益率、信贷利差和股票价值的金融环境在过去数周有所收紧。私募股权公司阿波罗全球管理公司（Apollo Global Management）的托斯滕·斯洛克（Torsten Slok）认为，定价的变化相当于美联储额外加息1.5个百分点，足以令经济走向硬着陆。

并非所有人都认同影响会如此之大。在美国，约有三分之一的信贷由银行提供，其余来自资本市场和抵押贷款机构等公司。这样企业就可以不受银行更苛刻贷款条件的限制。此外，最大型银行仍占到美国银行系统资产的半数以上，它们依然稳健。尽管如此，影响是真切存在的。随着银行加固资产负债表，存款和批发融资成本都在上升，会将紧缩效果传导至金融系统。德意志银行认为，即使力度很小，这股信贷冲击也将导致GDP年增长减少0.5个百分点。现在，美联储可能不得不在抑制通胀时少发点力。

最终，美联储能否稳定市场和抗通胀两手抓，取决于银行危机的严重程度。“假如金融问题很紧迫，那些发展较慢的宏观经济层面的问题总会被放在它们后面考虑，这也是合理的。”咨询公司Evercore ISI的克里希纳·古哈（Krishna Guha）表示。美国过去两周的紧急干预措施已经显现效力，存款外流放缓，市场逐步止损，美联储得以把注意力转回抗通胀。不难想象另一种情形是干预失败，迫使美联储停止加息。

这有助解释瑞士的官员们为何急于终结瑞信（Credit Suisse）的闹剧。央行官员非常清楚，这样的大银行失控倒闭肯定会在全球金融系统中引发冲击。在这种情况下，他们将面对要求他们放弃抗击通胀的巨大压力。“用合适的工具做事”拿来描述央行的工作目标说来好听。但只有当金融爆雷后恢复稳定的工作能很快做好，这话才真有意义。 ■



The roar gets nearer

Policymakers face two nightmares: stubborn inflation and market chaos

The Federal Reserve grapples with a dilemma that will soon hit other countries

IN HIS FIRST speech as a governor of the Federal Reserve, Ben Bernanke offered a simple adage to explain a complex topic. The question was if central banks should use monetary policy to tame frothy markets—for example, raising interest rates in order to deflate property bubbles. His answer was that the Fed should “use the right tool for the job”. It ought to rely, he argued, on regulatory and lending powers for financial matters, saving interest rates for economic goals such as price stability.

Two decades later, Mr Bernanke’s doctrine is facing a stiff test in the reverse direction—as a framework for dealing with frazzled, not frothy, markets. On one flank the Fed is trying to douse the red-hot embers of a crisis that began with a run on Silicon Valley Bank (SVB). On the other officials face stubborn inflation, having failed to wrestle it under control in the past year. The tension between stabilising the financial system, which calls for support from the central bank, and reining in price pressures, which calls for tight policy, is extreme. But with two different sets of tools, the Fed is attempting to do both things. It is an improbable mission. And it is one that other central banks will have little choice but to emulate in forthcoming months.

On March 22nd, at the end of a two-day meeting of the central bank’s rate-setting body, Jerome Powell, the Fed’s chairman, laid out the logic of its extensive support for the financial system. “Isolated banking problems, if left unaddressed, can undermine confidence in healthy banks,” he said. Yet he also maintained that the Fed could, and would, bring down inflation. “Without price stability, the economy does not work for anyone,” he said.

Putting policy where its mouth is, the Fed opted to lift rates by one-quarter of a percentage point.

Before the meeting there was debate about whether officials would follow through with their ninth straight rate rise. Continued tightening had appeared a foregone conclusion when figures for February revealed inflation was still uncomfortably high, running at 6% year-on-year, three-times as fast as the Fed's target. But as panic spread following SVB's collapse, some prominent voices called for a pause to survey the effects on the economy. Or as Eric Rosengren, a former president of the Fed's branch in Boston, put it: "After a significant shock from an earthquake should you immediately resume normal life?"

In the end the Fed was undeterred. Having already lifted rates by nearly five percentage points over the past year—its steepest tightening in four decades—the latest increase of a quarter-point was, in numerical terms, piddling. But as a measure of the Fed's resolve, it was freighted with significance: it showed that Mr Powell and his colleagues believe they can use monetary-policy tools, especially interest rates, to tackle inflation, even when tightening poses risks to financial stability.

The Fed is willing to take this stance because of the range of alternative tools it can deploy in response to the mayhem in markets. Over the past couple of weeks, the Fed, acting in concert with other parts of the state, has raced to safeguard both assets and liabilities in the banking system. On the asset side, it has given troubled banks easier access to liquidity, offering to lend against the face value of government-bond holdings, even when market pricing is much lower. This has spared banks from having to realise losses that, in aggregate, ran to \$620bn at the end of 2022—enough to wipe out nearly a third of equity capital in the American banking system.

As for liabilities, the Federal Deposit Insurance Corporation, a regulator,

pledged to stand behind large uninsured deposits in SVB and Signature, another bank that suffered a run. Janet Yellen, the treasury secretary, has hinted at similar support if depositors flee smaller banks, though on March 22nd she said the Biden administration was not considering blanket insurance (which would require approval from Congress). Still, even with deposit insurance legally capped at \$250,000, the message seems to be that accounts are safe no matter their size. The combination of the Fed's lending plus insurance has, for now, helped calm things down: after plunging by a quarter, the KBW index of American bank stocks has somewhat stabilised.

The Fed's nightmarish balancing act between inflation and financial stability looks very different from its past two crises. During both the global financial meltdown of 2007-09 and the sudden economic stoppage in 2020 when covid-19 struck, the Fed and other central banks threw everything they had at reviving the economy and propping up the financial system. On both occasions, financial and economic risks pointed sharply downwards. That may have contributed to doubts about the Fed's ability to walk and chew gum—to fight inflation and soothe market strains.

For Fed watchers, though, such cross-cutting actions look less surprising. In several cases—after a big bank collapse in 1984, a stockmarket crash in 1987 and a hedge-fund blow-up in 1998—the Fed briefly stopped raising rates or modestly cut them but resumed tightening policy before long. Economists at Citigroup, a bank, concluded that these experiences, not 2008 or 2020, are more pertinent today. Whereas markets are pricing in the possibility that the Fed may cut rates by half a percentage point before the end of this year, Citi's view is that the central bank may surprise investors with its willingness to keep policy tight so long as inflation remains high. Indeed, that is exactly what it has signalled. Along with raising rates on March 22nd, the Fed published a summary of its projections. The view of the median member of the Federal Open Market Committee is that they will raise rates by another quarter-point this year and only start cutting them next year.

Nevertheless, the neat division between monetary-policy and financial-stability tools can look blurrier in practice. Take the Fed's balance-sheet. As part of efforts to tame inflation, the central bank last year began quantitative tightening, letting a fixed number of maturing bonds roll off its balance-sheet each month, removing liquidity from the banking system. Between last May and the start of March it shrank its assets by about \$600bn. Then in the course of a few days after the SVB rout, its assets grew by \$300bn—a by-product of the credit it had provided to banks through its discount window and other emergency operations. Monetary wonks see a clear distinction: quantitative tightening is an enduring change to the Fed's balance-sheet, whereas the emergency credit will vanish when things normalise. But given that one of the main channels through which balance-sheet policies work is as a signal about the Fed's intentions, the potential for confusion is evident.

Another blurred line is the feedback between financial stability and monetary policy. Most of those who argued for a Fed pause were not crudely advocating that the central bank needs to rescue beleaguered investors. Rather, the more sophisticated point was that bank chaos and market turmoil were themselves tantamount to rate increases. Financial conditions—which include bond yields, credit spreads and stock values—have tightened in the past couple of weeks. Torsten Slok of Apollo Global Management, a private-equity firm, reckoned that the shift in pricing was equivalent to an extra 1.5 percentage points of rate increases by the Fed, enough to tip the economy into a hard landing.

Not all agree the effect will be so large. Banks are responsible for about one-third of credit provision in America, with capital markets and firms such as mortgage lenders offering the rest. This could insulate firms from stricter lending standards at banks. Moreover, America's biggest banks account for more than half the banking system by assets, and they remain in strong shape. Yet even with these caveats, the impact is still real. As banks shore up their balance-sheets, both deposit and wholesale-funding costs are rising,

which transmits the tightening to the financial system. Deutsche Bank thinks the lending shock, if minor, will shave half a percentage point off annual GDP growth. The Fed will probably now have to go less far to tame inflation.

Ultimately, its ability to treat instability and inflation on separate tracks depends on the severity of the banking crisis. “If financial issues are screaming, they will always, and rightly, trump slower-moving macroeconomic questions,” says Krishna Guha of Evercore ISI, an advisory firm. The fact that America’s emergency interventions in the past two weeks had gained traction, with deposit outflows slowing and markets paring their losses, is what enabled the Fed to turn its attention back to inflation. It is easy to imagine an alternative scenario in which the interventions failed, forcing it to desist from a rate rise.

This helps to explain the haste of Swiss officials to bring an end to the Credit Suisse drama. Central bankers know only too well that the uncontrolled collapse of such a big firm would send shock waves through the global financial system. In that case, they would have been under immense pressure to retreat from the fight against inflation. The right tool for the right job is an attractive way of delineating the objectives of central banking. Yet it only works so long as the job of restoring stability after a financial explosion is handled swiftly. ■



巴托比

职场烦恼的小小安慰

被干扰和冒牌者综合症的光明面

即使热爱自己工作的人也会有一些抱怨。即使工作出色的人也有自己的烦恼。办公室环境让人难以集中注意力；讨厌的同事令人抓狂；自己在组织中的职业发展道路也不甚清晰。职场的某些方面——比如“回复所有人”的邮件线程以及任何的角色扮演——已经完全无可救药了。本文是要为一些在工作中反复出现的烦恼提供一丝慰藉。

先从一个普遍的问题说起：被打扰。你已将Slack通知设置了静音，清空了日程表；巴赫《第一大提琴组曲》的前奏曲正在播放；你的手指已经在键盘上摆好，一个惊天动地的深刻想法在脑中逐渐成形。然后响起了敲门声，一个同事问你有没有时间讨论一下空调的事情。等到他们离开，那个伟大的念头也不见了踪影，任何泰然自若之感也随之消失。

这样的心境转换不只是令人恼火。2021年的一项调查发现，人们从一个应用切换到另一个后需要九分半钟时间才能恢复专注的状态。但被打扰也有好的一面。伊利诺伊大学芝加哥分校的哈沙德·普拉尼克（Harshad Puranik）等人在一篇论文中写道，他们请一些美国员工记录下他们被同事打扰分心的频率，并报告他们对所在组织的归属感。他们发现，被打扰也是一种与同事的社交互动，可以增强员工与他人的联结感。下次有人敲门时，提醒一下自己，至少你不孤单。

那些让办公室生活变得令人咬牙切齿的人物呢？每个公司都会有以讨好上司为业的人：对老板阿谀奉承，善于邀功请赏。这种油滑无疑让人讨厌。但它有时同样可能从更广泛的层面带来好处。

哥伦比亚商学院的蔡玮等人最近的研究发现，马屁精的存在会让团队的表现更优秀。在这项研究中，那些在绩效评估中获得的上司评价高于同事评价的人被划定为“向上影响者”。这种人太多了不好：多到一定程度，团队

成员都会花更多精力去竞争老板的认可而不是完成实际工作。但由于这些性格类型的人更愿意花时间和上司沟通，团队中有几个这样的人反而确保了这个团队不会被老板忽视。有几个马屁精可能对大家都有好处。

那种让员工最自觉困扰并可能阻碍他们发展的特质又如何？“冒牌者综合症”是指一些人认为自己不配身居要职。一般认为这种想法对个人和组织都是有害的。但它也可能有好的一面。

麻省理工学院斯隆管理学院的巴斯玛·特菲克（Basima Tewfik）的研究发现，与那些从不自我怀疑的人相比，担心自己是冒牌货的人在其他人眼里却拥有更好的人际交往技巧。这可能是由于他们对自己的能力信心不足，因此会通过与他人建立更牢固的关系来加以弥补。在一个越来越重视协作和软技能的世界里，这一点不可小视。

弱点也可能转化为其他优势。例如，理想中的创业者可能自信满满、魅力十足。但并不是每个人都符合这种人格模式。在最近的一项研究中，苏黎世大学的劳伦·豪（Lauren Howe）和约亨·门格斯（Jochen Menges）请一个投资游戏中的参与者将资金分配给创业公司，这些人此前都被问及自己有什么缺陷。他们发现，那些坦承自己有某种性格缺陷——比如优柔寡断或缺乏安全感——的创业者更有可能从具有相同特质的投资者那里拿到融资。有些缺点是断然不能承认的，比如愚蠢或嗜睡。但弱点有时也可以帮助人们走到前头，而不是阻碍他们。

虽说每朵乌云都镶着金边，但乌云毕竟还是乌云。你仍然成天被打扰。你身边仍然围绕着烦人的同事。冒牌者综合症仍然引发你不必要的焦虑。你的弱点仍然是弱点。但职场生活中的大多数事物都有光明的一面，可不是只有工资单是好事。 ■



Bartleby

The small consolations of office irritations

The silver linings of interruptions and impostor syndrome

EVEN PEOPLE who love their jobs have a few gripes. Even people who excel at their work have their share of worries. The office environment makes it hard to concentrate; their colleagues are annoying beyond belief; their career path within the organisation is not obvious. There are aspects of the workplace, like “reply all” email threads and any kind of role-playing, which are completely beyond redemption. This column is here to administer the balm of consolation for some of work’s recurring irritations.

Start with a pervasive problem: being interrupted. You have muted notifications on Slack and cleared your calendar; the Prelude from Bach’s Cello Suite No 1 is playing; your fingers are poised above the keyboard and a thought of world-altering profundity is gradually taking shape in your mind. Then there is a knock at the door, and a colleague asks if you have a minute to discuss the air-conditioning. By the time they have gone, so has that momentous thought and any sense of well-being.

Context-switching of this sort is more than simply annoying. A survey conducted in 2021 found that it takes people nine and a half minutes to resume a focused state of mind after switching between apps. But there is a bright side to being interrupted. A paper by Harshad Puranik of the University of Illinois Chicago and his co-authors asked a sample of employees in America to record how often they were distracted by colleagues and to report their sense of belonging to their organisations. They found that being interrupted involves a social interaction with colleagues that can strengthen a worker’s feelings of connection. The next time a knock comes, remind yourself that at least you are not lonely.

What about some of the characters who make office life so teeth-grinding? Every company has its share of toadies who specialise in managing up: flattering the bosses and claiming more credit than is their due. Unctuousness is undoubtedly irritating. But it, too, can sometimes have wider benefits.

Recent research by Wei Cai of Columbia Business School and her co-authors found that teams performed better when they had some crawlers among them. People who got better assessments from their superiors than from their peers in performance-review processes were designated as “upward influencers” in the study. Too many characters of this sort is bad: at some point, team members will expend more effort competing for recognition than getting actual work done. But because these personality types are prepared to invest more time communicating with their managers, the presence of a handful of them ensures that a team does not become invisible to the bosses. A few suck-ups can be good for everyone.

What of traits that workers find most irritating about themselves, the things that may be holding them back? Impostor syndrome, the belief some people have that they do not deserve to be in positions of influence, is usually thought of as being bad for individuals and organisations alike. But it can have an upside.

Research by Basima Tewfik of the MIT Sloan School of Management found that people who worry about being an impostor are regarded by others as having better interpersonal skills than those who are untroubled by self-doubt. It may be that a concern about lacking competence leads people to compensate by developing stronger relationships with others. In a world that increasingly prizes collaboration and soft skills, that is not to be sniffed at.

Weaknesses can turn into advantages in other ways, too. The idealised

entrepreneur may drip with confidence and charisma, for example. But not everyone fits that mould. In a recent study, Lauren Howe and Jochen Menges of the University of Zurich asked participants in an investment game who had been asked about their own flaws to allocate funds to startups. They found that entrepreneurs who reveal a personal shortcoming, such as indecisiveness or insecurity, are more likely to attract funding from investors who share these same characteristics. Some weaknesses are not to be admitted: stupidity, say, or narcolepsy. But flaws can sometimes help people get ahead, not hinder them.

The problem with silver linings is that they are attached to clouds. You are still being interrupted all the time. You are still surrounded by annoying colleagues. Impostor syndrome still causes you unnecessary anxiety. Your weaknesses are still weaknesses. But there are bright sides to most things in office life, and they go beyond the payslip. ■



跨国公司换新貌

西方公司是否没那么全球化了？

民族主义世界中的跨国公司【深度】

十二个月前，俄罗斯加入了一个耻辱名单：跟朝鲜和古巴一样，该国的消费者不能再畅饮可口可乐。这家美国饮料巨头在俄罗斯入侵乌克兰之后停止了在俄业务。三十年前苏联解体后，可口可乐在俄罗斯传播，那时全球商业的壁垒正在被拆除。如今，这些壁垒正在重新竖立起来，而且不仅仅围着俄罗斯。

据报道，美国财政部正在制定计划，要阻止在尖端技术上向敌对国家投资。它已经禁止向中国出售先进的微处理器和芯片制造设备。如果中国大陆效仿俄罗斯，对自己一直想要收复的台湾动武，中美贸易可能会骤然完全断绝。与此同时，美国正企图用5000亿美元补贴引诱半导体、电动汽车和清洁能源的供应链回流国内。预计欧盟随时都会推出类似的大规模补贴。

企业跨国运营总是会遇到从跨时区协调到适应形形色色的监管制度等各种困难。近年来地缘政治局势紧张，保护主义日益抬头，让全球化商业面临压力，这给一直是全球化最大受益者之一的西方企业巨头提出了棘手难题。它们最初的反应勾勒出了21世纪的西方跨国公司的轮廓。它减少了对中国的依赖，更多依赖软件和专利等无形资产。但总体而言，它的全球化特征并未减少。

17世纪，欧洲的殖民贸易公司走出旧大陆寻找商机（常常通过暴力），西方公司从那时起开始向全球扩张。到20世纪初，全球外国直接投资（FDI）存量徘徊在世界GDP的10%左右。FDI存量指标可以粗略显示跨国企业的密度。

大约在俄罗斯人习惯了大口畅饮在本地生产的可口可乐时，西方的跨国公司也体验了一把它们自己的痛饮气泡饮料般的畅快感。更自由的贸易、更

低的运输成本和更好的通信技术让它们向真正的全球化企业迈进。哪里能找到更廉价的劳动力、更低的税率或新客户，它们就会在哪里开张新店。2010年代初期，全球FDI存量达到相当于全球GDP的30%。西方企业在其中占到78%。美国的跨国公司一般有十几家外国子公司。

在过去十年左右的时间里，情况开始发生变化。美欧企业在海外市场的活跃度开始降低。受到2007至2009年全球金融危机和随之而来的欧元区债务纠纷的冲击，银行缩减了海外业务。而新的竞争者——尤其是来自中国的企业——开始挑战西方公司。例如，现在印度五大最畅销的智能手机品牌中有四个是中国的。去年，中国超越德国成为世界第二大汽车出口国，仅次于日本。

自2010年以来，美国和欧洲上市公司的海外销售额每年仅增长2%，低于2000年代的8%和1990年代的10%（见图表1）。跨国公司往它们的FDI存量上添加海外工厂的速度减缓。根据联合国贸发会议的数据，美国和欧洲的年度对外投资流量（不包括收益再投资）从2015年6590亿美元的峰值暴跌至2021年的2160亿美元。2021年的数字比2019年的1560亿美元有所增加；在2020年，新冠疫情让它们几乎完全停止了流动。2010年至2021年，西方占全球FDI存量的份额从78%下降到71%。典型的美国跨国公司现在平均只有九家外国子公司。

大西洋两岸的政客都对这一趋势表示欢迎。他们正在大谈特谈国内制造业的复兴，并越来越试图压制中国，它正从西方的工厂变为敌人。1月，美国用于工厂建设的月度支出达到109亿美元，同比增长55%。欧盟希望它的新补贴能产生类似的效果。

欧美企业界对于既是自己的产品生产地也是销售市场的中国的热情也在降温。美国经济分析局（BEA）的数据显示，美国跨国公司在中国的工厂和设备价值在2018年达到顶峰。西方政客可能会将这一变化归结为自己的功劳，但更大的原因可能是中国劳动力价格的上涨。自2010年以来，中国制造业的工资增长了三倍，名义工资从每小时2美元上涨到超过8美元。

而中国市场对某些行业仍然很重要。例如，西方半导体公司约30%的销售额来自中国。但在西方上市公司12万亿美元的海外销售额中，芯片制造仅占4000亿美元（见图表2）。根据投行摩根士丹利的数据，纵观所有行业，中国占西方公司海外收入的比例不到八分之一，比欧美之间或西方公司对其他新兴市场的销售额要小得多（见图表3）。欧洲公司的总收入中只有8%来自中国。美国公司的这个数字是4%。根据美国经济分析局的数据，2017年至2020年之间，美国跨国公司在中国的销售额没有增长，而同一时期在印度每年增长6%。

所以西方跨国公司对中国的依赖有所下降。然而，据此得出它们正在回归本国的结论可就错了。瑞银的阿伦德·卡普泰恩（Arend Kapteyn）说，生产从中国的“回岸”主要局限于一小部分受重视的行业。总体来说，在经通胀调整后，美国的制造业产出仍低于金融危机前的水平，欧洲则基本保持不变。

事实上，西方企业并没有“厌世”。看起来正相反。平均而言，美国公司的外国子公司数量可能比十年前少了四分之一，但在海外设有子公司的跨国企业数量大大增加，足以弥补这一减少。美国经济分析局的数据显示，这一数字从2010年的2300家激增至2020年的4600多家。3月13日的报道称，美国快餐连锁店Chick-fil-A计划斥资10亿美元在亚洲和欧洲扩张。

那些最大的公司保持着大量的外国业务。底特律汽车制造商通用汽车仍有100多家外国子公司。Chick-fil-A的大多数新增外国门店的鸡肉三明治都可以搭配可口可乐，这种饮料仍在200多个国家和地区为人们提神解渴。

西方企业也没有放弃在国外生产产品。苹果和阿迪达斯分别越来越多地在印度和越南等地缘政治友好的地方生产iPhone和运动鞋，而且那里的工资水平大约是中国的三分之一。本月，马斯克宣布特斯拉将在墨西哥蒙特雷（Monterrey）建造一座新工厂。墨西哥的工资也很低，而且还有一个好处——紧邻特斯拉的老家，跨过边境线就是得克萨斯州。

跨国公司也越来越不只追逐廉价的体力劳动力。科技进步意味着现在许多

公司最具生产力的资产不是实体厂房和设备，而是计算机程序和专利等无形资产。这增加了投资于人才的回报，尤其是在那些受过良好教育的劳动力索要的工资低于西方的地方。更快的宽带、视频通话和云计算等技术让跨国公司比以往任何时候都更容易利用这样的人才。日内瓦高级国际关系学院（Geneva Graduate Institute）的理查德·鲍德温（Richard Baldwin）预测，白领工作的离岸外包将构成新一轮全球化的基础，类似于前几十年制造业向海外的转移。

咨询公司Everest Group的吉米特·阿罗拉（Jimit Arora）指出，跨国公司已经开始在更大的范围内考虑哪些任务可以在海外完成。从2010年到2020年，美国跨国公司在低成本国家的研发支出大约翻了一番（见图表4）。去年11月，飞机制造商波音公司宣布将耗资2亿美元在印度班加罗尔（Bangalore）建造该公司在美国以外最大的研发中心。Alphabet、亚马逊和微软等美国科技巨头也在该市开设了研发中心。美国最大的连锁超市沃尔玛和英国飞机发动机制造商罗尔斯-罗伊斯也一样。

随着各行各业不断为数字时代重塑自我，无形资产的重要性只会与日俱增。德国工业巨头西门子已经自称是一家专注于数字模拟、数据分析等领域的“科技公司”。沃尔玛现在雇用了大约2.5万名技术专家，相当于Pinterest、Snap、Spotify和Zoom这四大当红科技公司的员工总和。

由于软件往往研发成本高而复制成本低，因此那些能够摊薄固定开发成本的大公司享有越来越大的竞争优势。而跨国公司能够最大程度地分摊这类成本。

从1990年到2021年，销售额低于10亿美元的美国和欧洲上市公司的平均股本回报率从8%下降到4%。对于收入在100亿美元或以上的公司，回报从12%上升到了18%（见图表5）。国际化的公司要做大也更容易。2021年，收入超过100亿美元的美国和欧洲上市公司平均有43%的销售额来自海外，而在销售额低于10亿美元的公司中，这一比例仅为32%。换句话说，全球覆盖比以往任何时候都更加重要。面对雄心勃勃的新兴市场竞争对手步步紧逼，西方的领军企业并没有后撤这个选项。■



The new-look global corporation

Are Western companies becoming less global?

Being a multinational in a nationalist world

TWELVE MONTHS ago Russia joined the ignominious list of countries—alongside North Korea and Cuba—where consumers are denied the joys of a Coca-Cola. The American beverage giant had halted its operations there following the Russian invasion of Ukraine. Thirty years before, when Coca-Cola expanded in Russia after the collapse of the Soviet Union, barriers to global commerce were being torn down. Today they are being re-erected—and not just around Russia.

America's Treasury Department is reportedly working up plans to stop outbound investment in cutting-edge technologies in adversarial countries. It has already banned the sale of advanced microprocessors and chipmaking equipment to China. Sino-American commerce could snap shut entirely if China imitates Russia's belligerence in its relations with its own coveted neighbour, Taiwan. At the same time, America is dangling subsidies worth half a trillion dollars with the aim of bringing supply chains for semiconductors, electric cars and clean energy back home. The European Union is expected to unveil a chunky package of similar sweeteners any day now.

Operating as a multinational company has always involved difficulties, from co-ordinating across time zones to navigating a patchwork of regulatory regimes. The latest strains on globalised commerce—wrought by geopolitical tensions and rising protectionism—raise tricky questions for the corporate giants of the West that have been among globalisation's biggest beneficiaries. Their initial responses sketch out the contours of the Western multinational of the 21st century. It is less reliant on China and

more reliant on intangible assets such as software and patents. But overall, it is no less global.

Western firms started spreading out into the world in the 1600s, when Europe's colonial trading houses ventured (often violently) beyond the old continent in search of commercial opportunities. By the start of the 20th century the global stock of foreign direct investment (FDI), a rough proxy for the prevalence of multinational businesses, was hovering at 10% or so of world GDP.

Then, around the time Russians took to glugging locally made Coke, the West's corporate globetrotters experienced their own carbonated high. Free trade, lower shipping costs and better communications technology allowed them to become more truly global. They set up shop wherever they could find cheaper labour, lower taxes or new customers. In the early 2010s the worldwide stock of FDI reached the equivalent of 30% of global output. Western businesses accounted for 78% of the total. The average American multinational had a dozen foreign subsidiaries.

In the past decade or so things started to change. American and European companies began to lose some of their foreign fizz. Banks battered by the global financial crisis of 2007-09 and the ensuing euro-zone debt rigmarole slimmed down their foreign businesses. And new competitors, especially from China, began to challenge Western firms. Four of the five biggest smartphone brands in India, for example, are now Chinese. Last year China overtook Germany as the world's second-largest car exporter, behind only Japan.

Since 2010 the foreign sales of listed American and European companies have grown by a meagre 2% per year, down from 8% in the 2000s and 10% in the 1990s (see chart 1). Multinationals have been adding fewer foreign factories to the FDI stock. Annual flows of American and European foreign

investments (excluding reinvested earnings) plunged from a peak of \$659bn in 2015 to \$216bn in 2021, according to the United Nations Conference on Trade and Development—and that was an uptick from \$156bn in 2019, before covid-19 quashed them almost completely in 2020. Between 2010 and 2021 the West's share of the worldwide FDI stock fell from 78% to 71%. The typical American multinational now has just nine foreign subsidiaries.

Politicians on both sides of the Atlantic applaud this trend. They are talking up a domestic manufacturing renaissance and increasingly trying to keep China, the West's factory turned foe, down. In January monthly spending on factory construction in America hit \$10.9bn, up by 55% on the year before. The EU hopes its new subsidies will have a similar effect.

America Inc and Europe SA are also cooling on China—both as maker of and market for their wares. According to BEA data, the value of American multinationals' factories and equipment in China peaked in 2018. Western politicians may claim the credit for this change, but a bigger reason may be pricier Chinese labour. Since 2010 manufacturing wages in China have increased four-fold, from \$2 per hour to over \$8 in nominal terms.

As for the Chinese market, it remains important for some sectors. Western semiconductor companies, for example, derive around 30% of their sales from China. But chipmaking accounts for just \$400bn of the \$12trn of sales generated abroad by listed Western companies (see chart 2). Look across all industries, and China is responsible for less than one-eighth of Western firms' foreign revenues, according to Morgan Stanley, an investment bank—a much smaller share than American and European sales across the Atlantic or to the rest of the emerging world (see chart 3). Only 8% of European companies' total revenues come from China. For their American counterparts, the figure is 4%. According to BEA figures, American multinationals' sales in China were flat between 2017 and 2020. In India they grew by 6% a year in the same period.

Western multinationals are, then, becoming somewhat less Chinese. Yet it would be a mistake to conclude that they are turning into homebodies. In so far as the “reshoring” of production from China is happening, observes Arend Kapteyn of UBS, a bank, it is mostly confined to a narrow set of favoured sectors. Overall manufacturing output remains below what it was before the financial crisis in America and roughly unchanged in Europe, after adjusting for inflation.

Indeed, Western business looks the opposite of world-weary. American firms may have a quarter fewer foreign subsidiaries than a decade ago, on average, but the drop was more than offset by the number of them with a presence abroad. This swelled from 2,300 in 2010 to over 4,600 in 2020, BEA data show. On March 13th it was reported that Chick-fil-A, an American fast-food chain, plans to spend \$1bn on expansion in Asia and Europe.

The biggest firms maintain a large foreign presence. General Motors, a Detroit carmaker, still boasts more than 100 foreign subsidiaries. Most of Chick-fil-A’s new foreign diners will be able to wash down chicken sandwiches with Coca-Cola, which continues to quench thirst in more than 200 countries and territories.

Western business is not giving up on foreign production, either. Apple and Adidas are increasingly sourcing their iPhones and sneakers, respectively, from geopolitically friendly places like India and Vietnam, where wages are roughly a third of those in China to boot. This month Elon Musk announced that Tesla would build a new factory in Monterrey, Mexico, another low-wage location with the added benefit of being next door to the car company’s home across the border in Texas.

Those globetrotters are increasingly after more than merely cheap manual labour. Technological progress means that many firms’ most productive assets are now not their physical plant and equipment but intangibles like

computer programs and patents. This increases the returns on investment in talent, especially in places where an educated workforce commands lower wages than in the West. Technologies such as speedier broadband, video calls and cloud computing make this talent pool easier than ever to tap. Richard Baldwin of the Geneva Graduate Institute predicts that the offshoring of white-collar work will form the basis of a new wave of globalisation akin to the dispersion of manufacturing in earlier decades.

Multinationals have already begun to think more expansively about what tasks can be done offshore, notes Jimit Arora of the Everest Group, a consultancy. American multinationals' spending on research and development (R&D) in low-cost countries roughly doubled between 2010 and 2020 (see chart 4). Last November Boeing, an aircraft manufacturer, announced it would build a \$200m R&D facility in the Indian city of Bangalore, its largest outside America. American tech giants such as Alphabet, Amazon and Microsoft have also opened R&D centres in the city. So has Walmart, America's mightiest supermarket chain, and Rolls-Royce, a British maker of aircraft engines.

The importance of intangibles will only grow as businesses across the economy reinvent themselves for the digital era. Siemens, a German industrial giant, already calls itself a "technology company" focused on digital simulations, data analytics and so on. Walmart now employs some 25,000 tech specialists, equivalent to the combined workforce of Pinterest, Snap, Spotify and Zoom, four tech darlings.

Because software tends to be expensive to build but cheap to reproduce, big firms that can spread the fixed costs of development enjoy an ever greater competitive advantage. And multinational companies can spread those costs widest of all.

Between 1990 and 2021 the average return on equity of American and

European listed companies with less than \$1bn in sales fell from 8% to 4%. That for firms with revenues of \$10bn or more rose from 12% to 18% (see chart 5). And being big is easier if you are international. In 2021 American and European listed companies with \$10bn-plus in revenue generated 43% of their sales abroad on average, compared with just 32% for those with sales below \$1bn. Global reach is, in other words, more important than ever. With ambitious emerging-market rivals nipping at their heels, retreat is not an option for the West's corporate champions. ■



熊彼特

版权与AI大战酝酿

当心*Napster*的前车之鉴

面对人工智能（AI），音乐行业有两种态度。一种是吉尔斯·马丁（Giles Martin）的做法。他是披头士乐队的制作人乔治·马丁（George Martin）的儿子。去年，为了给披头士1966年的专辑《左轮手枪》重新混音，他使用AI从单声道母带中学习每个乐队成员使用的乐器的声音，比如约翰·列侬的吉他，这样就能把它们分离出来，通过逆向工程制作出立体声。最后的效果令人惊艳。另一种态度也不赖。喜怒无常的澳大利亚唱作人尼克·凯夫（Nick Cave）读了创业公司OpenAI开发的AI工具ChatGPT以他的风格写的歌词。“这歌太烂了，”他写道，“写一首好歌不是模仿、复制或拼凑，而是相反。这是一种自杀行为，它摧毁了一个人过去努力制作出来的一切。”

OpenAI于3月14日发布了ChatGPT背后算法的最新版本，名为GPT-4。凯夫恐怕不会为其折服，而马丁可能觉得它颇有用武之地。面对ChatGPT（生成文本）或Stable Diffusion（生成图像）等内容生成应用背后的AI，全球最大的唱片公司环球音乐集团（Universal Music Group）的首席数字官迈克尔·纳什（Michael Nash）以这两人为例，说明人们对AI的兴奋与恐惧。AI可以辅助创作，但也可以摧毁或篡夺这个过程。然而，对于整个录制音乐业而言，这些机器人的出现让人联想到行业历史上的一个重大事件：*Napster*的迅速崛起和衰落。它是在世纪之交出现的一个主要分享盗版歌曲的平台，最终被版权法打垮。对于那些被指控践踏知识产权的激进的机器人供应商，纳什有一条简单的意见。这话出自一个来自*Napster*时代的音乐行业资深人士之口，颇有点恐吓的味道：“不要先投放市场，然后才乞求原谅。那是*Napster*路数。”

这里的主要问题不是AI对凯夫的戏仿，或伪造莎士比亚十四行诗。问题是这些机器人在接受训练来生成仿佛出自人手的内容时，吸收了海量的受版

权保护的数据。这些信息的来源五花八门：社交媒体、网络搜索、数字图书馆、电视、广播、统计数据库，等等。AI模型被指往往在未经允许的情况下搜掠数据库。原始材料的负责人抱怨说，他们的作品在未经同意、未署名或补偿的情况下被大量窃取。简而言之，一些AI平台对其他媒体的做法可能如同Napster对待歌曲一般——完全无视版权。诉状已经开始满天飞。

这是一个法律雷区，其影响超出了创意产业，延伸到了使用机器学习的各行各业，如自动驾驶汽车、医疗诊断、工厂机器人和保险风险管理。官僚主义十足的欧盟有一项涉及数据挖掘的版权指令（早于最近的机器人热潮之前）。专家表示，美国缺乏针对生成式AI的判例历史。相反，对于是否可允许基于“合理使用”原则开展未经许可的数据挖掘，仍存在争锋相对的理论。Napster在美国也曾试图以“合理使用”为自己辩护——最后失败了。这并不是说这次的结果也会是这样。

围绕“合理使用”的主要论点非常有趣。借用马克·莱姆利（Mark Lemley）和布莱恩·凯西（Bryan Casey）在期刊《德克萨斯法律评论》（Texas Law Review）上发表的一篇关于该主题的大师级论述，在使用受版权保护的作品时，如果是服务于有价值的社会目的、源材料是从原作转化而来，且不影响版权所有者的核心市场时，就被认为是合理的。批评者认为，AI并没有转化内容，而是对挖掘的数据库整体加以利用。他们声称，机器学习背后的公司滥用了“合理使用”，以“搭便车”的形式利用了他人的工作成果。他们认为这威胁到创作者的生计，而如果AI促进了大规模监视并传播错误信息，还将危及整个社会。两位作者权衡了这些论点，同时考虑到一个事实：能获得更多的训练集，AI就变得越好，而如果没法获得训练集，AI可能根本就无从谈起。换言之，该行业可能会夭折在襁褓中。他们称之为本世纪最重要的法律问题之一：“版权法是否允许机器人学习？”

盖蒂图片社（Getty Images）不久前提出的一起诉讼引发了关注。这家图片社指控Stable Diffusion的母公司Stability AI为了创建一个图像生成AI模型而侵犯了其图库中数百万张照片的版权，这个模型还将成为盖蒂的竞争对手。如果该案不能达成庭外和解，它可能成为“合理使用”的一个判例。

美国最高法院可能很快就会做出一项更重要的裁决，该案涉及已故艺术家安迪·沃霍尔（Andy Warhol）对流行偶像普林斯（Prince）受版权保护的图像所做的转化。纳什维尔市范德比尔特法学院（Vanderbilt Law School）的知识产权专家丹尼尔·热尔韦（Daniel Gervais）认为，大法官们可能就“合理使用”提供人们期待已久的总体指引。

抓取受版权保护的数据并不是生成式AI面临的唯一法律问题。在许多司法管辖区，版权只适用于人类创造的作品，因此机器人在多大程度上可以为它们所创造的东西主张知识产权保护就成了另一个灰色地带。在法庭之外，最大的问题将是政治上的，包括生成式AI是否应该就其显示的内容享有和社交媒体平台一样的免责保护，以及它对数据隐私构成了多大的威胁。

然而，知识产权的争夺将是一场大战。纳什表示，创意产业应该迅速表明立场，确保在训练AI模型时，艺术家的作品经授权并被合乎道德地使用。他敦促AI公司“记录和披露”其内容来源。但他也承认，这是一种微妙的平衡。创意人不想被视为进步的绊脚石。他们中许多人的工作也可能从AI中获益。Napster的“现实疗法”（纳什的称法）给我们的教训是，与其期盼新技术消失，不如参与其中。也许这一次，不需要经历15年的收入崩塌才能汲取这个教训。 ■



Schumpeter

A battle royal is brewing over copyright and AI

Beware the Napster precedent

CONSIDER TWO approaches in the music industry to artificial intelligence (AI). One is that of Giles Martin, son of Sir George Martin, producer of the Beatles. Last year, in order to remix the Fab Four's 1966 album "Revolver", he used AI to learn the sound of each band member's instruments (eg, John Lennon's guitar) from a mono master tape so that he could separate them and reverse engineer them into stereo. The result is glorious. The other approach is not bad either. It is the response of Nick Cave, a moody Australian singer-songwriter, when reviewing lyrics written in his style by ChatGPT, an AI tool developed by a startup called OpenAI. "This song sucks," he wrote. "Writing a good song is not mimicry, or replication, or pastiche, it is the opposite. It is an act of self-murder that destroys all one has strived to produce in the past."

Mr Cave is unlikely to be impressed by the latest version of the algorithm behind ChatGPT, dubbed GPT-4, which OpenAI unveiled on March 14th. Mr Martin may find it useful. Michael Nash, chief digital officer at Universal Music Group, the world's biggest label, cites their examples as evidence of both excitement and fear about the AI behind content-creating apps like ChatGPT (for text) or Stable Diffusion (for images). It could help the creative process. It could also destroy or usurp it. Yet for recorded music at large, the coming of the bots brings to mind a seismic event in its history: the rapid rise and fall of Napster, a platform for sharing mainly pirated songs at the turn of the millennium. Napster was ultimately brought down by copyright law. For aggressive bot providers accused of riding roughshod over intellectual property (IP), Mr Nash has a simple message that sounds, from a music-industry veteran of the Napster era, like a threat. "Don't deploy

in the market and beg for forgiveness. That's the Napster approach."

The main issue here is not AI-made parodies of Mr Cave or faux-Shakespearean sonnets. It is the oceans of copyrighted data the bots have siphoned up while being trained to create humanlike content. That information comes from everywhere: social-media feeds, internet searches, digital libraries, television, radio, banks of statistics and so on. Often, it is alleged, AI models plunder the databases without permission. Those responsible for the source material complain that their work is hoovered up without consent, credit or compensation. In short, some AI platforms may be doing with other media what Napster did with songs—ignoring copyright altogether. The lawsuits have started to fly.

It is a legal minefield with implications that extend beyond the creative industries to any business where machine-learning plays a role, such as self-driving cars, medical diagnostics, factory robotics and insurance-risk management. The European Union, true to bureaucratic form, has a directive on copyright that refers to data-mining (written before the recent bot boom). Experts say America lacks case history specific to generative AI. Instead, it has competing theories about whether or not data-mining without licences is permissible under the "fair use" doctrine. Napster also tried to deploy "fair use" as a defence in America—and failed. That is not to say that the outcome will be the same this time.

The main arguments around "fair use" are fascinating. To borrow from a masterclass on the topic by Mark Lemley and Bryan Casey in the Texas Law Review, a journal, use of copyrighted works is considered fair when it serves a valuable social purpose, the source material is transformed from the original and it does not affect the copyright owners' core market. Critics argue that AIs do not transform but exploit the entirety of the databases they mine. They claim that the firms behind machine learning abuse fair use to "free-ride" on the work of individuals. And they contend that this threatens

the livelihoods of the creators, as well as society at large if the AI promotes mass surveillance and the spread of misinformation. The authors weigh these arguments against the fact that the more access to training sets there is, the better AI will be, and that without such access there may be no AI at all. In other words, the industry might die in its infancy. They describe it as one of the most important legal questions of the century: “Will copyright law allow robots to learn?”

An early lawsuit attracting attention is from Getty Images. The photography agency accuses Stability AI, which owns Stable Diffusion, of infringing its copyright on millions of photos from its collection in order to build an image-generating AI model that will compete with Getty. Provided the case is not settled out of court, it could set a precedent on fair use. An even more important verdict could come soon from America’s Supreme Court in a case involving the transformation of copyrighted images of Prince, a pop idol, by the late Andy Warhol, an artist. Daniel Gervais, an IP expert at Vanderbilt Law School in Nashville, believes the justices may provide long-awaited guidance on fair use in general.

Scraping copyrighted data is not the only legal issue generative AI faces. In many jurisdictions copyright applies only to work created by humans, hence the extent to which bots can claim IP protection for the stuff they generate is another grey area. Outside the courtrooms the biggest questions will be political, including whether or not generative AI should enjoy the same liability protections for the content it displays as social-media platforms do, and to what extent it jeopardises data privacy.

Yet the IP battle will be a big one. Mr Nash says creative industries should swiftly take a stand to ensure artists’ output is licensed and used ethically in training AI models. He urges AI firms to “document and disclose” their sources. But, he acknowledges, it is a delicate balance. Creative types do not want to sound like enemies of progress. Many may benefit from AI in their

work. The lesson from Napster's "reality therapy", as Mr Nash calls it, is that it is better to engage with new technologies than hope they go away. Maybe this time it won't take 15 years of crumbling revenues to learn it. ■



美国的产业政策

州政府补贴推动美国电动汽车热潮，但有产能过剩之虞

单独来看，各州都算审慎行事。但整体来看，风险在增加

亚特兰大往东驱车一小时，下了州际公路，就驶入风景如画的佐治亚州乡村地带。道路两旁是高大的松树、乡间住宅和一座座教堂。突然间，一大片空旷的土地出现在眼前。黄色的大卡车正在压平地面，巨大的输电线沿着地块边缘一路延伸。让这里特别吸引产业投资者的东西反倒是看不见的：税收减免、直接补贴和其他支持，总额高达15亿美元。去年5月，佐治亚州宣布对总部位于加州、生产电动卡车和SUV的创业公司Rivian提供这个激励套餐，是当时该州给出的最大一笔企业补贴。但这项记录很快就被打破。到7月时，该州又承诺向现代汽车提供价值18亿美元的更大型补贴方案，同样用于兴建电动汽车工厂。

全美各地都在为电动汽车行业提供补贴。2月13日，密歇根州批准了对一家福特电池工厂超过10亿美元的激励措施。2月8日，俄亥俄州的私营经济发展部门向本田拨款近2.4亿美元。去年，堪萨斯州、密歇根州和北卡罗来纳州的公司获得了超过10亿美元的协议，另外还有几十笔较小的协议。由于联邦政府大力投资并提出本土成分规则，全球普遍担心美国将迅速崛起为电动汽车行业里的一大竞争威胁。随着美国各州争相吸引投资者，美国国内的竞争可能还更激烈。“要没有适当的激励配套，项目就会花落别家了。”佐治亚州经济发展署的一位发言人说。

各州过去并不是没有发放过企业补贴，但目前的补贴力度和速度非同一般。企业补贴监督机构Good Jobs First在去年一份报告中统计了51项州级电动汽车补贴方案，这是该机构自1980年有记录以来见证的规模最大的补贴潮。一名政府顾问估计，从历史上看，对每个新创造工作岗位的补贴约为5000美元，但在电动汽车上却达到了3万美元左右。

在一定程度上，强劲的财政状况让州政府有了底气：疫情相关的经济刺激

资金给大多数州政府留下了巨额预算盈余。作为拜登政府新产业推动政策的基石，《通胀削减法案》（IRA）将为电动汽车买家和制造商提供数十亿美元的税收抵免，这给各州平添了紧迫感。该法案将于2032年到期，想要利用这个机会的公司就必须加快行动。摩根士丹利全球汽车研究主管亚当·乔纳斯（Adam Jonas）在解释时用钓鱼做类比：“通胀削减法案在湖里放满了鳟鱼。现在各州都想用鱼饵把鳟鱼吸引过来。”

鉴于补贴激增，一个迫近的问题是有多少补贴最终会被浪费掉。佐治亚州对Rivian的补贴方案就引起了人们对这种风险的关注。待建工厂所在地附近的居民对达成协议所需的债券提出了质疑，他们指出Rivian一直是一家亏损的创业公司。“政府基本上就是作为一个投机商去投资这家公司。”反对者的代表律师约翰·克里斯蒂（John Christy）说。初审法官接受了这个意见，拒绝承认债券的效力。州政府已提出上诉，Rivian的计划悬而未决。

然而仔细看看佐治亚州的方案，就会发现各州都在努力避免浪费。税收减免取决于公司的表现。Rivian的情况是，它承诺在2028年底前投资50亿美元并创造7500个工作岗位，它必须至少兑现承诺的80%，并在2047年之前一直保持在该比例之上；如果达不到，政府可以收回补贴。税收减免只是补贴项目之一。近2亿美元将用于收购土地，为开发和建设公路和铁路连接做好土地整备。还有9000万美元将用于员工培训，提升当地的技能水平。

其他州正在设计有类似结构的激励方案，通常综合了土地整备、基础设施、工人培训和税收减免。即使目标公司失败了，各州仍会从中获益。“它们能获得回报，因为这是对自己人民的投资，是对土地和基础设施的投资。很容易就能找到下一个使用者去吸收这些产能。”房地产经纪公司世邦魏理仕（CBRE）的选址专家埃里克·斯塔夫里奥蒂斯（Eric Stavriots）说。

尽管如此，联邦和州政府的补贴在总量上仍可能导致过剩。截至去年11月，已宣布的计划将使美国的电池产能从2021年的每年55吉瓦时提高到

2030年的约900吉瓦时。这将足以支持每年约1000万辆纯电动汽车的产量——超过目前美国每年汽车购买量的一半，这是一个巨大的数字，尤其是考虑到进口。此外，投资只会进一步增加。这意味着美国可能会走向电动汽车产能过剩。而考虑到这项技术还在发展初期，现在建造的工厂可能很快就会淘汰。“甚至在许多这类项目完工之前，一些不需要政府补贴的公司可能就已经有了突破。”乔纳斯说。

从整个国家的角度来看，这未必是一个糟糕的结果。在这一轮热潮开始之前，美国电动汽车和电池的产能严重不足。想到未来的汽车可能要依赖主要竞争对手中国，官员们感到不安。在如此关键的行业里，自己拥有制造实力要好得多，哪怕付出产能过剩的代价。

然而对于各个州来说，挑战在于如何避免后遗症。在传统的汽车市场，美国的制造中心享受了整整半个世纪的繁荣才开始慢慢衰退。和今天的许多其他产业一样，电动汽车的投资周期轮转可能要快得多。有些对着风口上的新项目大把撒钱的州在本个十年结束前会开始懊悔自己太过慷慨了。■



America's industrial policy

State subsidies fuel America's EV boom but risk overcapacity

Individually, states are acting sensibly. Collectively, risks are growing

AN HOUR EAST of Atlanta, turn off the interstate highway and drive into a postcard scene of rural Georgia—a road lined by tall pines, country homes and a cluster of churches—when suddenly a vast expanse of clear-cut land appears. Big yellow trucks are flattening the earth and large transmission lines run along its edge. What makes it especially attractive for an industrial investor cannot be seen: tax breaks, direct grants and other assistance that, all in, come to \$1.5bn. When Georgia announced this incentive package last May for Rivian, a California-based startup that makes electric trucks and SUVs, it was the biggest corporate subsidy given by the state. Not for long, though. In July it promised an even bigger package, worth \$1.8bn, to Hyundai, also for an electric-vehicle (EV) facility.

Subsidies in the EV industry are popping up across America. On February 13th Michigan approved incentives of more than \$1bn for a Ford battery factory. On February 8th Ohio's private development agency gave nearly \$240m to Honda. Last year brought \$1bn-plus deals for firms in Kansas, Michigan and North Carolina, adding to dozens of smaller dollops. Globally, concern is rife about America's rapid emergence as a competitive threat in the EV industry, thanks to the federal government's hefty investments and domestic-content rules. Within America the competition can feel even fiercer, as states battle with one another to lure investors. "But for the right incentive, the project would go elsewhere," says a spokesperson for the Georgia Department of Economic Development.

States are not neophytes at business handouts, but the current boom is remarkable for its scale and speed. In a report last year Good Jobs First,

a corporate-subsidies watchdog, tallied 51 state-level EV subsidy packages, which helped make for the biggest mega-subsidy spree in its records dating back to 1980. One state consultant estimates that, historically, incentives work out to \$5,000 per created job, but that the EV ones run to about \$30,000.

In part state governments have been emboldened by strong finances: covid-19 stimulus payments left most with chunky budget surpluses. They also have extra urgency because of the Inflation Reduction Act (IRA), the cornerstone of the Biden administration's new industrial-policy push, which will give billions of dollars in tax credits to both buyers and makers of EVs. The IRA expires in 2032, so companies have to move fast to take advantage of it. Adam Jonas, head of global auto research at Morgan Stanley, a bank, explains it with a fishing analogy: "The IRA stocks the lake full of trout. And now the states are there trying to attract the trout with chum."

Given the rush of subsidies, a looming question is how many will end up being wasted. Georgia's package for Rivian has shone a spotlight on the risks. Residents near its future plant site challenged the bonds that are needed to make the deal work, pointing to Rivian's record as a loss-making startup. "The government is basically investing in this company as a speculative investor," says John Christy, a lawyer for the opponents. The trial judge concurred and refused to validate the bonds. The government has appealed, with Rivian's plans hanging in the balance.

Yet a closer look at Georgia's package shows how states are trying to guard against waste. Tax credits are contingent on performance. In Rivian's case the firm has to meet at least 80% of its commitments to invest \$5bn and create 7,500 jobs by the end of 2028, and then stay at that threshold until 2047; if it slips, the state can claw back benefits. Tax breaks are also just one element. Nearly \$200m will go to acquiring the land, preparing it for development and building road and rail links. Another \$90m will go

towards training for employees, adding to the local skills base.

Other states are designing incentives with similar structures, typically featuring a mix of site preparation, infrastructure, worker training and tax breaks. Even if the target company fails, the states still stand to reap benefits. “They’ll get a return because they’re investing in their people. They’re investing in their land and infrastructure. And another user could quickly come along and absorb the capacity,” says Eric Stavriots, a site-selection specialist with CBRE, a property broker.

Still, there is a risk that, in aggregate, national and state subsidies will result in excesses. As of November, announced plans would increase America’s battery-making capacity from 55 gigawatt-hours a year in 2021 to about 900 by 2030. That would support the production of some 10m all-electric vehicles a year—more than half the cars now bought annually in America, a vast amount, especially when factoring in imports. Moreover, investments are only increasing. The implication is that America could be headed towards EV overcapacity. And given how young the technology is, plants being built now may soon be obsolete. “Even before the completion of many of these projects, you might have breakthroughs in companies that don’t need government money,” says Mr Jonas.

From a national perspective, that may not necessarily be a bad outcome. Before the boom began, America was facing a severe undercapacity in EVs and batteries. The prospect of reliance on China, its chief rival, for vehicles of the future alarmed officials. Far better to have manufacturing heft, even at the cost of overcapacity, in such a critical industry.

For individual states, however, the challenge will be how to avoid hangovers. In the traditional auto market America’s manufacturing hubs had a solid half-century of prosperity before decline slowly set in. The EV investment cycle, like much else these days, may go much faster. Some

of the states now throwing money at gleaming new projects will rue their largesse before the decade is over. ■



机器人都在哪?

暂时还不用担心AI会带来就业末日

西方的问题是自动化程度太低，而不是太高

“我认为人形机器人与人类的比例可能会超过一比一。”马斯克在3月1日宣称。特斯拉这位自封的电音之王所言与其说是预测，不如说是承诺。马斯克的汽车公司正在开发一款代号为Optimus的AI人形机器人，供家庭和工厂使用。他在特斯拉投资者日那天发表了这番言论，同时还播放了一段Optimus独立行走的视频。

至于如何或何时能从一段宣传片发展到超80亿之众的机器人大军，马斯克并没有多加说明，所以这话听起来可能和科幻小说无异。但他已经介入了有关工作的未来的非常现实的辩论。因为某些形式的AI驱动的自动化正在迅速成为科学事实。

自去年11月以来，AI对话系统ChatGPT以其近乎以假乱真的聊天能力受到用户热捧。其他“生成式”AI通过分析互联网上的大量数据，也在生成类似的仿佛出自人类之手的文本、图像和声音。上个月，计算巨头IBM的老板预测，AI将取代大量白领文员工作。3月6日，微软宣布推出一整套AI“副驾驶”(co-pilot)，可以辅助从销售和营销到供应链管理等一系列工作。容易激动的观察人士开始絮叨工作的末日要来了。

对技术取代工作的担忧当然毫不新鲜。在19世纪初的英国，卢德分子放火焚烧工厂的机器。20世纪50年代，对二战期间的机械化创新的采用引发了一轮对大规模失业的恐慌，“自动化”一词首次受到关注（见图表1）。1978年，面对那个时代的突破性技术微处理器，英国首相詹姆斯·卡拉汉（James Callaghan）的反应是让政府开展调查，研究该技术消灭就业的潜力。十年前，牛津大学的卡尔·弗雷（Carl Frey）和迈克尔·奥斯本（Michael Osborne）发表了一篇轰动一时的论文，称美国工人所做的工作有47%可以在“未来十年或二十年内”实现自动化，该论文到目前为止已

被引用5000多次。如今，即使是技术乐观主义者马斯克也想知道机器人数量超过人类意味着什么：“甚至不清楚到那时的经济会是什么样。”

虽说要证实弗雷和奥斯本的观点还要几年时间，马斯克的说法也大可暂时忽略，但更早之前对科技会扼杀工作的担忧从未变成过现实。相反，发达国家的劳动力市场历来吃紧，而且随着社会不断老龄化还日益呈现结构性紧张的态势。目前，每个失业的美国人对应着两个职位空缺，创历史新高。美国的制造业和接待业分别报称有50万和80万个用工缺口（职位空缺数与失业前就职于该行业的失业者人数之差）。

因此，发达经济体眼前的问题不是自动化程度太高，而是太低。这个问题还因为一个因素而加剧：大型企业在实践中往往难以把自动化这桩事办好。而在应用眼下火爆的AI时事情也不太可能变得容易些。

在工厂车间执行焊接、钻孔或移动物体等重复性任务的机械臂已经存在了几十年。一直以来，机器臂的应用集中在汽车行业，这是因为汽车零件重量高、批量大、且种类有限，非常适合利用机械臂完成任务。需要精准的重复性操作的电子行业也很早开始应用机械臂。

美国行业组织推进自动化协会（Association for Advancing Automation）的主席杰夫·伯恩斯坦（Jeff Burnstein）指出，近年来采用机器人的行业有所增加。瑞士工业公司ABB的机器人业务负责人萨米·阿提亚（Sami Atiya）指出，计算机视觉的进步让机器人的灵巧度大增。轻型“协作机器人”不再像以前那样要被围在限定区域内，而是与人类工人并肩工作，自动驾驶汽车在工厂和仓库运送货物。

与此同时，机器人的价格已经大大降低。据资产管理公司Ark Invest估计，2005年工业机器人的平均价格为6.9万美元，2017年降至2.7万美元。去年12月，ABB在上海开设了一个6.7万平方米的“超级工厂”，由机器人生产机器人。安装成本也已下降，因为新的“无代码”系统不需要工作人员掌握编程技能，另一个行业机构国际机器人联合会（IFR）的秘书长苏珊娜·比勒（Susanne Bieller）指出。

由于技术升级、价格降低，全球工业机器人存量从2011年的100万台增加到2021年的近350万台（见图表2）。日本大型机器人制造商发那科

（Fanuc）的销售额上一季度同比增长17%；为全球工厂提供自动化顾问服务的日本公司基恩士（Keyence）的销售额飙升了24%。2021年企业高管努力寻求替代因疫情而无法工作的人力，造成了机器人销售的一个短暂高峰，虽然现在机器人的销售额较当时已有所下降，但机器人制造商的股价仍比疫情前高出五分之一（见图表3）。

尽管增长很快，但机器人采用率的绝对水平仍然很低，在西方尤其如此。IFR的数据显示，即使在采用机器人的积极程度上遥遥领先全球的韩国公司，工业机器人和工人之比也只有1比10——与马斯克的愿景相去甚远。在美国、中国、欧洲和日本，这个比例是1比25至40之间。波士顿咨询公司的顾问称，2020年全球工业机器人支出为250亿美元，不到全球资本支出（不包括能源和采矿业）的1%。人们在情趣玩具上花的钱都比这多。

德国工业巨头西门子的工厂自动化部门负责人莱纳·布雷姆（Rainer Brehm）表示，工业设备寿命较长，限制了更智能的新设备取代智能水平较低的旧设备的速度。而且在发达经济体中，现在大多数琐碎乏味的工作都在服务业中，而这方面的体力活更难实现自动化（见图表4）。人体的关节和手指可以在244个运动平面上活动，自由灵巧，堪称奇迹。而一般机器人只有六个这样的“自由度”，工业机械臂制造商优傲（Universal Robots）的首席执行官金姆·波夫森（Kim Povlsen）指出。

办公室工作的自动化进程同样停滞不前，原因和旧系统限制和企业惰性类似。从理论上讲，数字化应该可以在订购库存、向供应商付款或做账等日常例行任务中取代大部分人工操作。

研究公司高德纳（Gartner）的凯茜·托恩博姆（Cathy Tornbohm）指出，实际上，大多数在数字时代之前成立的企业用的都是一堆过时又不兼容的系统。许多公司舍不得花大价钱请IT顾问来理顺系统，宁愿将琐碎的后台工作外包给印度或菲律宾等低成本国家。另一家研究公司IDC估计，将单调乏味的办公室工作自动化的软件市场规模为每年200亿美元，比在各种

实体机器人上的支出还要少。

假以时日，进一步的创新应该会移除其中一些障碍。在热衷使用机器人的韩国，实体机器人的应用进展顺利。韩国最大的机器人制造商之一斗山机器人公司（Doosan Robotics）已向外部开发人员开放软件，来为其机器人创建预编程应用。该公司的机器人现在被用于各行各业，从制作咖啡到在建筑工地上铺设地板等。炸鸡外卖店Robert Chicken使用机械臂操作炸锅，为了降低加盟商的前期投资，该公司以每月900美元左右的价格向他们出租机器人，成本大大低于一名人工操作员。韩国互联网巨头Naver有一个开发机器人的部门，其运输机器人可以穿行于繁忙复杂的环境中，已有大量这样的机器人开始为其员工递送午餐盒和包裹。

办公流程自动化也在变得更精妙。UiPath是将简单机械的任务（比如把信息从一个程序复制粘贴到另一个程序）自动化方面的先驱，该公司现在也提供其他工具，用图像识别算法从文档中提取数据，或者通过观察员工在计算机上的操作来绘制业务流程。UiPath的联席CEO罗伯·恩斯林（Rob Enslin）表示，公司已经为一万名客户提供服务。微软的一款工具Power Automate能让没有编程经验的普通办公室职员把费用或差旅审批等工作自动化。这款工具现在有700万月活用户，负责微软众多自动化产品的查尔斯·拉曼纳（Charles Lamanna）说。

一些企业也开始尝试使用生成式AI。然而，与机器人和流程自动化一样，这项新技术的应用也不会一蹴而就。安理国际律师事务所（Allen & Overy）在2月推出了类似ChatGPT的虚拟法律助理，但要求其律师核对它生成的所有内容。科技新闻网站CNET从去年11月开始悄悄发布了73篇由机器人撰写的文章，先是让新闻工作者感到惊愕，在发现这些文章错误百出之后，又让他们喜不自禁。

拉曼纳认为，支撑聊天机器人的底层AI技术有一天可能会成为自动化的福音。但从科幻小说变成科学事实是一回事，而从科学事实变成经济现实又是另一回事了。■



Where are all the robots?

Don't fear an AI-induced jobs apocalypse just yet

The West suffers from too little automation, not too much

"I THINK WE might exceed a one-to-one ratio of humanoid robots to humans," Elon Musk declared on March 1st. Coming from the self-styled technoking of Tesla, it was not so much a prediction as a promise. Mr Musk's car company is developing one such artificially intelligent automaton, codenamed Optimus, for use at home and in the factory. His remarks, made during Tesla's investor day, were accompanied by a video of Optimus walking around apparently unassisted.

Given that Mr Musk did not elaborate how—or when—you get from a promotional clip to an army of more than 8bn robots, this might all smack of science-fiction. But he has waded into a very real debate about the future of work. For certain forms of AI-enabled automation are fast becoming science fact.

Since November ChatGPT, an AI conversationalist, has dazzled users with its passable impression of a human interlocutor. Other "generative" AIs have been conjuring up similarly human-like texts, images and sounds by analysing reams of data on the internet. Last month the boss of IBM, a computing giant, forecast that AI will do away with much white-collar clerical work. On March 6th Microsoft announced the launch of a suite of AI "co-pilots" for workers in jobs ranging from sales and marketing to supply-chain management. Excitable observers murmur about a looming job apocalypse.

Fears over the job-displacing effects of technology are, of course, nothing new. In early 19th-century Britain, the Luddites burned factory machines.

The term “automation” first rose to prominence as the adoption of wartime innovations in mechanisation sparked a wave of panic over mass joblessness in the 1950s (see chart 1). In 1978 James Callaghan, Britain’s prime minister, greeted the breakthrough technology of his era—the microprocessor—with a government inquiry into its job-killing potential. Ten years ago Carl Frey and Michael Osborne of Oxford University published a blockbuster paper, since cited over 5,000 times, claiming that 47% of the tasks American workers perform could be automated away “over the next decade or two”. Now even the techno-optimistic Mr Musk wonders what it would mean for robots to outnumber humans: “It’s not even clear what an economy is at that point.”

Although Messrs Frey and Osborne still have a few years to be proved right, and Mr Musk can be safely ignored for the time being, the earlier fears about job-killing technology never materialised. On the contrary, labour markets across the rich world are historically tight—and getting structurally tighter as societies age. There are currently two vacancies for every unemployed American, the highest rate on record. America’s manufacturing and hospitality sectors report labour shortages of 500,000 and 800,000 respectively (as measured by the gap between job openings and unemployed workers whose last job was in the sector in question).

The immediate problem for advanced economies is, then, not too much automation but too little. It is exacerbated by the fact that, for large businesses, automating tends to be difficult to get right in practice. And it is likely to prove no easier with the latest buzzy AIs.

Mechanical arms on a factory floor performing repetitive tasks such as welding, drilling or moving an object have been around for decades. Robot usage historically centred on the car industry, whose heavy parts and large batches with limited variety are ideally suited to the machines. The electronics industry, with its need for precise but repetitive movements,

was also an early adopter.

More recently the list of industries which are embracing robots has lengthened, observes Jeff Burnstein, president of the Association for Advancing Automation, an American industry group. Advances in computer vision have made machines much more dexterous, points out Sami Atiya, who runs the robotics business of ABB, a Swiss industrial firm. Lightweight “collaborative robots” now work side-by-side with human workers rather than being caged off, and autonomous vehicles ferry objects from one place to another in factories and warehouses.

At the same time, robot prices have tumbled. The average price of an industrial robot fell from \$69,000 in 2005 to \$27,000 in 2017, reckons Ark Invest, an asset manager. In December ABB opened a 67,000-square-metre “mega factory” in Shanghai where robots make other robots. Installation costs have come down, too, with new “no code” systems requiring no programming skills, notes Susanne Bieller, general secretary of the International Federation of Robotics (IFR), another industry body.

As a consequence of better technology and lower prices, the global stock of industrial robots grew from 1m in 2011 to nearly 3.5m in 2021 (see chart 2). Sales at Fanuc, a large Japanese robot-maker, rose by 17% last quarter, year on year; those of Keyence, a Japanese company that acts as an automation consultant to the world’s factories, shot up by 24%. Although they are down from the frothy peaks of 2021, when chief executives sought alternatives to human workforces incapacitated by covid-19, robot-makers’ share prices remain a fifth higher than before the pandemic (see chart 3).

For all that growth, however, absolute levels of adoption remain low, especially in the West. According to the IFR, even South Korean firms, by far the world’s keenest robot-adopters, employ ten manufacturing workers for every industrial robot—a long way from Mr Musk’s vision. In America,

China, Europe and Japan the figure is 25-40 to one. The \$25bn that, according to consultants at BCG, the world spent on industrial robots in 2020 was less than 1% of global capital expenditure (excluding the energy and mining sectors). People spent more on sex toys.

The long lifetimes of industrial equipment limit how quickly older, dumber machines can be replaced with cleverer new ones, observes Rainer Brehm, who runs the factory-automation unit of Siemens, a German industrial giant. And most menial jobs in advanced economies these days are anyway in the services industries, where physical tasks are harder to automate (see chart 4). The human body, with its joints and digits affording 244 planes of motion, is a marvel of versatility. A typical robot has six such “degrees of freedom”, notes Kim Povlsen, chief executive of Universal Robots, a manufacturer of industrial robot arms.

The automation of office work has been similarly halting, for similar reasons of legacy systems and corporate inertia. In theory, digitisation should make it possible to remove most human involvement from routine tasks like ordering inventory, paying suppliers or totting up accounts.

In practice, most businesses born before the digital era use a tangle of outdated and incompatible systems, notes Cathy Tornbohm of Gartner, a research firm. Rather than shell out on IT consultants to come and untangle the thicket, many firms prefer to outsource the menial office work to low-cost countries like India or the Philippines. IDC, another research firm, puts the market for software that automates unrewarding office tedium at \$20bn a year, even less than is being spent on robots of the physical variety.

In time, further innovation is likely to remove some of those obstacles. For physical robots, this is well under way in machine-mad South Korea. Doosan Robotics, one of the country’s biggest robot-makers, has opened up its software to outside developers to create pre-programmed applications

for its robots. These are now used for everything from making coffee to laying flooring on construction sites. Robert Chicken uses robotic arms to operate its deep fryers at its fast-food restaurants; to keep upfront investment for franchisees down, the company rents the robots out to them for around \$900 a month, substantially less than the cost of a human operator. Naver, a South Korean internet giant, has a unit developing robot vehicles that can navigate busy environments with complicated layouts: an army of such bots already whizzes around delivering lunch boxes and parcels to its workers.

Office-process automation is also becoming more sophisticated. UiPath, a pioneer in automating mindless tasks such as copying and pasting information from one program to another, now offers other tools that extract data from paperwork using image-recognition algorithms or that map business processes by observing what workers do on their computers. Rob Enslin, UiPath's co-CEO, says the company already serves 10,000 clients. Power Automate, a tool from Microsoft that allows regular desk jockeys with little programming experience to automate tasks, such as expense or travel approvals, now has 7m monthly active users, says Charles Lamanna, who is responsible for many of the software giant's automation products.

Some businesses are tentatively beginning to embrace generative AI, too. However, as with robots and process automation, bedding in the new technology will not happen overnight. Allen & Overy, a law firm that in February launched a virtual legal assistant with ChatGPT-like powers, requires its lawyers to cross-check everything the bot spits out. CNET, a tech-news site, starting in November quietly published 73 articles written by a bot, first to the consternation and then the delight of journalists, after the articles were found to be riddled with errors.

The AI technology that underpins chatbots could one day be a boon for

automation, reckons Mr Lamanna. But getting from science fiction to science fact is one thing. Getting from there to economic fact is quite another. ■



经济学人视频

假货行业为何蒸蒸日上 - 预告

大品牌该感到担忧吗？



The Economist Film

Why the counterfeit business is booming - trailer

Should the big brands be worried?



先天与后天

彼得·弗兰科潘在《地球变形记》中以不同的视角看待过去

环境如何塑造历史——历史又如何塑造环境【《地球变形记》书评】

《地球变形记》，彼得·弗兰科潘著。克诺夫出版社；736页；40美元。布鲁姆斯伯里出版社；30英镑。

伏尔泰在18世纪中期写道，三样东西对人影响最大：气候、政府和宗教。他把气候放在首位，走在了时代的前面。彼得·弗兰科潘（Peter Frankopan）以伏尔泰的论述作为他新书的开场白，接着展示了各种自然灾害是如何塑造人类历史的：不仅有洪水和风暴，还有地震、火山爆发和陨石撞击。

伏尔泰对1755年发生在里斯本的地震十分感兴趣，并把它写进了自己的哲理小说《老实人》。那场地震发生在11月1日诸圣节，当时大部分当地人正在做弥撒。紧接着是滔天海啸。葡萄牙首都很快变成一片废墟。据信数万人在这场灾难中丧生，该市人口消失了一大部分。

这场地震和随之而来的动荡集中展现了自然灾害如何能改变人们的观念。当时，科学观察的风潮开始动摇教会在解释地球生命方面的特权。人们为这场灾难的意义争论不休，一派是伏尔泰等有现代思想的理性主义者，另一派是宗教信徒，他们认为这是上帝震怒的征兆。

在牛津大学教授全球史的弗兰科潘一直热切地要拓展西方人对过去的理解。他在2015年出版的《丝绸之路》（The Silk Roads）是关于中亚和早期全球化的；三年后，《新丝绸之路》（The New Silk Roads）问世，副标题中规中矩：“世界的现在和未来”。如果说他最近的新书有什么不同的话，那就是野心更大了。与基于战争、经济和政治权力（有些人称之为“人与地图”）的历史研究不同，《地球变形记》致力于把最广泛意义上的气候置于故事的中心。

本书先是简略地回顾了地球的形成过程，包括陆地板块漂移和火山岛的形成。然后它开始聚焦于人类怎样“出于或好或坏的意愿来开发、塑造和扭曲环境”，这始于1.2万年前的全新世初期，当时条件适宜，人类开始散布到全球各地。

弗兰科潘以他特有的轻快风格，大致按时间顺序回溯了冰河期和温暖期是如何交替的；全球资源是如何被开发的；气候如何影响了粮食生产和城市的兴起；城市化继而又如何加快了疾病的传播；以及在过去几十年里，人们对地球生态的焦虑又如何深深扎根。换言之，他既展示了气候怎样塑造现代生活，也解释了气候如何越来越多地界定世界经济和政治纷争。

这并不是一个新领域。法国历史学家费尔南·布罗代尔（Fernand Braudel）在近75年前发表的关于地中海的研究中就将地理和环境视为历史的基石。然而，《地球变形记》提出了新颖而紧迫的问题。哪些国家会在未来主导世界？有水资源会比有矿产资源更重要吗？如果印度、巴基斯坦和孟加拉国不能友好合作，它们又如何能净化令其国民窒息的肮脏空气呢？

作者并没有声称自己能预见未来。重要的是，他的著述将鼓励读者以不同的思路思考过去。他强调了计算机建模和数据分析的新方式，它们正在照亮人们知之甚少的领域——例如，红外光谱让研究人员能够弄清楚12世纪南部非洲沙什河和林波波河之间地区的社会变化；近年还确定了在阿巴斯哈里发统治时期，在耶路撒冷的泥坑洼地里保存种子的过程。这为伊斯兰时代早期农作物向西传播提供了新的证据。

一些已消逝的人和社会此前似乎是沉默的，这些研究方法让他们发出了声音。同样地，要求承认那些在过去改变了气候的罪责的压力——以及对于在今天制定出更好政策的要求——都变得越来越难以抗拒。■



Nature and nurture

Peter Frankopan looks at the past differently in “The Earth Transformed”

How the environment shapes history—and vice versa

The Earth Transformed. By Peter Frankopan. Knopf; 736 pages; \$40. Bloomsbury; £30

PEOPLE ARE exercised by three things above all else, wrote Voltaire in the mid-18th century: climate, government and religion. He was ahead of his time in putting climate first. Peter Frankopan opens his new book with Voltaire’s comment and proceeds to show how all manner of natural disasters have shaped human history: not just floods and storms, but earthquakes, volcanic eruptions and crashing meteorites, too.

Voltaire was fascinated by the earthquake that struck Lisbon in 1755, which he incorporated into his philosophical novel “Candide”. Tremors began on the morning of November 1st, All Saints Day, when most of the locals were at mass. A huge tsunami followed. Soon the Portuguese capital lay in ruins. Tens of thousands of people are thought to have died, a big chunk of the city’s population.

The earthquake and ensuing upheaval epitomise the way natural disasters can change mindsets. It struck as the vogue for scientific observation was beginning to undermine the church’s prerogative in explaining life on Earth. The meaning of the calamity was a matter of dispute between, on one side, modernising rationalists such as Voltaire and, on the other, believers, for whom it was a sign of God’s wrath.

Professor Frankopan, who teaches global history at Oxford, has long been keen to expand Westerners’ understanding of the past. “The Silk Roads”,

his book of 2015, was about Central Asia and early globalisation; it was followed three years later by “The New Silk Roads”, modestly subtitled: “The Present and Future of the World”. His latest book is, if anything, even more ambitious. In contrast to the study of history based on war, economics and political power (what some call “chaps and maps”), “The Earth Transformed” aims to put climate in its broadest sense at the centre of the story.

It canters through the formation of the Earth, with its shifting land masses and pop-up volcanic islands. Then it focuses on how humanity has “exploited, moulded and bent the environment to its will, both for good and for ill”, beginning 12,000 years ago at the start of the Holocene period, when humans spread across the globe amid favourable conditions.

In roughly chronological order, and in his characteristically pacey style, Professor Frankopan traces how ice ages alternated with warmer periods; how resources came to be exploited around the globe; how climate influenced food production and the rise of cities; how, in turn, urbanisation promoted the spread of disease; and how, over the past few decades, anxiety about the Earth’s ecology has become entrenched. He shows, in other words, both how the climate shaped modern life and how it increasingly defines the world’s economic and political tensions.

This is not a new field. In his study of the Mediterranean, published almost 75 years ago, Fernand Braudel, a French historian, identified geography and the environment as the bedrock layers of history. Still, “The Earth Transformed” raises fresh and urgent questions. Which will be the dominant countries of the future? Will access to water be more important than access to mineral resources? How can India, Pakistan and Bangladesh clean up the filthy air that chokes their citizens if they fail to co-operate amicably?

The author does not claim to be able to see into the future. Above all, his

work will encourage readers to think differently about the past. He highlights new forms of computer modelling and data analysis that are shedding light on little-known areas—*infrared spectroscopy* that has allowed researchers to study social change in the 12th century in the area between the Shashi and Limpopo rivers of southern Africa, for example, or the recent identification of the process whereby seeds were preserved in the pits and cesspits of Jerusalem under the Abbasid caliphate. That has offered fresh evidence about the westward spread of crops in the early Islamic period.

In these ways, bygone people and societies that had seemed mute are finding a voice. By the same token, pressure to acknowledge climate-changing sins of the past—and demands for better policies now—are becoming harder to resist. ■



期限风险

搜寻硅谷银行式的投资组合

日本投资机构同样依赖长期债券

硅谷银行倒闭的原因很多。但罪魁祸首是该机构的债券组合，其价值随着加息而急跌。难怪分析师和投资者正争相探寻别处是否有类似的情况。其中一个令人不安的发现是在日本。那里的投资机构已经积累了大量本国及外国的长期债券。

由于债券抛售以及随加息而重新估价（这种可能性被称为“期限风险”），上述机构持有的这些债券价值已经大跌。包括保险公司、投资机构和养老基金在内的“其他金融机构”持有的长期外国债券在6月价值1.5万亿美元（这是现有的最新数据），比2021年底低了约2930亿美元。

日本投资公司农林中央金库就持有这类债券。该公司一直是抵押贷款债务（即以单一产品担保的捆绑贷款）的大买家。它所持有的债券组合价值受加息影响而下跌，从去年3月的36万亿日元（2930亿美元）降至12月的28万亿日元。另一家面临风险的机构是日本邮政银行，这是一家储蓄银行，近三分之一的股份由日本政府持有。在它持有的证券中，外国证券已从2007年的基本为零上升到35%。

这些机构的客户很可能最终不会像硅谷银行的客户那么杯弓蛇影。硅谷这番抛售潮是由恐慌的风险投资家引发的。日本邮政银行在全国拥有庞大的个人储户，据称约有1.2亿个账户。农林中央金库的客户大多是农业合作社，似乎也不太会像一惊一乍的科技业客户那么容易出逃。

但还有货币波动的风险。正如智库外交关系委员会（Council on Foreign Relations）的布拉德·塞瑟（Brad Setser）所指出的，美国加息令对冲货币风险的成本大大增加。投资者以及之前向他们出售债券的公司和政府都面临这个问题。去年，日本投资者卖出的外国长期债券比购入的高出1650亿美元，是日本史上最大规模的抛售。加息导致全球大片地区的债券发行机

构的贷款成本上升。以往的可靠买家消失更是雪上加霜。

而且，大量持有外国金融资产只是风险的一个因素。自1990年代初日本发生臭名昭著的房地产和股票泡沫破灭后，日本的利率按全球标准衡量一直处于谷底。三十年的相对经济停滞和不时出现的通缩意味着债券收益率非常低，促使金融机构为谋求略高一些的回报而转向以日元计价的长期债券。如此一来，货币政策即使稍微紧缩，可能造成的损害也会加大。

但是日本能否继续维持低利率越发是个未知数。消费者价格通胀在1月升至4.3%；大企业的工资看起来势必将以几十年来的最快速度上涨。加息一个百分点将导致银行的日元计价债券价值减少超过九万亿日元。大银行的未变现亏损将占其资本的10%左右。信用金库（各类信用合作机构）的损失将更高，约为30%。

去年，日本央行公布的分析表明，债务的价值变动会抵消这些损失。相比银行对新发贷款收取的利息，它们向储户支付的利息的涨速往往慢得多，从而缓解了压力。这项分析显示，对地区性银行而言，这两股力量几乎会完全相互抵消。但日本央行这些计算是假设储户高度忠诚而得来的。银行投资组合价值会随加息下跌是肯定的；至于储户粘性，近来并没有测试过。

日本央行坚称目前仍看不到加息的前景。但最近日本的通胀压力和世界其他地区通胀上升意味着越来越难以坚守这条路线。仅仅是有可能加息就已经在影响外国债券的持有量，因为投资者在抛售资产。而随着日本的金融机构从债券买家转为卖家，全球的企业及政府债券发行者正在最需要支持之时失去曾经的可靠主顾。 ■



Duration dangers

The search for Silicon Valley Bank-style portfolios

Japanese investment outfits are similarly reliant on long-term bonds

THE DEMISE of Silicon Valley Bank had many causes. But at its heart was the institution's bond portfolio, which plummeted in value as interest rates rose. Little surprise, then, that analysts and investors are scrambling to locate similar hoards elsewhere. One disconcerting finding lies in Japan. Investment institutions there have accumulated vast stocks of domestic and foreign long-maturity bonds.

These bond holdings have already slumped in value, thanks to a combination of sales and the revaluation that occurs when rates rise—the potential for which is known as “duration risk”. Long-term foreign-bond holdings by “other financial corporations”, a category which includes insurance firms, investment outfits and pension funds, ran to \$1.5trn in June, the most recent figure available, some \$293bn below their level at the end of 2021.

Norinchukin Bank, a Japanese investment firm, is one holder of such bonds. The company has been a mammoth buyer of collateralised-loan obligations, bundles of loans secured in a single product. The value of its bond portfolio has been clipped by rising rates, from ¥36trn (\$293bn) in March last year to ¥28trn in December. Japan Post Bank, a savings bank, of which the Japanese government owns almost a third, is another exposed institution. Foreign securities have risen from essentially zero in 2007 to 35% of the firm's total holdings.

These institutions' customers are likely to prove less flighty than SVB's. In Silicon Valley the run was led by panicked venture capitalists. Japan Post

Bank has an army of individual depositors across the country, boasting around 120m accounts. Norinchukin Bank's clients, which are mostly agricultural co-operatives, also seem less likely to flee than excitable tech types.

But there is a risk from currency movements. As Brad Setser of the Council on Foreign Relations, a think-tank, has noted, the rise in American interest rates has made hedging against currency risk far more expensive. This is true for both investors and the companies and governments from which they once bought bonds. Japanese investors sold \$165bn more in foreign long-term bonds than they bought last year, the largest disposal on record. Rising rates have left bond issuers across huge swathes of the world paying more to borrow. The disappearance of previously reliable buyers only adds to the pain.

And enormous holdings of foreign financial assets are just one element of the risk. Japanese interest rates have been at rock-bottom levels by global standards since the early 1990s, after the country's infamous land and stock bubble burst. Three decades of relative economic stagnation and occasional deflation have meant very low bond yields, which have driven financial institutions to long-term yen-denominated bonds for modestly higher returns. This increases the amount of damage even slightly tighter monetary policy might do.

But it is increasingly unclear whether Japan will actually be able to maintain its low-rate approach. Consumer-price inflation rose to 4.3% in January; wages at large firms look set to rise at their fastest pace in decades. A one-percentage-point rate rise would knock more than ¥9trn off the value of banks' yen-denominated bonds. Unrealised losses at big banks would be equivalent to around 10% of their capital. Those at shinkin banks, types of credit union, would be higher still at around 30%.

Last year the Bank of Japan (BoJ) published analysis suggesting these losses would be offset by the changing value of liabilities. The interest rates banks offer to depositors tend to rise far more slowly than those they charge on new loans, relieving pressure. For regional banks, the analysis suggested, the two forces would almost entirely offset one another. But the central bank's calculations depend on assumptions about the loyalty of depositors. The slump in the value of banks' portfolios from higher rates is certain; the stickiness of depositors has not been tested recently.

The BoJ insists there is still no prospect of rate rises. But recent inflationary pressure and rises in the rest of the world mean this line is getting harder to hold. The mere possibility of an increase is already having an impact on foreign-bond holdings, as investors dispose of assets. And as Japanese institutions shift from buyers to sellers, global corporate and government bond-issuers are losing once-reliable customers, just when they require them most. ■



梧桐

硅谷银行破产预示市场进入痛苦的新阶段

美联储的紧缩政策开始发威

有句老话说，要平息通胀，央行官员就必须收紧货币政策，直到哪里崩溃为止。在过去一年的大部分时间里，人们很容易把这陈词滥调抛在脑后。从2022年3月开始，美联储以1980年代以来最快的速度加息。就算在市场暴跌之时，世界金融体系依然安然无恙。去年9月英国养老基金摇摇欲坠，英国央行迅速出手助其企稳。前加密货币交易所FTX的崩盘备受瞩目，但远离主流市场，而且按监管机构的说法是因为欺诈而非美联储的决策造成的。

现在，真的有地方崩溃了。3月10日，美国中型贷款机构硅谷银行宣告破产，给市场造成连串冲击波。最明显的影响是其他银行股大跌，因为投资者担心这些银行存在类似的问题。纳斯达克的银行股指数在一周内下跌四分之一，抹去了之前25年的涨幅。美国地区性贷款机构的股票受到的冲击更大得多。随后，震荡蔓延全球：欧洲银行瑞信（Credit Suisse）的股票在3月15日急跌。金融市场进入新阶段，开始感受到美联储紧缩周期的威力。

这个阶段的一个特点是，市场突然顺应美联储，而非与之对抗。一年多来，美联储官员一直在重复传达同样的信息：事实证明通胀比预期更顽固，意味着未来加息幅度需要比之前预测的更高。3月14日发布的数据显示基本消费价格涨速再次超过预期，更是为这一信息提供了支撑。

政策制定者希望收紧贷款标准、利息成本或货币市场流动性等金融条件，从而减少总需求并冷却价格涨势。但自去年10月以来市场一直在做反方向拉动。数据供应商彭博编制的指数显示金融环境稳步变宽松。过去一周，所有这些放宽趋势都被逆转。市场被硅谷银行倒闭震惊，自行发挥起美联储的作用。

这并不意味着投资者已经不再和美联储对着干。他们仍押注美联储会很快降息，尽管官员们毫无此类暗示。不过战场已经转移了。今年早前，降息预期是源自希望通胀下降速度会超过美联储的预期。现在，降息预期是恐惧情绪的反映。3月13日，两年期美国国债收益率下降了0.61个百分点，是40多年来的最大单日跌幅。3月15日的恐慌性交易令人担心市场失灵。眼看已有银行倒闭，投资者押注美联储将会降息，原因不是通胀怪兽已被驯服，而是为避免再把哪里搞崩溃。

结合其他市场的反应来看，这显示了一定程度的认知失调。股市指数大范围下跌，但并非暴跌。美国大型公司的标普500指数与年初水平持平。出现危机时，投资者趋向避险，美元往往因而走强，而这次却略微走低。一方面，投资者认为美联储对银行倒闭的担忧足以令其开始降息。另一方面，投资者自己对银行倒闭连带后果的担忧还没有严重到冲击定价。

在这种自相矛盾的背后，是人们认为美联储的通胀目标与其保护金融稳定的责任之间存在冲突。硅谷银行倒闭源于固定利率债券（其价值随利率上升而下降）的损失，看似就是对这一点的印证。这种观点认为，既然稳定银行系统的重要性甚至超过抗通胀，那美联储就不敢再加息。这降低了经济衰退的风险，提振了股市，减少了对美元等避险资产的需求。

别那么肯定。在硅谷银行倒闭后，美联储承诺为其他银行提供支持——以价值仅为贷款价值三分之二的证券为抵押发放贷款。无论利率升到多高，这应该都能防止任何略有偿付能力的机构倒闭。这样的出手大方伴随着一个令人不安的事实。为压制通胀，美联储需要让贷款机构紧张起来，提高贷款成本，使企业注意规避风险。让硅谷银行这类莽撞不顾后果的银行破产并不是什么悲惨的事故，这是美联储职责的一部分。■



Buttonwood

For markets Silicon Valley Bank's demise signals a painful new phase

The Fed's tightening is starting to bite

TO QUELL INFLATION, goes the adage, central bankers must tighten monetary policy until something breaks. For much of the past year this cliché has been easy to dismiss. Starting in March 2022, America's Federal Reserve has raised rates at the fastest clip since the 1980s. Even as markets plunged, the world's financial system stayed wreckage-free. When British pension funds wobbled in September, the Bank of England swiftly helped right them. The most notable collapse—that of FTX, a disgraced former crypto exchange—was well outside the mainstream and, regulators say, caused by fraud rather than the Fed.

Now something has broken. The failure of Silicon Valley Bank (SVB), a mid-tier American lender that went bust on March 10th, sent shock waves through markets. Most noticeable were convulsions in the stocks of other banks, which investors worried may have similar vulnerabilities. Nasdaq's index of bank stocks dropped by a quarter in the course of a week, erasing gains from the preceding 25 years. Shares in American regional lenders were bludgeoned much harder. Then the turmoil went global: shares in Credit Suisse, a European bank, cratered on March 15th. Financial markets have entered a new phase, in which the Fed's tightening cycle starts to bite.

One feature of this phase is that markets are suddenly working with the Fed rather than against it. For more than a year, the central bank's officials have been repeating the same message: that inflation is proving more stubborn than expected, meaning interest rates will need to rise higher than previously predicted. This message was reinforced by data released on March 14th showing that underlying consumer prices had once again risen

faster than expected.

Policymakers want to tighten financial conditions—such as lending standards, interest costs or money-market liquidity—in order to reduce aggregate demand and cool price rises. Since October, markets have been pulling in the other direction. A gauge of financial conditions compiled by Bloomberg, a data provider, has shown them steadily loosening. Over the past week, all this loosening has been reversed. SVB's collapse has shocked markets into doing the Fed's job.

That does not mean investors have given up fighting the Fed. They are still betting it will soon start cutting rates, even though officials have given no such indication. The battleground has nevertheless shifted. Earlier this year, expectations of rate cuts sprang from hopes inflation would fall faster than the Fed expected. Now they reflect fear. On March 13th the two-year Treasury yield fell by 0.61 percentage points, the biggest one-day drop in more than 40 years. Panicked trading on March 15th prompted worries of the market seizing up. Given that some banks have failed, investors are betting that the Fed will cut rates not because the inflation monster is tamed, but in order to avoid breaking anything else.

Taken in conjunction with the reaction in other markets, this suggests a degree of cognitive dissonance. Broader stockmarket indices fell, but not precipitously. The S&P 500 index of large American firms is level with its position at the start of the year. The dollar, which tends to strengthen in crises as investors flock to safety, weakened a little. On the one hand, investors think the Fed should fear bank failures enough to start cutting rates. On the other, they do not themselves fear the fallout of such a failure enough to reflect it in prices.

Lying behind this contradiction is supposed tension between the Fed's inflation target and its duty to protect financial stability. The failure of SVB,

which was rooted in losses from fixed-rate bonds (the value of which fell as rates rose), looks like evidence for this. Since even the fight against inflation pales in importance next to the stability of the banking system, goes the argument, the Fed cannot afford to raise rates any higher. This lowers the risk of recession, gives a boost to stocks and reduces the need for haven assets like the dollar.

Do not be so sure. Following SVB's collapse, the Fed has promised to backstop other banks. Its support—lending against securities worth as little as two-thirds of the loan value—should prevent any remotely solvent institution from going under wherever interest rates end up. Alongside this generosity lies an uncomfortable truth. To squeeze inflation out of the economy, the Fed needs to make lenders nervous, loans expensive and businesses risk-averse. Allowing reckless banks such as SVB to fail is not a tragic accident. It is part of the Fed's job. ■



【首文】速度过快，无法着陆

顽强的经济加大抗通胀难度

加息还不足以减缓全球增长

你也许以为，全球货币政策40年来最快速的一轮收紧会给世界经济带来沉重打击。然而在2023年，全球经济好像无视了加息的影响。不仅通胀居高不下，经济活动似乎也在加速。增长加快听起来可能是件好事，但对于试图让经济实现有控制的减速的政策制定者而言，这是件头疼的事情。而且这可能意味着当最终经济步向衰退时将会加倍痛苦。

商业调查数据显示，去年年底，世界各地的制造业和服务业产出都在萎缩。现在，制造业产出持平，服务业正在回暖。美国消费者正在大笔花钱。工资和价格都继续快速增长，连以往两者长期停滞的地方也是如此。在日本，这个春季工资应该会迎来一番大涨。在欧元区，除食品和能源价格外的月度“核心”通胀率在2月升至破记录新高。劳动力市场异常吃紧。在主要由富裕国家组成的经合组织里，半数成员国的就业率正处于创纪录的高点。

从股票到信贷，金融市场定价反映了超出原有趋势水平的全球经济增长。不久前，投资者还在争论世界经济将面临的是“硬着陆”（发生经济衰退）还是“软着陆”（控制住了通胀但不引发衰退）。今天，他们在问世界经济还要不要着陆。

这轮明显加速有几方面的原因。2022年底市场短暂繁荣，激起了狂热情绪。中国结束新冠清零政策，重新开放，令经济迅速复苏，新兴市场订单量随之大增。欧洲能源价格下降使其经济受到的制约大减。但最重要的是，大多数大型经济体的消费者和企业的财务状况都非常好。许多家庭在疫情期间积累了大量储蓄，手头仍非常宽裕；企业之前设法锁定了长期低利率，目前还没有受到贷款成本上升的太多影响。全球经济中只有在房地产等对利率最敏感的部门，加息的影响才是明显的。在美国，经济如此强

劲，连房地产似乎都略有反弹。

这番加速意味着衰退不会很快降临，但也意味着，央行若想把通胀成功降至2%的目标水平，进一步加息在所难免。3月7日，美联储主席鲍威尔暗示了这一点，股市应声下跌。政策制定者现在面临两大艰难判断。

首先是货币紧缩的全部效力现在还有多少没有发挥出来。经济学家常常大谈利率政策起效存在“长期、多变的滞后效应”，但研究表明现在加息政策也许起效更快。假如去年紧缩的效力已经完全显现，可能还需要大幅紧缩。第二个判断是，那些似乎使经济在很大程度上不受加息影响的因素会持续多久。总有一天，消费者会耗尽存下来的现金，企业会感受到更高借贷成本带来的压力。在瑞典，加息的效果迅速传导到家庭，整体经济正承受痛苦。

有一点是明确的：能让通胀下降而又不导致增长大幅放缓的理想路径似乎比一个月前又更窄了。央行越发可能必须在容忍更高通胀或是连续第二年大踩刹车之间做抉择。 ■



Too fast to land

A stubbornly strong economy complicates the fight against inflation

Higher interest rates are not sufficiently slowing global growth

YOU MIGHT have expected the fastest tightening of global monetary policy in 40 years to deal a heavy blow to the world economy. Yet in 2023 it seems to be shrugging off the effects of higher interest rates. Not only is inflation stubbornly high, but economic activity also appears to have quickened. Faster growth may sound good, but it is a headache for policymakers, who are trying to bring about a managed slowdown. And it could mean that a recession, when it eventually strikes, is more painful.

At the end of last year, according to business surveys, manufacturing and services output were both shrinking around the world. Today manufacturing output is flat and services are rebounding. American consumers are spending freely. Both wages and prices continue to grow fast, even in places where they were long stagnant. Japan looks set for a round of bumper wage rises in the spring. In the euro zone the monthly rate of “core” inflation, which excludes food and energy prices, broke records in February. Labour markets are extraordinarily tight. In half of the members of the OECD, a group of mostly rich countries, employment rates are currently at record highs.

From equities to credit, financial markets are priced for global economic growth that is above trend. Not so long ago, investors were debating whether the world economy would face a “hard landing” involving a recession, or a “soft landing”, in which inflation was conquered without any downturn. Today they are asking whether the world economy is landing at all.

There are several reasons for the apparent acceleration. The mini-boom that

took hold in the markets late in 2022 stimulated animal spirits. China's reopening from zero-covid has led to a swift economic recovery which has caused order books in emerging markets to fill up. Falling energy prices in Europe have loosened the screws on its economy. But above all else, consumers and firms in most big economies are in strikingly good financial health. Many households are still flush with savings built up during the covid-19 pandemic; firms managed to lock in low interest rates for long stretches and have yet to suffer much from higher borrowing costs. Only in the most rate-sensitive sectors of the global economy, such as property, is the impact of higher rates clearly visible. In America the economy is so strong that even housing may be recovering slightly.

The acceleration means that recession is not imminent. But it also means that central banks will have to raise interest rates further if they are to succeed in returning inflation to their 2% targets. On March 7th Jerome Powell, the chairman of the Federal Reserve, hinted as much, causing stockmarkets to fall. Policymakers now face two difficult judgments.

The first is the extent to which monetary tightening to date has yet to have its full effect. Economists often talk up the "long and variable lags" with which interest rates work, but research suggests policy may be working faster today. If the effects of last year's tightening are already exhausted, much more may be needed. A second judgment is over the persistence of the factors that seem to have immunised much of the economy against rate rises. Eventually, consumers will run out of spare cash and firms will feel the pinch from higher borrowing costs. In Sweden, where interest-rate rises rapidly pass through to households, the economy is suffering.

One thing is clear: the ideal path, where inflation falls without growth faltering much, looks narrower than it did even a month ago. Instead, central banks are increasingly likely to have to choose between tolerating higher inflation or slamming on the brakes for a second year running. ■



把握当下

中国公司如何解决TikTok问题

在反华情绪中开展业务的首席执行官指南

上个月在美式橄榄球运动的中心地带观看超级碗比赛的球迷看到了一则令人惊讶的电视广告。一位女士在浏览一款名为Temu的移动购物应用，在各种时髦但廉价的服装之间神奇地切换。广告词——“我觉得自己很富有；我觉得自己像个亿万富翁”——指的是Temu无穷无尽的服装选择和极低的价格带来的财富感。自去年9月推出以来，Temu已成为美国下载次数最多的iPhone应用。这对于一个总部位于波士顿的年轻品牌来说堪称壮举。更令人印象深刻的一点是Temu来自中国。

对于在西方的中国企业来说，这是一个关键时刻。一方面，中国品牌在美国从未如此受欢迎。iPhone下载量紧随Temu之后的是视频编辑器CapCut 和时间黑洞TikTok。时装零售商Shein的排名高于亚马逊。今年它可能会在纽约完成世界上最大的首次公开募股（IPO）之一。

与此同时，西方对中国企业的猜忌不断加深，中国与西方之间的地缘政治局势愈发紧张。美国已在国内封杀中国电信设备制造商华为，并粉碎了其占领西方市场的努力。3月6日，据报道，德国政府即将迫使移动运营商停止购买华为设备并更换已安装的中国设备。TikTok可能会受到类似的严厉对待。以美国为首的几个国家正在讨论全面禁止TikTok，因为担心中国政府利用该平台进行反西方宣传或攫取西方用户的个人数据（TikTok否认了这两项指控）。

对那些瞄准富有的西方购物者的雄心勃勃的中国公司来说，它们面对一个难题：如何在越来越不受欢迎的地方开展业务？Shein、Temu和陷入困境的TikTok等公司正在拿出的答案有很多共同点。它们能否成功将决定中国商业在西方的命运。

中国公司在1980年代开始在全球崭露头角，因为外国人大量投资中国工

厂，从这里生产出的廉价商品被运往西方。消费者几乎完全通过沃尔玛等零售商或那些从中国采购产品的西方品牌购买它们。然后，在2000年代中期，中国公司开始在国外市场建立业务。在山姆大叔令华为折翼之前，这家公司一直在西方销售自己的网络套件和手机。家电制造商海尔等其他中国领军企业购买并培育了西方品牌（比如海尔之于通用电气的白色家电部门）。据数据公司路孚特统计，2011年至2021年间，中国企业收购了价值近900亿美元的外国零售和消费品牌。许多收购目标都是西方公司。

然而，近年来交易速度慢了下来。2022年，中国公司在外国品牌上的支出仅为4亿美元（见图表）。北京当局对资本外逃变得更加谨慎，同时西方政府对此类交易变得更加敌视，经常出手阻止。寻求在西方建立影响力的中国品牌日子不好过。中国公司联想在2004年收购了IBM的个人电脑部门，到目前只拿下了美国PC市场15%的份额，远远落后于惠普和戴尔，后两者合计占据了一半以上的份额。2021年超越苹果成为全球第二大智能手机制造商的小米一直未能打入美国市场。

最新一波全球化的中国品牌采取了不同的方式。在美国市场与中国品牌合作的营销人员吉姆·菲尔兹（Jim Fields）表示，许多品牌最初关注的是中国国内市场，直到新冠疫情以及中国严厉的防疫措施迫使它们将目光投向国外以寻求增长。Shein、Temu和TikTok等公司可能是登上了头条，但好几百家中国公司都在美国、欧洲和日本取得类似的进展——采用了类似的策略。

首先是不要标榜自己的中国根源。本刊浏览了数十家公司的网站，发现大多数很容易被误认为是西方品牌。它们的名字听起来像英语：BettyCora生产指甲贴；Snapmakers制造3D打印机。几乎没有一家提到它们的原籍国。一位目前正计划在美国推出自己品牌的年轻企业家发现，长期以来人们对中国制造的商品存在质量低劣的偏见。这种看法与1980年代第一波廉价工厂商品浪潮有关。近年来，美国针对亚裔人的仇恨犯罪不断增加，这也不鼓励公司亮出中国身份。这位企业家表示，大多数希望开展此类业务的人都会尽可能避免提及中国。

第二个共同特征是利用技术在服务和价格上击败西方竞争对手。许多中国公司使用自己的网站和移动应用直接向客户销售产品。这绕过了零售商，同时获得了有关消费者趋势的数据，使它们能够对需求的变化做出快速反应——或者，使用复杂的分析，预测这些变化并提前做出反应。

这种“按需制造”使Shein的美国销售额在2020年至2022年间增长了两倍，突破200亿美元。它的应用在美国每月吸引3000万用户。数百家中国公司正在美国市场上试验这种模式。Halara是一家新兴的女装零售商，其应用每月有大约有150万数字访问者。竞争对手Newchic吸引了170万用户。咨询公司贝恩的成鑫表示，通过数据分析了解客户的能力在发达市场上是一大优势。

这些公司对技术和供应链的精明运用使它们能够限制自己的非中国资产——这是第三个共同战略。中国研究公司36氪的邹萍表示，轻资产对投资者很有吸引力。如果西方政客进一步施压，这种做法有助于削减成本并降低资产搁浅的风险。

对于许多中国品牌来说，其唯一的西方资产是面向客户的网站和应用。虽然Shein最近在印第安纳州开设了一个配送中心，但它将大部分商品直接从中国运送给美国的买家。尽管Temu的总部设在波士顿，但它在美国没有仓库，更不用说工厂了（尽管它没有排除储存环节）。Naturehike是一家露营装备制造商，它在中国之外一个人都没有雇就征服了西方和日本。相反，发言人王芳芳（音译）说，公司正在提高按需制造能力，以便更好地了解远方的客户。今年2月，宁德时代同意向福特汽车公司提供电动汽车电池，方法是将其专利授权给这家美国汽车制造商，而不是在美国建厂。

为防范西方抵制以及共产党干预其西方业务，一些中国公司采用的最显著方式是将其治理结构与中国拉开距离。第一个奉行这一战略的知名企业是TikTok的母公司字节跳动。从一开始，它就将TikTok广受欢迎的中国姊妹应用“抖音”与世界其他地区使用的版本分开（后者不能在中国使用）。随后，TikTok将其总部迁至新加坡，以独立于字节跳动北京总部的决策。据

报道，现在它想创建一个美国子公司来负责保护该应用，该子公司将向一个外部董事会而不是字节跳动报告。就字节跳动而言，它强调其总部位于开曼群岛，而不是中国。

发现这一切并没能完全安抚西方监管机构后，其他中国公司走得更远。去年，Shein也从广州搬到了新加坡。这个城市国家现在是它的法律和运营总部所在地。再加上它计划在纽约上市，如果说Shein是中国的，其高管们几乎会勃然大怒。更多的企业可能会采用这种模式的某个版本。

这些策略成功与否很难衡量。来自中国的出口数据并未区分中国品牌和为外国客户制造的商品。许多包裹是通过快递发送的，不算作出口。但很明显，至少在某些领域，中国品牌正在抢占西方市场份额。Anker已成为美国最大的手机充电器供应商之一。2021年，其18亿美元的全球销售额中约有一半来自北美；不到4%来自中国。一些中国智能电器（如扫地机器人）制造商与美国和德国公司一起跻身全球顶级卖家之列。其中之一的Roborock在2021年的海外销售额为5亿美元，占其总收入的58%，高于两年前的14%。美国是它的主要市场。EcoFlow等中国公司有望主导当地家用充电宝的销售。

投资者对此看涨。Shein的IPO可能会一鸣惊人。去年，新加坡基金隐山资本与美国私募股权公司TPG筹集了近5亿美元，用于投资那些支持未来全球品牌供应链的中国公司。尽管如此，这些成功故事背后的一些企业家仍然忧心忡忡。一个问题是克服“中国制造”标签的不良声誉。如今，仿冒或劣质仿制品可能会损害真的投资于研发的中国公司的声誉。2021年，亚马逊禁止了600个中国品牌，原因是担心它们在大量制造对自家产品的虚假评论。

但不断恶化的中美关系最让中国老板们夜不能寐。许多人将TikTok视为风向标。今年1月，该公司表示将在美国建立一个数据中心来存储本地用户的数据，并允许美国当局访问其算法；3月6日，《华尔街日报》报道称TikTok也在欧洲寻求类似的协议。尽管该公司做出了这样的保证，美国国会仍在推进允许拜登总统禁止该应用的法案。

如果北京和华盛顿继续分道扬镳（看起来很有可能），美国政客可能还会瞄准其他中国应用。对于那些收集购物习惯数据的公司——也就是说大多数面向消费者的公司——这会让它们的技术优势变成地缘政治弱点。要应对这种威胁就得需要完全另一个层次的创造性了。





Seizing the moment

How China Inc is tackling the TikTok problem

A CEO's guide to doing business amid anti-Chinese sentiment

AMERICAN-FOOTBALL fans watching the Super Bowl last month in the sport's heartland were treated to a surprising TV commercial. In it, a woman switched magically between chic but cheap outfits as she scrolled through a mobile-shopping app called Temu. The jingle—"I feel so rich; I feel like a billionaire"—refers to the sensation of wealth evoked by the endless choice and rock-bottom prices for Temu's clothes. Since its launch last September Temu has become America's most-downloaded app for iPhones. That is a feat for a young brand based in Boston. It is all the more impressive because Temu hails from China.

This is a critical moment for Chinese companies in the West. On the one hand, Chinese brands have never been more popular in America. Hot on Temu's heels in iPhone downloads are CapCut, a video-editor, and TikTok, a time sink. Shein, a fashion retailer, ranks above Amazon. This year it may pull off one of the world's biggest initial public offerings (IPOs) in New York.

At the same time, Western suspicions of Chinese business are mounting, together with intensifying geopolitical tensions between China and the West. America has banned Huawei, a Chinese maker of telecoms gear, at home and crushed its efforts to capture Western markets. On March 6th it was reported that Germany's government was close to forcing mobile operators to stop buying Huawei kit and to replace installed Chinese equipment. TikTok may be in for similarly harsh treatment. Several countries, led by America, are discussing full bans on TikTok over concerns about the Chinese government using the platform for anti-Western propaganda or to gobble up Western users' personal data (TikTok denies

both these accusations).

For ambitious Chinese firms eyeing wealthy Western shoppers this presents a conundrum: how do you do business in places where you are increasingly unwelcome? Companies like Shein, Temu and the beleaguered TikTok are all coming up with answers that have a lot in common. Whether they pull it off will determine the fate of Chinese commerce in the West.

China Inc began making a global mark in the 1980s, as foreigners poured investments into Chinese factories which then shipped cheap goods to the West. Consumers would buy these almost exclusively through retailers such as Walmart or from Western brands that sourced products from China. Then, in the mid-2000s, Chinese firms began building a presence in foreign markets. Until Uncle Sam clipped its wings, Huawei was selling its own networking kit and handsets across the West. Other Chinese champions such as Haier, a home-appliance maker, bought and nurtured Western brands (GE's white-goods division, in Haier's case). Between 2011 and 2021 Chinese firms acquired nearly \$90bn-worth of foreign retail and consumer brands, according to Refinitiv, a data company. Many of the targets were Western.

In recent years, however, the dealmaking has slowed. In 2022 Chinese companies spent just \$400m on foreign brands (see chart). The authorities in Beijing have grown warier of capital flight even as Western governments have become more hostile to such transactions, often blocking them. Chinese brands seeking to build a Western presence have had little joy. Lenovo, a Chinese firm that in 2004 acquired IBM's personal-computer division, has captured a mediocre 15% of America's PC market, far behind HP and Dell, which together control more than half of it. Xiaomi, which in 2021 overtook Apple to become the world's second-biggest smartphone-maker, has been unable to crack America.

The latest wave of global Chinese brands has taken a different approach. Many initially eyed the domestic market, before the covid-19 pandemic and China's draconian response to it forced them to look abroad for growth, says Jim Fields, a marketer who works with Chinese brands in America. Companies such as Shein, Temu and TikTok may grab the headlines but hundreds of Chinese firms have been making similar inroads in America, Europe and Japan—using similar strategies.

The first is not to flaunt their Chineseness. The Economist has reviewed dozens of companies' websites and found that most could easily pass for a Western brand. Their names sound English: BettyCora produces press-on nails; Snapmakers makes 3D printers. Almost none mention their country of origin. One young entrepreneur who is currently planning the launch of his own brand in America discerns a long-standing prejudice against Chinese-made goods as being of poor quality. This perception is linked to the first wave of cheap factory wares in the 1980s. Increased hate crimes against people of Asian descent in America in recent years has not encouraged companies to come out as Chinese. Most people hoping to start such businesses will avoid references to China if possible, the entrepreneur says.

The second common characteristic is the use of technology to beat Western rivals on service and price. Many Chinese firms use their own websites and mobile apps to sell directly to customers. They thus bypass retailers while gaining access to data on consumer trends, allowing them to react quickly to shifts in demand—or, using sophisticated analytics, predict these changes and respond in advance.

This “on-demand manufacturing” has allowed Shein to triple its American sales between 2020 and 2022, to over \$20bn. Its app attracts 30m monthly users in America. Hundreds of Chinese firms are experimenting with this model in the American marketplace. Halara, a newish women’s-apparel retailer, gets around 1.5m digital visitors monthly to its app. Newchic, a

rival, attracts 1.7m. The ability to understand customers through data analytics is a big advantage in developed markets, says Xin Cheng of Bain & Company, a consultancy.

The firms' savvy use of technology and supply chains allows them to limit their non-Chinese assets—their third shared strategy. Asset-lightness appeals to investors, says Zou Ping of 36Kr, a Chinese research firm. It helps cut costs and reduce the risk of assets being stranded should Western politicians turn the screws.

For many Chinese brands, their only Western assets are customer-facing websites and apps. Although it recently opened a distribution centre in Indiana, Shein ships most goods directly from China to buyers in America. Its Boston base notwithstanding, Temu has no warehouses in America, let alone factories (though it does not rule out storage). Naturehike, a maker of camping gear, has conquered the West and Japan without employing a single person outside China. Instead, says Wang Fangfang, a spokeswoman, it is boosting its on-demand manufacturing capacity so it can better understand customers from afar. In February CATL agreed to furnish its electric-vehicle batteries to Ford by licensing its patents to the American carmaker rather than building a factory in America.

The most dramatic way in which some Chinese companies are guarding themselves against a Western backlash, as well as Communist Party meddling in their Western business, is by distancing their governance structures from China. The first big name to pursue this strategy was ByteDance, TikTok's parent company. From the start, it kept TikTok's popular Chinese sister app, Douyin, separate from the version used in the rest of the world (which in turn cannot be used in China). Then TikTok moved its headquarters to Singapore, to separate itself from decision-making at ByteDance's headquarters in Beijing. Now it reportedly wants to create an American subsidiary tasked with safeguarding the app, which would report

to an outside board of directors rather than ByteDance. ByteDance, for its part, stresses it is domiciled in the Cayman Islands, not China.

Seeing that none of this has fully placated Western regulators, other Chinese companies are going further. Last year Shein also decamped to Singapore, from Guangzhou. The city-state is now its legal and operational home. Add its planned New York listing and its executives almost bristle when you call Shein Chinese. More businesses may adopt a version of this model.

The success of these strategies is hard to gauge. Export figures from China do not distinguish between Chinese brands and goods made for foreign clients. Many packages are sent by courier and not counted as exports. But it is clear that, in some areas at least, Chinese brands are taking market share in the West. Anker has become one of America's biggest purveyors of phone chargers. In 2021 about half its \$1.8bn in global sales came from North America; less than 4% came from China. A few Chinese makers of smart appliances like robot vacuum cleaners rank among top global sellers alongside American and German firms. One, Roborock, had foreign sales of \$500m in 2021, accounting for 58% of its total revenues, up from 14% two years earlier. America is its main market. Chinese firms such as EcoFlow are poised to dominate sales of household power banks there.

Investors are bullish. Shein's IPO could be a blockbuster. Last year Hidden Hill Capital, a Singaporean fund, raised nearly \$500m with TPG, an American private-equity firm, to invest in Chinese firms backing the supply chains of future global brands. Some of the entrepreneurs behind these success stories nevertheless worry. One concern is overcoming the shabby reputation of the "Made in China" label. Today fake or shoddily made me-too items can hurt the cachet of Chinese firms that do invest in research and development. In 2021 Amazon banned 600 Chinese brands on concerns that they were churning out fake reviews of their wares.

But Chinese bosses lose most sleep over the deteriorating Sino-American relations. Many look to TikTok as the bellwether. In January the firm said it would set up a data centre in America to store local users' data and give American authorities access to its algorithms; on March 6th the Wall Street Journal reported that it was seeking a similar deal in Europe. Despite the assurances, bills are moving through Congress that would let President Joe Biden ban the app.

If Beijing and Washington continue to grow apart, as seems likely, American politicians may take aim at other Chinese apps. For those that collect data on shopping habits—which is to say most of the consumer-facing ones—this would turn their technological strength into a geopolitical weakness. Facing up to that threat will require a whole other level of ingenuity. ■

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玻璃天花板指数

经历多年缩减后，男女薪资差再度拉大？

幸运的话，2021年的差距扩大只是暂时现象

平均而言，女性赚得比男性少。这在很大程度上是因为她们所从事的工作——或出于自愿选择或为顺从社会期望；这类工作的薪资往往低于通常由男性从事的工作。有些差异则是缘于性别歧视，比如在同样的职位上女性的薪资低于男性。新冠疫情之前，男女薪资中位数的差距至少在慢慢缩小。每年3月8日的国际妇女节，本刊都会发布有关职场赋权女性的玻璃天花板指数，今年的指数显示，在大多由富国组成的经合组织的一些成员国（包括英国和加拿大），这种有益的趋势在2021年发生了逆转（见图表，完整指数参见economist.com/glassceiling）。

一种解释是疫情“后遗症”。封锁期间，酒店、餐馆和商店关门，其员工的薪酬受到了尤其大的冲击。而在这些员工中，女性的比例特别高。如果是这样，薪酬差距拉大可能只是暂时的：自经济重新开放以来，这些行业的用工需求一直很旺盛。在过去一年左右的时间里，美国休闲招待行业工人的收入增长快过交通运输等男性主导的行业里的体力工作者。

女性在光谱另一端的斩获将有助于让男女薪资差恢复到疫情前趋势。2022年，在经合组织所有成员国中，董事会成员中女性占比首次超过30%。研究公司MSCI现在预计董事会男女占比将在2038年达到五五开，比之前的预计提前了四年。在MSCI全球证券指数涵盖的约3000家大公司中，董事会中女性占多数的只有64家。不过这个数字已是2021年的两倍，而且包括了花旗集团和壳牌等巨头。信用评级机构穆迪不久前公布的分析显示，北美的这类公司信用评级一直更高。要厘清因果关系不容易，但为女性赋权应该不难。■



The glass-ceiling index

After years in decline, is the gender pay gap opening up?

With luck, the increase in 2021 was a blip

ON AVERAGE, WOMEN earn less than men. Much of this is because of the jobs they perform, by choice or social expectation; these are often worse-paid than typical male occupations. Some, as when women's pay is lower for the same position, is the result of discrimination. Before the covid-19 pandemic, the gap between median male and female wages was at least edging down. The Economist's glass-ceiling index of female workplace empowerment, published each year on March 8th, international women's day, shows that this salutary trend reversed in 2021 in some of the mostly rich members of the OECD, including Britain and Canada (see chart, and economist.com/glassceiling for the full index).

One explanation is a hangover from the pandemic. When hotels, restaurants and shops shut their doors amid lockdowns, their workers' wages suffered disproportionately. And those workers were disproportionately women. If so, the widening pay gap may have been a blip: demand from employers in these sectors has been hot since economies began to reopen. Americans working in leisure and hospitality have seen their earnings grow faster than those toiling in more male-dominated industries such as transport over the past year or so.

The return to the pre-pandemic trend will be helped by women's gains at the other end of the income spectrum. In 2022 the share of board members across the OECD who were women crept over 30% for the first time. MSCI now expects parity by 2038, four years earlier than previous estimates. Only 64 out of 3,000 or so big companies in the research firm's global stock index had a female-majority board. But that was double the number in 2021

and includes giants like Citigroup and Shell. Analysis just published by Moody's, a credit-rating agency, shows that such firms in North America have consistently higher credit ratings. Disentangling cause and effect is not easy. Empowering women ought to be. ■



高科技拔河

金融业应用人工智能带来的启示

人类可以和机器一决高下

谁是新技术最早的采用者？答案通常是超级富豪，因为尖端产品往往很昂贵。早期应用者往往也受到残酷竞争的推动，试图超越现状。因此，最有可能拿起新工具的群体莫过于资金极为雄厚且竞争极为激烈的对冲基金行业了。

这条规律看起来在人工智能（AI）和机器学习技术上同样成立。几十年前，对冲基金就开始部署它们，远远早于最近的大众追捧热潮。首先出现的是“宽客”，即量化投资机构，它们利用数据和算法挑选股票，并对一些资产的涨跌做短期押注。纽约的量化基金Two Sigma自2001年成立以来一直在实验这类方法。英国的英仕曼集团（Man Group）设有一个庞大的量化投资部门，在2014年推出了首只采用机器学习技术的基金。位于康涅狄格州格林威治的AQR资本管理公司（AQR Capital Management）大约在同一时期开始采用AI。之后业内其他公司也纷纷跟进。对冲基金的经历表明AI有能力彻底改变商业——但同时也表明这需要时间，而且进展可能时断时续。

把AI和机器学习应用于基金似乎是机器人行军中的最后一步。使用算法选股的指数基金交易费用低廉，规模已经大大扩张——2019年，指数基金的资产管理规模令传统的主动型基金相形见绌。交易所交易基金可以提供收费低廉的基本投资策略，比如选择成长型股票，几乎不需要人工参与。成立于1982年的文艺复兴科技（Renaissance Technologies）是史上第一家量化投资机构，其王牌基金几十年来的平均年回报率为66%。本世纪的头十年，高速光缆让Citadel Securities和Virtu等高频交易做市商兴起，它们能够以纳秒为单位进行股票交易。之后成立的一些量化投资机构，如AQR和Two Sigma等，在回报率上优于人类操盘手，吸纳了大量资产。

到2019年底，交易双方都已全面使用自动化算法；高频交易员常常与已经实现了投资过程自动化的量化投资机构对决；被动型指数基金投资者的大部分资产都由算法管理；规模最大、最成功的那些对冲基金或多或少都使用了量化投资方法。传统类型的基金纷纷败下阵来。明星投资者菲利普·贾布尔（Philippe Jabre）在2018年关闭自己的基金时，指责计算机化模型“悄无声息地取代了”传统从业者。由于所有这些自动化操作，股票市场比以往任何时候都更高效。交易速度快如闪电，成本几乎为零。个人用自己的储蓄做投资时只需付出一丁点成本。

机器学习曾经有望取得更丰硕的成果。一位投资者这样描述：量化投资始于一个假设——动量假设，即认为那些涨幅快于指数中其他成分股的股票会继续这样的涨势。根据这一假设，可以用历史数据来检验个股，评估它们的价值是否会继续上涨。相比之下，通过机器学习，投资者可以“从数据开始，再寻找假设”。换句话说，算法既可以决定选什么，也可以决定为什么这样选。

但是，自动化的伟大进军也并非势如破竹——人类做出了反击。临近2019年底时，面对新入局的竞争对手Robinhood，包括嘉信理财（Charles Schwab）、E*TRADE和TD Ameritrade在内的所有主要散户经纪商都将佣金降至零。几个月后，在疫情封控导致的无聊以及政府派发的经济刺激支票的推动下，散户交易开始飙升。这在2021年疯狂的前几个月中达到顶峰——日间交易者在社交媒体上抱团，争相买入不被看好的股票，推动其价格不断上涨。与此同时，许多量化投资策略似乎不起作用了。在2020年和2021年初，大多数量化基金的表现不如人类操盘的对冲基金，也低于市场平均水平。在遭遇持续赎回之后，AQR清盘了几只基金。

市场在2022年发生了逆转，这些趋势中有很多也随之反转。随着亏损不断增加，散户的交易占比回落。量化基金强势回归。就在市场跌去20%之际，AQR运营时间最长的基金回报率却高达44%。

这样的起起落落，以及机器人日益重要的作用，为其他行业提供了借鉴。首先，人类面对新技术可能会做出意想不到的反应。交易执行成本的下降

似乎让机器投资大行其道——直到有一天交易成本降为零，又推动散户东山再起。即使目前散户的交易占比不在峰值，但仍高于2019年前。如今散户交易占到股票交易量的三分之一（不包括做市商）。它们在股票期权（一种押注股票的衍生品）中的占比甚至更大。

其次，并非所有技术都会让市场变得更高效。AQR的联合创始人克利夫·阿斯内斯（Cliff Asness）认为，AQR一度表现不佳的原因之一是估值变得非常极端以及“到处都是泡沫”的情况长期持续。某种程度上这可能也是散户投资者过度狂热造成的。“能获取信息并且获取速度很快并不代表就能处理好信息，”阿斯内斯认为，“我倒是认为，社交媒体之类的东西会降低而不是提高市场效率……人们不去听反对意见，他们只听和自己一致的意见。这在政治上可能导致一些危险的疯狂之举，而在市场上可能导致一些非常不可思议的价格行为。”

第三，机器人需要时间找准自己的位置。使用机器学习的基金已经存在有一段时间了，其表现似乎超过了（至少略微超过了）人类操盘的基金。但它们并没有积聚起大量资产，部分原因是销路很难打开。毕竟少有人理解其中的风险。那些致力于机器学习技术的从业人员太清楚这一点了。为了建立客户信心，“我们已经显著加大投入，向客户解释为什么我们认为这些机器学习策略行之有效。”英仕曼集团旗下量化投资部门Man Numeric的格雷格·邦德（Greg Bond）表示。

有那么一段时间，所有人都认为量化投资机构已经解决了这个问题。但今天人们不这么看了。至少在股市，自动化还不像在其他领域里那样，形成令许多人忧惧的赢家通吃的局面。目前更像是人类和机器在拔河。虽然绳子向着机器那边移，但人类还没有放手。 ■



A techy tug-of-war

Lessons from finance's experience with artificial intelligence

Humans can take on the machines

WHO ARE the earliest adopters of new technologies? Cutting-edge stuff tends to be expensive, meaning the answer is often the extremely rich. Early adopters also tend to be incentivised by cut-throat competition to look beyond the status quo. As such, there may be no group more likely to pick up new tools than the uber-rich and hyper-competitive hedge-fund industry.

This rule appears to hold for artificial intelligence (AI) and machine learning, which were first employed by hedge funds decades ago, well before the recent hype. First came the “quants”, or quantitative investors, who use data and algorithms to pick stocks and place short-term bets on which assets will rise and fall. Two Sigma, a quant fund in New York, has been experimenting with these techniques since its founding in 2001. Man Group, a British outfit with a big quant arm, launched its first machine-learning fund in 2014. AQR Capital Management, from Greenwich, Connecticut, began using AI at around the same time. Then came the rest of the industry. The hedge funds’ experience demonstrates AI’s ability to revolutionise business—but also shows that it takes time to do so, and that progress can be interrupted.

AI and machine-learning funds seemed like the final step in the march of the robots. Cheap index funds, with stocks picked by algorithms, had already swelled in size, with assets under management eclipsing those of traditional active funds in 2019. Exchange-traded funds offered cheap exposure to basic strategies, such as picking growth stocks, with little need for human involvement. The flagship fund of Renaissance Technologies, the first ever quant outfit, established in 1982, earned average annual returns

of 66% for decades. In the 2000s fast cables gave rise to high-frequency marketmakers, including Citadel Securities and Virtu, which were able to trade shares by the nanosecond. Newer quant outfits, like AQR and Two Sigma, beat humans' returns and gobbled up assets.

By the end of 2019, automated algorithms took both sides of trades; more often than not high-frequency traders faced off against quant investors, who had automated their investment processes; algorithms managed a majority of investors' assets in passive index funds; and all of the biggest, most successful hedge funds used quantitative methods, at least to some degree. The traditional types were throwing in the towel. Philippe Jabbé, a star investor, blamed computerised models that had "imperceptibly replaced" traditional actors when he closed his fund in 2018. As a result of all this automation, the stockmarket was more efficient than ever before. Execution was lightning fast and cost next to nothing. Individuals could invest savings for a fraction of a penny on the dollar.

Machine learning held the promise of still greater fruits. The way one investor described it was that quantitative investing started with a hypothesis: that of momentum, or the idea that stocks which have risen faster than the rest of the index would continue to do so. This hypothesis allows individual stocks to be tested against historical data to assess if their value will continue to rise. By contrast, with machine learning, investors could "start with the data and look for a hypothesis". In other words, the algorithms could decide both what to pick and why to pick it.

Yet automation's great march forward has not continued unabated—humans have fought back. Towards the end of 2019 all the major retail brokers, including Charles Schwab, E*TRADE and TD Ameritrade, slashed commissions to zero in the face of competition from a new entrant, Robinhood. A few months later, spurred by pandemic boredom and stimulus cheques, retail trading began to spike. It reached a peak in the

frenzied early months of 2021 when day traders, co-ordinating on social media, piled into unloved stocks, causing their prices to spiral higher. At the same time, many quantitative strategies seemed to stall. Most quants underperformed the markets, as well as human hedge funds, in 2020 and early 2021. AQR closed a handful of funds after persistent outflows.

When markets reversed in 2022, many of these trends flipped. Retail's share of trading fell back as losses piled up. The quants came back with a vengeance. AQR's longest-running fund returned a whopping 44%, even as markets shed 20%.

This zigzag, and robots' growing role, holds lessons for other industries. The first is that humans can react in unexpected ways to new technology. The falling cost of trade execution seemed to empower investing machines—until costs went to zero, at which point it fuelled a retail renaissance. Even if retail's share of trading is not at its peak, it remains elevated compared with before 2019. Retail trades now make up a third of trading volumes in stocks (excluding marketmakers). Their dominance of stock options, a type of derivative bet on shares, is even greater.

The second is that not all technologies make markets more efficient. One of the explanations for AQR'S period of underperformance, argues Cliff Asness, the firm's co-founder, is how extreme valuations became and how long a "bubble in everything" persisted. In part this might be the result of overexuberance among retail investors. "Getting information and getting it quickly does not mean processing it well," reckons Mr Asness. "I tend to think things like social media make the market less, not more, efficient...People don't hear counter-opinions, they hear their own, and in politics that can lead to some dangerous craziness and in markets that can lead to some really weird price action."

The third is that robots take time to find their place. Machine-learning funds

have been around for a while and appear to outperform human competitors, at least a little. But they have not amassed vast assets, in part because they are a hard sell. After all, few people understand the risks involved. Those who have devoted their careers to machine learning are acutely aware of this. In order to build confidence, “we have invested a lot more in explaining to clients why we think the machine-learning strategies are doing what they are doing,” reports Greg Bond of Man Numeric, Man Group’s quantitative arm.

There was a time when everyone thought the quants had figured it out. That is not the perception today. When it comes to the stockmarket, at least, automation has not been the winner-takes-all event that many fear elsewhere. It is more like a tug-of-war between humans and machines. And though the machines are winning, humans have not let go just yet. ■



熊彼特

如何阻止集装箱运输同质化

两家最大的海运公司制订了截然不同的航线

从没听说过地中海航运公司（Mediterranean Shipping Company，以下简称MSC）这家全球最大的远洋船运公司？不用不好意思。人家本来就要这么低调。它的创始人詹路易吉·阿本德（Gianluigi Aponte）是一位不爱抛头露面的意大利亿万富翁，常年住在瑞士这个没有海岸线但保密文化却深如大海的国家。如今他的这家公司已经悄然统领整个航运界。创建于1970年的MSC最初只有一艘货船，往返于索马里和意大利南部，但去年已超越A.P.穆勒-马士基（A.P. Moller-Maersk）成为全球最大的集装箱运输公司。不过这家公司低调的文化依然如故。其CEO索伦·托夫特（Soren Toft）本月在长滩一个航运业聚会上的发言几乎没有透露任何东西。“我们不会开[公开发表看法]这个惯例的。”他冷冰冰说道。

不要觉得扫兴。行动比言辞透露的东西更多。MSC不仅赶超了马士基，还把它远远抛在身后。据巴克莱银行（Barclays）的亚历克西亚·多格尼（Alexia Dogani）称，待MSC订购的船舶交付后，它的船只总吨位可能比马士基这家丹麦对手高40%。与此同时，成立于1904的航运业贵族马士基却渐渐放弃了称霸公海的目标。它不再大量订购船舶，而是把投资重点放在供应链中从港口到铁路、公路和航空网络的高回报服务上，用行话说就是要化身一家集成商，而不只是集装箱船运公司。

也就是说，在这个全球贸易的核心行业中，位列最前的两家公司对未来发展押注方向截然不同。这一切发生在后疫情时代，集装箱运输放缓，而全球化的长远未来成疑。不论两者当中有谁会成功，它们为采用不同路径应对产业同质化提供了有趣的自然实验。

MSC和马士基这次分道扬镳非同寻常。八年来，两者一直维持着名为2M的联盟关系，就像航空公司通过代码共享协议交换旅客那样，它们两家也

会互换集装箱舱位。这个组合一直显得很古怪：想象一下瑞安航空这样的廉价航空公司和新加坡航空这样的豪华航空公司结盟，你就有概念了。

MSC曾经出了名地不靠谱（有一个老梗说MSC这个缩写代表“maybe ship comes”，也就是“也许船会来”），按一位马士基前员工的说法，MSC的员工配置是“精简到缺人的程度”。马士基则正相反，它是业内最准时、人员最充足、最服务导向的船运公司。但在2010年代中期，马士基订购了太多超大型船舶，需要有人帮助消化多余的舱位。主打低价的MSC欣然效劳，原因之一是它想效仿马士基的服务标准。两者合作卓有成效，以致人们开始认为缔结联盟是行业内改善财务纪律的基石。2020年，马士基的首席运营官托夫特跳槽到了MSC，标志着MSC的“马士基化”。

但这样的联盟也有弊端。正如研究公司海洋情报（Sea Intelligence）的艾伦·墨菲（Alan Murphy）所指出，联盟是一条“通往同质化的快车道”。一旦你把自己的货物委托给别人的船舶来运输，就很难再做到差异化。而且随着两家公司的发展战略分化，联盟变得越发不合时宜。MSC趁着疫情期间行情高涨订购了足够多的船舶来独力承运。而随着马士基把注意力转向物流服务，它需要对货物有完全的控制权，而如果货物在自家船上自然更便于掌控。1月下旬，两家公司表示将在2025年结束联盟关系，各奔前程。

两者策略各异，但都大胆到近乎鲁莽。MSC疯狂买船将导致今年航运市场运力严重过剩，拉低运费。外界认为它是希望以压倒性的规模实现规模经济，降低单位成本，进一步扩大市场份额（按货运量计算目前约为17%）。在周期性、重投资的行业中，这是自认可以打赢对手的市场领导者的经典策略。问题是，较小规模的航运公司也在把疫情期间赚到的意外之财用来购入新船。航运咨询公司德路里（Drewry）的西蒙·希尼（Simon Heaney）认为，追求规模也可能意味着MSC的服务水准会下降。他指出，监管机构澳大利亚海事安全局（AMSA）上月透露今年已扣留过五艘MSC货船，大多是因为船只维护不合格。

马士基则存在另外一个问题。它在订购新船上保持节制虽是明智之举，但也有其风险——船只数量比MSC少，可能会让那些想在船期和目的地上有

更多选择的客户却步。马士基表示，自己的许多客户将因可靠性、数据驱动的市场洞察，以及临时转运货物的灵活性获益，多过他们从船队规模扩大中获得的好处。怀疑者则质疑客户会否甘愿为整合服务付出更高的价格，尤其是在经济不景气之时。而且，马士基的物流业务还要和DHL和德迅（Kuehne+Nagel）等利用各种承运商来完成类似服务的货运代理公司竞争。如果马士基的战略影响了它们的生意，它们可能就不再选用马士基的货船承运货物。

马士基以前就试过这样的转向，以失败告终。但这是个新时代，可供它利用的数据比以往任何时候都要多。那些正在斟酌是否减少对中国的敞口、在亚洲增加产能，或是在北美“近岸”生产的公司可能会欢迎新的供应链选择。而且马士基也许可以就势为乐于掏钱支持环保的客户提供更气候友好的货运路线。

从经济角度来看，两家公司的长期战略如果能成功都会是好事一桩。如果MSC推动航运成本下降，将有助降低商品价格。如果马士基变身为提供平稳流畅的综合物流服务的集成商，供应链就可以回归到以往那种可靠到沉闷、没有新闻价值的状态。这将是连MSC也喜闻乐见的。 ■



Schumpeter

How to stop the commoditisation of container shipping

The two biggest carriers chart radically different routes

DON'T FEEL bad if MSC, the Mediterranean Shipping Company, is the biggest ocean-going carrier you have never heard of. It is meant to be that way. Its founder, Gianluigi Aponte, is a publicity-shy Italian billionaire, based in Switzerland, a country with no maritime borders and a culture of secrecy as deep as the ocean. His firm has taken the seafaring world by stealth. Born in 1970 with a single vessel trading between Somalia and southern Italy, MSC last year overtook A.P. Moller-Maersk to become the world's biggest container-shipping company. Yet its culture of silence remains. When its CEO, Soren Toft, spoke at a shipping jamboree in Long Beach this month, he revealed next to nothing. "We're not going to make [talking in public] a habit," he said gruffly.

Do not be put off. Actions speak louder than words. MSC hasn't simply edged past Maersk. It has left it in its wake. When it takes delivery of the ships it has on order, its total tonnage could be a whopping 40% greater than its Danish rival's, according to Alexia Dogani of Barclays, a bank. Meanwhile Maersk, the industry blue-blood with a pedigree dating back to 1904, is abandoning the quest for dominance on the high seas. Instead of a big order book, it hopes to focus investment on higher-return services along the supply chain, from ports to rail, road and air networks, becoming, in the jargon, an integrator rather than a mere box-carrier.

In effect, then, the number one and number two companies in an industry at the centre of world trade are placing radically different bets on the future. They are doing this against the backdrop of a post-pandemic slowdown in container shipping, as well as longer-term questions about the future of

globalisation. Whether either succeeds or not, they provide an intriguing natural experiment on different approaches to industrial commoditisation.

It is an extraordinary parting of the ways. For eight years the two companies have been in an alliance, called 2M, in which, like airlines swapping passengers in code-sharing agreements, they provide container space on each other's vessels. They have always made an odd couple. Imagine a budget airline like Ryanair teaming up with a plush carrier like Singapore Airlines and you get the picture. MSC was infamously unreliable (its initials, an old joke went, stood for "maybe ship comes"). Its staffing levels, as one ex-Maersk employee puts it, were "lean to the point of starvation". Maersk was the opposite. It was the industry's most punctual, best-staffed and most service-oriented carrier. But in the mid-2010s it had over-ordered mega-sized vessels, and needed help filling them. MSC, whose main selling point is cost, was delighted to oblige, partly to emulate Maersk's standards of service. It worked so well that alliances began to be considered the cornerstone of improved financial discipline in the industry. In a sign of MSC's "Maerskisation", in 2020 Mr Toft jumped ship from the Danish firm, where he had been chief operating officer.

There were drawbacks, though. As Alan Murphy of Sea Intelligence, a research firm, notes, alliances are a "fast track to commoditisation". Once you entrust your cargo to someone else's ships, it is hard to differentiate yourself. Moreover, as the strategies of both companies diverged, the alliance made less sense. MSC used boom times during the covid-19 pandemic to order enough ships to go it alone. As Maersk focused on logistics, it needed complete control of its cargoes, which was easier if they were on its own ships. In late January the two firms said that they would end the alliance in 2025 and sail their separate ways.

Their divergent strategies are bold—almost to the point of recklessness. MSC's buying spree will contribute to serious overcapacity in the market

this year, driving down shipping rates. The assumption is that it hopes that its overwhelming size will enable it to achieve economies of scale, reduce unit costs and further expand market share, which is about 17% by volume. This is the classic approach of the market leader in a cyclical, investment-heavy industry, which feels it can outgun its competitors. The trouble is that smaller shipping lines are also spending their pandemic windfall on new ships. Size may also mean that MSC's standards slip, says Simon Heaney of Drewry, a shipping consultancy. He notes that last month the Australian Maritime Safety Authority, a regulator, said it had detained five MSC ships already this year, many because of substandard maintenance practices.

Maersk has a different problem. However sensible it is to maintain a disciplined order book, the risk is that its smaller fleet relative to MSC's puts off customers who want a greater choice of sailings and destinations. Maersk argues that many of its customers will benefit more from reliability, data-driven insights and the flexibility to divert cargoes at short notice than they will from size. Sceptics wonder whether customers will cough up more for integrated services, especially in a lacklustre economy. Moreover, Maersk's logistics business will compete with freight-forwarders, such as DHL and Kuehne+Nagel, which perform similar functions using a variety of carriers. If Maersk's strategy puts their noses out of joint, they may stop directing cargoes to its ships.

Maersk has tried and failed to pivot in this way in the past. But this is a new era. It has more data than ever to work with. Companies wondering whether to reduce their exposure to China, to create additional capacity in Asia, or to "nearshore" production to North America may welcome new supply-chain options. And Maersk may be able to make a virtue of offering climate-friendlier freight routes for customers willing to pay for greenery.

From an economic point of view, the success of both long-term strategies would be a good thing. If MSC drives down shipping costs, this would help

reduce goods prices. If Maersk becomes a smooth integrator, supply chains could go back to being as boringly reliable—and unnewsworthy—as they once were. Even MSC would welcome that. ■



好莱坞大亨

萨姆纳·雷石东，以及派拉蒙之争

《无剧本》犀利审视了一个媒体帝国，以及经营它的那些品格欠佳的男人们【《无剧本》书评】

《无剧本》。詹姆斯·斯图尔特和蕾切尔·艾布拉姆斯著。企鹅出版社，416页，32美元。基石出版社，25英镑。

“你为什么对人这么刻薄？”萨姆纳·雷石东（Sumner Redstone）众多女友中的一个问道。当时雷石东把一名主厨叫到桌边，只为朝他扔去一块过熟的牛排。“我不在乎，”这位大亨回答，“我反正是要下地狱的。”

尽管他曾吹嘘自己会长生不死——“世界上已知的抗氧化剂我全都吃过喝过”——但雷石东还是于2020年去世，享年97岁。两位《纽约时报》记者詹姆斯·斯图尔特（James Stewart）和蕾切尔·艾布拉姆斯（Rachel Abrams）的深度记述拼合出了一份他生命最后几年的图景，以有时令人不适的细节，挖掘了他在会议室和卧室里惊人的荒唐行径。

雷石东拿到了哈佛大学的奖学金，在那里学习了日语，后来又在二战中协助破译密码。他从弟弟手中夺过了总部位于波士顿的家族企业全国娱乐公司（National Amusements）的控制权，这家公司经营着两家汽车影院。他后来积累起全世界最大的娱乐资产集合之一，拥有维亚康姆（Viacom）和哥伦比亚广播公司（CBS）的控股权，两家公司在在他去世前合并，成了现在的派拉蒙全球（Paramount Global）。

尽管他赚取了数十亿美元的财富，还在好莱坞星光大道上留下了一颗星，但用一位苦不堪言的长期饭搭子的话说，他也“被洛杉矶的每一家餐厅拉黑了”。他用“N”打头的词描述奥巴马，在给女儿莎莉（Shari）发传真时以“C”打头的词称呼她，并抄送维亚康姆（她在该公司担任董事）的高管。他骚扰自己的女员工，在公司专机上问一名空姐是否喜欢被打屁股。

他对年轻女性的剥削——以及当他年老力衰时她们对他的压榨——是《无剧本》（Unscripted）前半部分的焦点。雷石东用好处、礼物和现金收买年轻姑娘们的爱戴，确保她们不惹事生非。最招他喜欢的姑娘会在事业上获得帮助。比如Electric Barbarellas乐队的一名歌手就因着他的坚持得以在CBS上亮相演出。在他生命的最后阶段，两个同居女友兼护工从他身上榨取了1.5亿美元。最后，在私家侦探和许多律师的帮助下，他的家人驱逐了这二人。

书的后半部分讲述了雷石东家族的生意。萨姆纳晚年仍然是公司的执行董事长，尽管他得让人抬着去参加年度会议，在会上几乎不说话。后来，随着他说话越来越困难，他用一台经过编程的笔记本电脑替自己开口，它能说一些短句，包括“要不要来点水果沙拉？”和“去你妈的。”在一次听证会上，他怎么也想不起自己的本名（是Rothstein，后来被他的父亲英文化了），投资者开始焦躁不安。最终，在一次认知测试中，他无法完成基本的算术或拼写。他退下来了。

这为雷石东家族和CBS管理层之间的董事会大战开辟了战场。现在莎莉接过了家族帅印，而后者主要由前演员莱斯利·穆恩维斯（Leslie Moonves）领导。穆恩维斯那会儿是CBS的董事长兼CEO，一旦CBS和维亚康姆合并，他很可能要同时掌管这两家公司。他曾被《好莱坞报道》（Hollywood Reporter）评为娱乐界第四大权势人物，也是投资者眼中的红人。然而，在哈维·韦恩斯坦（Harvey Weinstein）被爆连环性侵案后，多名女性指控过去曾遭穆恩维斯侵犯，不过他始终否认。

CBS的董事会多由上了年纪的男性组成，最初倾向于接受他矢口否认的言辞。“这种事我们谁都干过。”董事之一阿诺德·科佩尔森（Arnold Kopelson）说。甚至一些声称要帮助那些所谓受害者的人似乎也在拿她们当枪使，比如一名经纪人利用他客户的申讨逼迫穆恩维斯给自己代理的其他演员安排角色。直到《纽约客》和《名利场》发起调查才把穆恩维斯拉下了台（CBS的公关主管让它们的记者“他妈的讲点道德”，“找个真实的故事讲讲”）。

像许多真人秀节目一样，《无剧本》之所以抓人眼球，是因为它的一众演员太可怕了。日料店里的大声争吵、限制令、抚养权之争（争夺孩子和宠物）、保密协议和灵媒……各种狗血戏份这里都有。莎莉·雷石东（Shari Redstone）是剧中少数几个讨人喜欢的角色之一，至少她得到了一个好莱坞式的结局。在与父亲和解后，她送走了穆恩维斯，成为新合并的派拉蒙的董事长。本剧以萨姆纳·雷石东的葬礼收尾。在葬礼上，莎莉唱起了《我的路》（My Way）。 ■



Hollywood moguls

Sumner Redstone and the battle for Paramount

“Unscripted” is an unsparing examination of a media empire and the flawed men who ran it

Unscripted. By James Stewart and Rachel Abrams. Penguin Press; 416 pages; \$32. Cornerstone Press; £25

“WHY ARE you so mean to people?” asked one of Sumner Redstone’s many girlfriends, after he had summoned a chef to their table just to throw an overcooked steak at him. “I don’t care,” replied the mogul. “I’m going to hell anyway.”

Though he boasted he would live for ever—“I eat and drink every antioxidant known to man”—Redstone died in 2020, aged 97. James Stewart and Rachel Abrams, two New York Times journalists, have put together a deeply reported account of his final years, delving in sometimes excruciating detail into his extraordinary antics in both the boardroom and the bedroom.

After a scholarship to Harvard, where he learned Japanese and later helped crack codes in the second world war, Redstone saw off his brother to inherit control of the Boston-based family business, National Amusements, which ran two drive-in cinemas. He went on to amass one of the world’s largest collections of entertainment assets, with controlling stakes in Viacom and CBS, combined before his death to form what is now Paramount Global.

Though he earned a multi-billion-dollar fortune and a star on the Hollywood Walk of Fame, he was also “banned from every restaurant in LA”, in the words of one long-suffering dining companion. He described Barack Obama using the N-word and faxed his daughter, Shari, to call her

the C-word, copying executives at Viacom, where she was on the board. He harassed his female staff, asking an attendant on a company jet if she liked to be spanked.

His exploitation of younger women—and, as he became infirm, their exploitation of him—is the focus of the first half of “Unscripted”. To buy their affection and discretion, Redstone doled out favours, gifts and cash. Favourites got career leg-ups; one, a singer in a band called the Electric Barbarellas, performed on CBS at his insistence. Towards the end of his life, two live-in girlfriends-cum-nurses extracted \$150m from him. Finally his family evicted the pair, with the help of private detectives and a lot of lawyers.

The second half of the book concerns the Redstone businesses, where Sumner remained executive chairman even as he had to be carried into annual meetings at which he barely spoke. Later, as his voice deteriorated, he had a laptop programmed to say phrases including “Would you like some fruit salad?” and “Fuck you.” After a legal hearing in which he struggled to recall his birth name (Rothstein, later anglicised by his father), investors began to fret. Eventually, following a cognitive test in which he could not perform basic arithmetic or spelling, he stepped down.

This set the stage for a boardroom battle between the Redstones, now led by Shari, and CBS’s management, principally Leslie Moonves, a former actor who was chairman and chief executive and stood to run both CBS and Viacom should they be combined. Mr Moonves, named the fourth-most-powerful person in entertainment by the Hollywood Reporter, was a hit with investors. Yet after Harvey Weinstein was unmasked as a serial sexual abuser, numerous women accused Mr Moonves of past assaults, which he has always denied.

The mainly elderly, male board of CBS was initially inclined to accept these

denials. “We all did that,” said Arnold Kopelson, a director. Even some of those claiming to help the alleged victims appeared to take advantage of them, such as the agent who used his client’s claims to press Mr Moonves to give parts to other actors on his books. Only investigations by the New Yorker and Vanity Fair (whose journalists were told by CBS’s communications chief to “have some fucking ethics” and “find a real story”) brought Mr Moonves down.

Like a lot of reality TV, “Unscripted” is riveting because its cast is so awful. Shouting matches in Nobu, restraining orders, custody battles (over children and pets), non-disclosure agreements and psychics all feature. One of the few sympathetic characters, Shari Redstone, at least gets a Hollywood ending. After a reconciliation with her father, she sees off Mr Moonves and becomes chairwoman of the newly combined Paramount. The book ends at Sumner Redstone’s funeral, with Shari singing “My Way”. ■



双速变速器

印度的繁荣对穷人有帮助吗？

从汽车销量看这个国家的经济增长

在一个廉价劳动力的国度，开最豪华豪车的人不是亿万富翁，而是拿着微薄工资的泊车员。他必须一辆、又一辆、再一辆地把车并排挤进狭窄的停车位里，回头再把它们开出来。自新冠疫情爆发以来，印度的汽车销量增长了16%——一定程度上是因笨重的SUV越来越受欢迎所致——这让代客泊车的活计难度更大了。

对许多人来说，印度汽车销售火爆象征着该国经济的超高速崛起。2月28日的最新数据显示，2022年最后一个季度，印度GDP同比增长4.4%，低于上一季度的6.3%。尽管增速放缓，但国际货币基金组织预计，到2023年印度将成为增长最快的大型经济体，占全球经济增长的15%。执政的印度人民党（Bharatiya Janata Party）认为印度正处于“Amrit Kaal”阶段，一个将给所有印度人带来繁荣的吉祥时期。

并不是所有人都相信人民党这番自我宣传。在持怀疑态度的人看来，不断增长的汽车销量实际上证明了印度经济增长中不光彩的不平衡。事实上，自新冠疫情爆发以来，踏板车和摩托车等两轮车的销售停滞，自2019年以来下降了15%。它们是普罗大众的交通工具：半数印度家庭拥有一辆两轮车，有汽车的家庭不足一成。

在印度政治中，没有多少问题比普通民众的福祉更重要。麻烦在于要解决这个问题困难重重。官方统计数据七零八落。部长们已经十多年没有公布过贫困状况评估了。因此，要做估算和推断必须采用其他调查和数据集，比如汽车销量。

这类数据揭示出减贫的趋势陷入停滞，甚至可能还倒退了。研究机构印度经济监测中心（Centre for Monitoring Indian Economy，以下简称CMIE）对44,000户家庭的调查显示，印度年收入低于10万卢比（1200美元）的最

贫困家庭中，只有6%认为他们的家庭比一年前富裕了。疫情爆发时严苛的封锁措施打击了经济，之后的复苏极其缓慢。

世界银行估计，停工停产导致5600万印度人陷入极端贫困。在那以后，通货膨胀又进一步侵蚀了购买力：在大多数穷人居住的农村地区，实际工资停滞不前，年通胀率在1月猛涨至6.5%。食品开支占到家庭总支出60%的贫困家庭感受到的压力最为沉重。自2019年以来，农村食品成本上涨了28%；洋葱价格涨幅高达51%，惨不忍睹。

劳动力市场的数据也与印度官方公布的亮眼增长数字不一致。参与一项保障低薪工作的农村就业计划的人数仍高于疫情前水平。CMIE的调查显示，失业率也比以前更高，过去两年平均超过7%。许多人已经放弃了找工作：自疫情以来劳动参与率一直下降。

印度经济存在很多问题，从糟糕的基础教育到无力扩大有限的制造部门等。但这些问题即便在此前经济井喷式增长令数以百万计的人口脱贫之际也是存在的。因此，近期的痛苦反映的更可能是疫情后遗症。例如，城市里的建筑公司抱怨劳动力短缺，因为许多在封锁期间回到农村的工人尚未返城。

这些问题可能终于开始有些缓和了。最新公布的数据显示，农村地区的工资水平可能正在上升。在为贫困人口开设的银行账户里，存款也在增加。甚至连两轮车的销量也在缓慢爬升。不过，要让Amrit Kaal成真，还需要更大的进步。 ■



Two-speed transmission

Is India's boom helping the poor?

What vehicle sales reveal about the country's growth

IN A LAND where labour is cheap, the man who drives the most luxury cars is not a billionaire. He is a parking attendant. On a meagre salary, he must park, double-park and triple-park cars in tight spaces, and then extricate them. In India, where car sales have increased by 16% since the start of the covid-19 pandemic—a trend partly driven by the growing popularity of hefty sports-utility vehicles—this tricky job is becoming even more difficult.

To many, India's automobile boom symbolises the country's superfast economic rise. On February 28th new figures revealed that India's GDP grew by 4.4% year on year in the last quarter of 2022, down from 6.3% in the previous quarter. Despite the slowdown, the IMF expects India to be the fastest-growing major economy in 2023, and to account for 15% of global growth. The governing Bharatiya Janata Party (BJP) believes the country is in the midst of Amrit Kaal, an auspicious period that will bring prosperity to all Indians.

Not everyone is convinced by the BJP's boosterism. To sceptics, rising vehicle sales in fact demonstrate the unsavoury lopsidedness of India's economic growth. Indeed, purchases of two-wheelers, such as scooters and motorcycles, have sputtered since covid hit, and are down by 15% since 2019. These are the vehicles of the masses: half of households own a two-wheeler; fewer than one in ten own a car.

Not many questions are more central to Indian politics than the wellbeing of the country's everyman. The problem is that answering the question is fraught with difficulty. Official statistics are patchy. Ministers have not

published a poverty estimate in more than a decade. Thus assessments and inferences must be made using other surveys and data sets, such as vehicle sales.

These suggest poverty reduction has stalled, and maybe even reversed. According to a survey of 44,000 households by the Centre for Monitoring Indian Economy (CMIE), a research outfit, only 6% of India's poorest households—those bringing in less than 100,000 rupees (\$1,200) a year—believe their families are better off than a year ago. The recovery from the pandemic, when harsh lockdowns whacked the economy, has been horribly slow.

The World Bank estimates shutdowns pushed 56m Indians into extreme poverty. Since then inflation has further eroded purchasing power: real wages in rural areas, where most of the poor live, have stagnated, and annual inflation jumped to 6.5% in January. Poor families, for whom food makes up 60% of household expenditure, have felt the strongest pinch. Rural food costs have risen by 28% since 2019; onion prices by an eye-watering 51%.

Labour-market data also bely India's impressive headline growth figures. Take-up for a rural-employment programme, which guarantees low-wage work to participants, remains above pre-covid levels. CMIE surveys suggest the unemployment rate is also higher, averaging more than 7% over the past two years. Many people have given up looking: labour-force participation rates have fallen since the pandemic.

There are plenty of problems with India's economy, from poor primary education to an inability to grow its limited manufacturing sector. But these were present even as previous growth spurts lifted millions out of poverty. Recent pains are thus more likely to reflect the pandemic's after-effects. Construction firms in cities, for example, complain of labour shortages, as many workers who headed to villages during lockdowns have not yet

returned.

These may at last be starting to ease. The latest data releases suggest that rural wages may be picking up. Deposits in bank accounts set up for the poor are also rising. Even sales of two-wheelers are slowly creeping up. A lot more improvement will be needed, however, for claims of Amrit Kaal to ring true.





【首文】回归本源

科技业衰退推动风险投资走向老路

战略性行业里能盈利的小公司现在备受青睐

直到去年，风险投资（VC）一直都顺风顺水。先前利率接近于零，其他领域的回报又很低，大公司、对冲基金和主权财富投资者开始把大笔资金投向创业公司，推动其估值一路走高。仅在2021年，流向创业公司的资金就翻了一番，接近6400亿美元。之后通胀飙升和利率上行让这个市场崩溃。去年全球对创业公司的投资减少了三分之一。从2021年第四季度到2022年同期，私人创业公司的估值缩水了56%。

人们难免会把这次衰退与2000年至2001年的互联网泡沫相比较，当时行业寒冬降临，风险投资陷入冰封。对公司创始人和投资者来说，幸运的是今天并不像当年那么寒意彻骨。创业公司的资产负债表要强于20年前；估值相对于营收也不是特别离谱。单在美国，风险投资家就有3000亿美元的“干火药”。然而，这个正在从科技业衰退中爬出、进入高成本资金时代的行业看起来已与进入这轮衰退之前不同了。在很多方面，风险投资正在重新走向几十年前的老路。

一个改变是开始关注能盈利的小公司。在好年景里，风险投资有时会忘掉这条惯例，因为那时增长迅猛，对未来更大利润的渴望更甚于对今天盈利的看重。许多寻求快速回报的投资者涌向成立时间更长的“后期”创业公司，它们可能很快就会上市，看上去肯定会获得令人振奋的高估值。

然而，眼下股市动荡不定，让风险投资家难以衡量后期创业公司的价值。随着利率上升，亏损的公司已经失宠：高盛编制的一个指数显示，自2021年11月以来，无盈利的科技公司的股价下跌了三分之二。风投公司也在告诫它们投资的公司勒紧裤腰带，创造现金。它们新下的赌注越来越多地投向更年轻的公司，以及那些正在大幅削减成本、可能更快实现盈利的公司。

第二个转变是重新聚焦战略性企业。风险投资发展的早期就是这样，那时投资者常常注资于那些争夺巨额政府合同的半导体制造商。而现在，很多投资者都在紧盯着那些势必会从各地政府重拾产业政策中获利的行业里的公司。例如美国和欧洲政府就计划拿出几千亿美元支持芯片公司和清洁技术。

风险投资家当然知道如何发现机会。硅谷投资巨擘安德森-霍洛维茨

（Andreessen Horowitz）发起了“美国活力”基金，其中一些投资就给了那些能获得美国政府支持的公司。包括新加坡主权财富基金淡马锡在内的其他风投机构表示，越来越预期自己的投资将与政府的战略目标相一致。

风险投资模式的最后一个转变是看重更好的治理。在景气的年份里，太多的风投资金追逐太少的好项目。这种错配让公司创始人在谈判中处于优势，让他们得以把外来监督保持在相对宽松的水平。去年由风险投资支持的加密货币交易所FTX惊天暴雷之后，外界才发现这家创业公司的大风投方和主权财富基金投资方无一在其董事会拥有席位，这让山姆·班克曼-弗里德（Sam Bankman-Fried）和他的同事们完全为所欲为。

现在风险融资更难获得了。像老虎全球（Tiger Global）等原本不插手所投公司事务的基金已经开始撤退。其他投资者表示有意接手它们的董事会席位。这限制了创始人发号施令的权力，应该能够改善公司的治理。风投资本稀缺也可能促使创业公司更快上市，而反垄断机构对科技巨头的收购案盯得更紧可能也有同样的效果。意识到自己可能很快会在公众市场上面对严格监管的创始人也可能会更守规矩。

这种新的克制不会永远持续下去。身为风险投资家，自然就是容易兴奋的一群人——看看生成式人工智能点燃的热闹气氛就知道了。一些对冲基金在经历了之前的低迷后撤出了风险投资，等待估值调整时再回来。到一定时候，周期必然会再次反转，把风险投资送上令人炫目的高度。不过目前，老式做法正在回归，这标志着一个可喜的转变。■



[Back to its roots](#)

The tech slump is encouraging venture capital to rediscover old ways

Small, profitable firms in strategic industries are now all the rage

UNTIL LAST year, venture capital (VC) had been riding high. With interest rates close to zero and little yield to be found elsewhere, large companies, hedge funds and sovereign-wealth investors began ploughing cash into startups, sending valuations upwards. In 2021 alone the amount of money flowing to startups doubled to nearly \$640bn. Then soaring inflation and surging interest rates brought the market crashing down. Last year the investments made in startups worldwide sank by a third. Between the final quarter of 2021 and the same period in 2022, the valuations of private startups tumbled by 56%.

The downturn inevitably draws comparisons to the dotcom crash of 2000-01, when deep winter set in and VC investments froze. Luckily for both founders and their backers, conditions are not so frosty today. Startups' balance-sheets are stronger than they were 20 years ago; valuations are not quite so detached from revenues. In America alone, venture capitalists have about \$300bn in dry powder. Nonetheless, the industry that is emerging from the tech slump and into an era of dearer money looks different from the one that went into it. In many respects, VC is returning to the ways of decades past.

One change is a focus on small, profitable firms. This is a habit venture investing sometimes forgot in the boom years, when rapid growth and the hope of big profits tomorrow were prized over profits today. Many backers who were in search of a quick return piled into older, "late-stage" startups, which would probably go public soon and seemed assured of heady valuations.

Today, however, stockmarkets are volatile, making it hard for venture investors to gauge the value of late-stage startups. As interest rates have risen, lossmakers have fallen out of favour: according to an index compiled by Goldman Sachs, the stock prices of unprofitable tech companies have fallen by two-thirds since November 2021. VCs, too, are telling their portfolio firms to tighten their belts and generate cash. Increasingly their new bets are on younger firms, and those which are cutting costs sharply and likely to turn a profit sooner.

A second shift is a renewed emphasis on strategic firms. In an echo of VC's earliest days, when investors often backed semiconductor-makers that vied to win huge public contracts, many today are eyeing up firms in areas that stand to gain from governments' new fondness for industrial policy. Administrations in both America and Europe, for instance, plan to spend hundreds of billions of dollars supporting chip firms and clean tech.

Venture capitalists, understandably, know how to spot an opportunity. Andreessen Horowitz, a stalwart of Silicon Valley investing, has launched an "American Dynamism" fund that partly invests in firms which tap support from Uncle Sam. Other venture investors, including Temasek, a Singaporean sovereign-wealth fund, say they increasingly expect their investments to align with states' strategic aims.

A final shift in VC's approach is an emphasis on better governance. In the boom years too much venture money chased too few good investments. The mismatch gave founders the upper hand in negotiations, helping them keep oversight relatively light. After the spectacular blow up last year of FTX, a venture-backed crypto exchange, it became clear that none of FTX's big venture- and sovereign-fund investors had taken seats on the startup's board, leaving Sam Bankman-Fried, the founder, and his colleagues entirely to their own devices.

Now venture finance is harder to come by. Tiger Global and other funds that were previously hands-off have started to retreat. Other investors say they intend to take up their board seats. That reduces the power of founders to dictate terms and should improve governance. A lack of venture dollars may also encourage startups to go public sooner, as might trustbusters' greater scrutiny of big tech acquisitions. The knowledge that they might soon face scrutiny in the public markets could also discipline founders.

This new sobriety will not last for ever. Venture capitalists are, by nature, excitable: look at the buzz over generative artificial intelligence. Some hedge funds have left venture investing after previous downturns only to return when valuations adjusted. In time the cycle will surely turn once more, sending VC investments to dizzying heights. For the moment, though, the old ways are back—and that marks a welcome change. ■



世界工人

年轻的非洲人正登录平台、打卡上班

互联网创造了新型工作，但不平等的模式依然存在

他的家在肯尼亚西部的小镇奔戈马（Bungoma），但他的办公地是全世界。为了维护自己的信誉，凯文（Kevin）要求隐去真名。他写过关于中国赌场的文章，尽管从未去过中国。他还给从未见过的举重杠铃、耳机和家庭安保系统写过评价。

非洲的数字工人正在为旧的劳动力地理格局重新布线。在线平台上的自由职业者可以接触到世界各地的客户，施展从写博客到设计网页的种种技能。另一些人受雇于外包公司，筛选用于训练聊天机器人和自动驾驶汽车的数据。乐观主义者希望，在线工作可以让非洲走上印度和菲律宾等国走过的由服务业主导的增长道路。悲观主义者则担心这类工作会加剧不公。

有些人是被这类工作的灵活性和报酬所吸引，另一些人是因为找不到传统的工作。有人为自由职业“传教布道”。坦桑尼亚的学生巴拉卡·马弗莱（Baraka Mafole）组织培训活动，还用斯瓦希里语写了一本关于如何利用在线平台的书。“现在人人都在谈论数字工作。”他说。在肯尼亚，政府的Ajira项目运营着多个支持中心，力争将100万肯尼亚人连上在线平台，让肯尼亚成为一个“数字枢纽”。

典型的工作任务包括文字转录、数据输入、在线营销，甚至帮懒惰的学生写论文。琼·万德拉（Joan Wandera）白天是内罗毕的一名办公室白领，晚上是美国企业的“虚拟助理”。“这让你对其他国家有很多了解。”她说。有时候倒是潜在客户需要学一学。有的客户以为非洲人不会说英语，她叹道。

自由职业，正如更大范围的外包行业一样，“正在对抗对非洲的一种错误观感——人们以为这地方不会有数字工作”，爱丁堡大学的穆罕默德·阿米尔·安瓦尔（Mohammad Amir Anwar）说。他与人合著了一本关于非洲数

字劳动力的书。一些非洲自由职业者用VPN和化名假装自己身在别处。停电加上亚洲等地的廉价劳动力对零工的竞争也带来了其他挑战。

现有数据表明，非洲要成为一个数字自由职业者的大陆还需要时间。2019年，安瓦尔和同事估算，在非洲大陆最受欢迎的平台Upwork上有12万非洲工人，比菲律宾还少。大多数人似乎没有赚到钱。

工作外包也引发了伦理问题。在肯尼亚一家由外包公司Sama运营的Facebook内容审核中心，员工们告诉《时代》杂志，他们的待遇很差，并且在工作性质上被误导。一名前雇员将这两家公司告上法庭，指控它们破坏工会、强迫劳动和贩卖人口。Sama今年不再为Facebook提供服务。Facebook的母公司Meta表示，它高度重视自己对内容审查员负有的责任。

技术变革向不可预测的方向跳跃。新型AI工具ChatGPT在肯尼亚工人的帮助下接受训练，正是他们标记出了数万段淫秽和暴力文本。有一天，它会不会让凯文这样的自由职业者变得多余呢？■



Workers of the world

Young Africans are logging in and clocking on

The internet creates new kinds of work, but patterns of inequality persist

HIS HOME is Bungoma, a small town in western Kenya, but his workplace is the world. Kevin, who asks that his real name be withheld to protect his credibility, has written about casinos in China without ever going there. He has reviewed weightlifters' barbells, headphones and home-security systems he has never seen.

Africa's digital workers are rewiring the old geographies of labour. Freelances on online platforms can reach clients around the world, harnessing skills from blogging to web design. Others are hired by outsourcing companies, sifting data used to train chatbots and self-driving cars. Optimists hope that online work can set Africa on the path of services-led growth trodden by countries such as India and the Philippines. Pessimists worry such work will entrench injustices.

Some are drawn to the work by the flexibility and pay; others because they cannot find a conventional job. There are evangelists for freelancing. Baraka Mafole, a student in Tanzania, organises training events and has written a book in Swahili about navigating online platforms. "Now everyone is speaking about digital jobs," he says. In Kenya the government's Ajira programme runs support centres that aim to link a million Kenyans to online platforms and make the country a "digital hub".

Typical tasks include transcription, data entry, online marketing, or even writing essays for indolent students. Joan Wandera is a Nairobi office worker by day, and by night a "virtual assistant" for American businesses. "It helps you learn a lot about other countries," she says. Sometimes it is

potential clients who have learning to do. Some clients assume Africans cannot speak English, she sighs.

Freelances, like the wider outsourcing industry, “are fighting against a reputation of Africa as somewhere where you would not expect digital work to take place,” says Mohammad Amir Anwar of the University of Edinburgh, who co-wrote a book about Africa’s digital workforce. Some African freelances use virtual private networks and fake names to pretend they are somewhere else. Power cuts and competition for gigs from cheaper workers in Asia and beyond create other challenges.

The available data suggest that it will take time for Africa to become a continent of digital freelances. In 2019 Mr Anwar and colleagues estimated that there were 120,000 African workers on Upwork, the continent’s most popular platform—fewer than in the Philippines. Most did not seem to be making any money.

Outsourcing practices have also sparked ethical questions. At a Facebook content-moderation centre in Kenya, run by Sama, an outsourcing firm, workers told Time magazine that they were mistreated and misled about the nature of their work. A former employee has taken both companies to court, accusing them of union-busting, forced labour and human-trafficking. Sama discontinued its services for Facebook this year. Meta, Facebook’s parent company, says it takes seriously its responsibilities to its content moderators.

Technological change ricochets in unpredictable directions. ChatGPT, a new AI tool, was trained with the help of Kenyan workers, who flagged up tens of thousands of passages of obscene and violent text. Could it one day make freelances such as Kevin redundant? ■



寄予厚望

彭安杰可能正是争执不休的世行所需要的

他获提名反映了世行的一些问题。他能解决这些问题吗？

在戴维·马尔帕斯（David Malpass）宣布将辞去世行行长职务一周后的2月23日，也是在世行表示要花费几个月时间“公开透明、任人唯贤”地寻找继任者仅仅几个小时后，大家就都知道谁将继任了。白宫提名了万事达卡前老板彭安杰（Ajay Banga），实际上让他成了世行的候任行长。彭安杰是印度裔美国人，用他的话讲是“印度制造”，此前一直在私营企业工作，对他的任命打破了传统。

然而，新兴经济体并没有把他的提名视为一种胜利。自1944年美国和欧洲达成一项不成文约定以来，世行行长由美国提名，国际货币基金组织（IMF）总裁由欧洲提名。美国也在世行拥有大比例的投票权。这种安排在二战后是合理的。但现在，从中国到巴拿马的许多国家都希望它们在世界经济中不断增大的影响力能在全球性机构中有所体现。

彭安杰的首要任务将是解决内讧。这种矛盾正蔓延到有关世行作用的争论中。美国和欧洲希望世行能放宽条件提供更多贷款，以减轻利率上升、气候变化以及中国减少向穷国提供贷款所带来的负担。但一些新兴经济体表示反对，称这样做将危及该行最安全的AAA信用评级。没有额外的资本来源，世行在它的作用范围上出现了重大缺口。其官员在乌克兰重建事宜上一直保持沉默，也没能像区域机构那样大力资助绿色基建。

另一场争斗关乎债务减免。中国坚持要求世行减记其贷款，这让债务减免工作陷入了停顿。马尔帕斯迄今仍坚持自己的反对立场，认为这样做会削弱世行的放贷能力。中国更具对抗性的姿态降低了美国政策制定者在近期同意给北京更多投票权的可能性。

有些人认为彭安杰（他是持有《经济学人》母公司股份的Exor集团的董事会成员）并不具备打破僵局所需的斡旋能力。他将是自1995年的银行家兼

律师詹姆斯·沃尔芬森（James Wolfensohn）之后，第一位没有全职政府工作履历或发展事务类工作经验的世行行长。但彭安杰的职业生涯仍可能是一笔财富。在华尔街工作十多年后，他领导万事达卡从2009年一家市值200亿美元的信用卡公司崛起为一个市值3000亿美元的支付平台。因此他很适合领导数字支付方面的工作，这也是世行的工作重点之一。他还以把庞大笨拙的组织变得更精简高效闻名。

彭安杰也许还能帮助世行最终启动绿色议程。去年9月，马尔帕斯以自己“不是科学家”为由，躲避正面回答关于化石燃料和全球变暖的问题。¹ 1月，西方国家拒绝了世行应对气候变化的计划，认为它缺乏雄心。而在万事达卡，彭安杰曾撰写博文大力支持绿色转型。人们希望他能利用本人在华尔街的专业经验引导企业将资金注入绿色科技和基础设施。

美国理想中的世行是一台运转良好、可持续发展的机器，就像彭安杰领导过的万事达卡一样。在重施魔法之前，这位新行长必须首先争取到新兴经济体的支持，停止司空见惯的内斗。要做到这一点，他必须先让它们忘记他的任命不完全公平。 ■



Banking on it

Ajay Banga may be just what the fractious World Bank requires

His nomination is a symptom of the institution's problems. Could he be their solution?

ON FEBRUARY 23RD, a week after David Malpass announced his resignation as president of the World Bank, and mere hours after the bank said the search for a successor would be months-long, “open, merit-based and transparent”, everyone knew who would win. Ajay Banga, a former boss of Mastercard, was nominated by the White House, making him the lender’s leader-in-waiting. A naturalised American who was, in his words, “made in India”, and a private-sector businessman, Mr Banga represents a break from tradition.

Emerging economies did not, however, take his nomination as a victory. The White House has chosen every World Bank president since it struck a gentlemen’s agreement with Europe, which gets to pick the IMF’s boss, in 1944. America also holds an outsized share of votes at the bank. This made sense after the second world war. Now countries from China to Panama want their growing presence in the world economy reflected in its institutions.

Mr Banga’s first task will be to tackle infighting. The same tensions are spilling into disputes about the bank’s role. America and Europe want it to lend more, with looser constraints, to alleviate the burden of rising interest rates, climate change and reduced Chinese lending to poor countries. But some emerging economies are pushing back, saying such a move would risk the organisation’s ultra-safe AAA credit rating. Without extra capital, the bank has gaping holes in its coverage. Its officials have been quiet on Ukraine’s reconstruction, and struggled to pump as much as regional outfits into green infrastructure.

Another fight is about debt relief, which China has brought to a standstill by insisting the World Bank takes write-downs on its loans. Mr Malpass has so far stood his ground, countering that this would impair the bank's ability to lend. A more antagonistic China lowers the chances that American policymakers will consent to giving Beijing more votes any time soon.

Some doubt Mr Banga (who is on the board of Exor, which owns a stake in The Economist's parent company) is capable of the bureaucratic manoeuvres needed to break the deadlock. He will be the first appointee with no full-time experience in development or government since James Wolfensohn, a banker and lawyer, in 1995. But Mr Banga's career could be an asset. After more than a decade on Wall Street, he oversaw the rise of Mastercard from a credit-card firm worth \$20bn in 2009 to a payment platform worth \$300bn. He is well placed to guide work on digital payments, a priority at the bank. And he has a reputation for transforming unwieldy organisations into slicker outfits.

Mr Banga may also help the bank at long last embrace a green agenda. In September Mr Malpass dodged a question about fossil fuels and global warming, saying he was "not a scientist". In January Western countries rejected the bank's climate plan for being insufficiently ambitious. By contrast, at Mastercard Mr Banga wrote super-green blogs. The hope is that he will use his Wall Street know-how to get firms to funnel cash to green tech and infrastructure.

America's ideal World Bank is a well-oiled machine with a sustainable bent, much like the Mastercard that Mr Banga left behind. Before he repeats the trick, the new president will have to first stop routine infighting by getting emerging economies on side. To do that, he will have to make them forget the less-than-equitable circumstances of his selection. ■



智能服务

ChatGPT式AI让投资者疯狂

就连马斯克也想造一台自己的AI聊天机器人

自ChatGPT于去年11月推出以来，有一个迷你产业逆科技界整体的低迷运势而上。每周都有公司推出基于“基础”模型的“生成式”AI，这些模型就是赋予了ChatGPT和其他类似的AI系统以智慧的庞大而复杂的算法。2月24日Facebook的母公司Meta发布了一个名为LLaMA的模型。据报道，特斯拉和推特的老板马斯克希望创建一种不像ChatGPT那么“觉醒主义”的人工智能。英国企业家本·托塞尔（Ben Tossell）维护的一个目录刚刚扩容，纳入了Isaac Editor（帮助学生撰写论文）和Ask Seneca（根据斯多葛学派哲学家的著作回答问题）等。ChatGPT可能引起了广泛热议，并且有超过1亿用户与之对话。但托塞尔的数据库显示，生成式AI的真正进展发生在通过基础模型实现的各式各样重点不在聊天的服务上。

每个模型都要经过大量文本、图像、声音文件或其他数据的训练，让它们能够解读用自然语言写就的指令，并用文本、艺术或音乐的形式做出回应。尽管此类系统已经存在了一段时间，但真正抓住全世界和投资者想象力的却是ChatGPT等面向消费者的服务。风投公司Index Ventures的麦克·沃尔皮（Mike Volpi）说，自己和其他高科技风投者在加密币崩盘和空空如也的元宇宙上烧掉了大把的钱，正急于寻找下一个投资的风口浪尖。此外，与网络浏览器和智能手机相比，在基础模型之上构建新服务和应用程序还要更容易。另一家风投公司Accel的史蒂夫·拉夫林（Steve Loughlin）说：“只要打开笔记本电脑，创建一个帐户，就能开始与模型交互了。”

大量资金正在涌入这个业务领域。据报道，今年1月，微软在早前投资了10亿美元的基础上，又向开发出ChatGPT的创业公司OpenAI投资了100亿美元。另一家风投公司NfX的皮特·弗林特（Pete Flint）估计现在有500多家生成式AI创业公司。到目前为止它们总共融资超过110亿美元，这还不包括OpenAI筹到的钱（见图表）。沃尔皮提到了“寒武纪大爆发”。

那么哪些生成式AI平台能够赚到大钱呢？目前这是科技圈子里令人挠头的话题。“在生成式AI里是否会出现长期的赢家通吃的生态，现在还不清楚。”另一家风投公司Andreessen Horowitz的马丁·卡萨多（Martin Casado）及其同事最近在一篇博客文章中写道。许多创业公司提供的都是跟风的理念，通常只是添加功能而不是推出新产品。即使是资源密集型的基础模型最终也可能变成一种低利润的日常商品，因为尽管OpenAI的GPT-3.5等专有模型目前在领跑，但开源的替代方案也并没有落后很多。

生成式AI也在试探法律雷区。模型经常会出现错误。而且它们可能会突然行为失常。Sydney是微软正在用OpenAI的技术为其搜索引擎必应开发的聊天机器人，它已经侮辱了几名用户，并向至少一名用户表达了爱意（此后已受规束）。AI平台可能享受不到庇护了社交媒体的免责条款的法律保护。一些现有模型在未经许可或支付费用的情况下使用基于网络的内容进行训练，这些内容的版权持有者已经开始强烈抗议。照片库Getty Images和艺术家个人已对Stable Diffusion等AI艺术生成器提起诉讼。Stable Diffusion表示：“我们会严肃对待这些问题，现在正在查看相关文件，将作出相应的回应。”新闻媒体同样对这类大量使用文本的AI心存忧虑。

OpenAI已经在淡化今年晚些时候将推出的GPT-4，这是其基础模型的升级版，备受期待。这不会抑制风投公司对生成式AI的兴趣。而对于更厌恶风险的投资者而言，目前最安全的赌注是那些提供训练和运行基础模型所需的充足处理能力的供应商。今年迄今为止，设计AI应用芯片的英伟达（Nvidia）的股价已经上涨了60%。云计算服务和数据中心业主也在摩拳擦掌。无论哪个AI平台脱颖而出，在淘金热中镐和铲子总归是不愁卖的。





Intelligence services

Investors are going nuts for ChatGPT-ish artificial intelligence

Even Elon Musk wants his own AI chatbot

SINCE CHATGPT'S launch in November, a mini-industry has defied the broader slump in tech. Not a week goes by without someone unveiling a “generative” artificial intelligence (AI) based on “foundation” models—the vast and complex algorithms that give ChatGPT and other AIs like it their wits. On February 24th Meta, Facebook's parent company, released a model called LLaMA. Elon Musk, boss of Tesla and Twitter, reportedly wants to create an AI that would be less “woke” than ChatGPT. One catalogue, maintained by Ben Tossell, a British entrepreneur, has just grown to include, among others, Isaac Editor (which helps students write essays) and Ask Seneca (which answers questions based on the stoic philosopher's writings). ChatGPT may be much talked about and, with over 100m users, talked to. Yet Mr Tossell's database hints that the real action in generative AI is in all manner of less chatty services enabled by foundation models.

Each model is trained on reams of text, images, sound files or other data. This allows them to interpret instructions in natural language and respond with text, art or music. Though such systems have been around for some time, it took a consumer-facing service such as ChatGPT to capture the world's—and investors'—imagination. As Mike Volpi of Index Ventures, a venture-capital (VC) firm, says, this happened just as his fellow tech backers, burned by the cryptocurrency crash and the empty metaverse, were on the lookout for the next big thing. In addition, even more than web browsers and smartphones, foundation models make it easy to build new services and applications on top of them. “You can open your laptop, get an account and start interacting with the model,” says Steve Loughlin of Accel, another VC firm.

Money is flooding into the business. In January it was reported that Microsoft poured \$10bn in OpenAI, the startup behind ChatGPT, on top of an earlier investment of \$1bn. Pete Flint of NFX, another VC firm, now counts more than 500 generative-AI startups. They have so far collectively raised more than \$11bn—and that is excluding OpenAI (see chart). Mr Volpi talks of a “Cambrian explosion”.

So which generative-AI platforms will make the big bucks? For now, this is the subject of head-scratching in tech circles. “It’s just not clear if there will be a long-term, winner-take-all dynamic in generative AI,” wrote Martin Casado and colleagues at Andreessen Horowitz, one more VC firm, in a recent blog post. Many startups offer me-too ideas, often more feature than product. Even the resource-intensive foundation models may end up as a low-margin commodity: though proprietary ones such as OpenAI’s GPT-3.5 are ahead, open-source alternatives aren’t far behind.

Generative AI is also tiptoeing into a legal minefield. The models often get things wrong. And they can go off the rails. Sydney, the chatbot Microsoft is developing for its Bing search engine using OpenAI’s tech, has insulted a few users and professed its love to at least one (it has since been reined in). AI platforms may not enjoy the legal protection from liability that shields social media. Copyright holders of web-based content on which existing models are being trained without asking permission or paying compensation are up in arms. Getty Images, a repository of photographs, and individual artists have filed lawsuits against AI art-generators such as Stable Diffusion. Stable Diffusion says, “We take these matters seriously. We are reviewing the documents and will respond accordingly.” News outlets fear text-gobbling AIs, too.

OpenAI is already downplaying the launch later this year of GPT-4, the highly anticipated update to its foundation model. It won’t temper VC types’ appetite for generative AI. For more risk-averse investors, the safest bet at

the moment is on the providers of the ample processing power needed to train and run foundation models. The share price of Nvidia, which designs chips useful for AI applications, is up by 60% so far this year. Cloud-computing services and data-centre landlords are rubbing their hands, too. Whichever AI platform comes out top, you can't go wrong selling picks and shovels in a gold rush. ■



巴托比

炒作的善用与滥用

兴奋情绪何以能助力企业家，也能拖累他们

炒作和荒谬相伴相生。随着下一个大事件引发的兴奋情绪日益高涨，人们争先恐后“上车”。一年半以前，元宇宙就是未来。公司纷纷任命首席元宇宙官，未来学家们絮絮叨叨谈论着web 3.0。这个构想并没有消失。上个月，哥伦比亚的一间法院首次在元宇宙里开庭（想象一款名叫《Wii Justice》的电子游戏，你就大概明白了那是个什么场景）。但是这股兴奋劲儿已经消散，至少现在是这样。微软上个月解散了自己的工业元宇宙团队；首席元宇宙官的职业前景之虚幻甚至是他们这些人也难以想象的。

其他技术也遭遇了同样的逆转。曾经有一段时间，热烈吹捧区块链、加密货币和非同质化代币是非常时兴的事情。现在，用户、投资者和管理者的注意力都盯牢在人工智能（AI）上。自去年11月底人工智能聊天机器人ChatGPT向公众开放以来，它又掀起了另一波炒作。已有超过一亿人让它用五步抑扬格写宜家家具的说明书，或者同等不可或缺的东西；风险投资基金正在向人工智能创业公司投入大量资金；老牌公司正忙不迭地解释它们将如何使用这项技术去做从客户服务到编程的所有事情。

炒作也不一定就会以失望收尾。有些技术不像其他技术那样充满投机性。举例来说，元宇宙在很大程度上仍是概念性的，而人工智能已是一个成熟的领域。即使泡沫破裂，仍可能留下一些改变世界的公司。由咨询公司高德纳（Gartner）普及开来的“炒作周期”确实存在。这一概念实质上描述了一个新想法在一段时间内受到不受控制的热情追捧，接着又遭遇强烈抵制。

这使得炒作对企业家来说苦乐参半。挑起人们的兴奋可以解锁融资和吸引用户。一些人认为炒作是一种公共品，对于新技术的启动至关重要。但它也会带来种种难题。问题是如何管理炒作以带来最好的结果。

对企业家来说，一个摆在眼前的诱惑是通过做出疯狂的甚至是欺骗性的承诺来利用炒作。加州大学洛杉矶分校安德森管理学院（UCLA Anderson School of Management）的保罗·蒙塔兹（Paul Momtaz）在2021年发表的一篇论文研究了风靡一时的首次代币发行（ICO，即直接向公众发行新的加密货币）领域。蒙塔兹发现，发行者系统性地夸大了自家代币的前景，而投资者也信以为真。夸下海口比实话实说能在更短的时间内筹到更多的钱。如今ICO炒作已大幅降温，但割韭菜的机会看来依然存在：打着ChatGPT名头的新创加密货币已经超过了100种。

如果企业家只融资一次，存心夸大可能是一个完全合乎逻辑的策略。但如果他们想要创建一项事业，在多轮融资中获取资金，或与投资者和用户保持密切关系，炒作可能就会成为一种拖累。有些危险是明摆着的：如果事情没有像承诺的那般发展，就会让人落得失望，损害企业信誉。其他的危险则更加微妙：与特定技术联系过于紧密，可能会缩小创业公司向新产品或商业模式转型的空间。

因此，炒作需谨慎。悉尼科技大学（University of Technology Sydney）的丹妮尔·洛格（Danielle Logue）和嘉治商学院（Judge Business School）的马修·格莱姆斯（Matthew Grimes）近期发表了一篇论文，研究了2013年随着影响力投资日渐火热而建立的一些社会投资股票市场所采取的不同路径。作者对比了一家伦敦交易和一家加拿大交易所的做法，前者做派浮夸，吸引来了名人名士高调的支持，并承诺会掀起一场金融革命，随后却以倒闭收场；后者更多依赖专家建议和渐进主义，相较之下更为成功。

炒作的利与弊在ChatGPT尚不长久的公共生命中也已明显展现。炒作帮助它成为历史上扩张最快的消费技术。但现在，这项技术的缺陷也引起了同样多的关注。微软虽然已将该聊天机器人的增强版集成到它的必应搜索引擎中，但限制了对这个新版本的访问，也对用户能连续向它提问的次数设置了上限（这个主意非常值得在所有会议中采用）。正如格莱姆斯所指出的那样，推出全新产品的企业家需要扭曲现实却不过度推高期待。他们如何炒作将决定他们能否完成这一高难度的平衡术。 ■



Bartleby

The uses and abuses of hype

How excitement can help and hinder entrepreneurs

HYPE AND absurdity go together. As excitement about the next big thing builds, people fall over themselves to get on board. A year and a half ago, the metaverse was the future. Companies appointed chief metaverse officers, and futurologists burbled about web 3.0. The idea has not gone away. Colombia held its first court case in the metaverse last month (imagine a video game called Wii Justice and you get the picture). But the excitement has evaporated, at least for now. Microsoft disbanded its industrial metaverse team last month; the career prospects of chief metaverse officers are more virtual than even they would like.

Other technologies have suffered the same reversal. There was a point when it was deeply fashionable to rave about the blockchain, crypto and non-fungible tokens. Now the attention of users, investors and managers is firmly fixed on artificial intelligence (AI). Since ChatGPT, an AI chatbot, was made available to the public at the end of November, it has generated another wave of hype. Over 100m people have asked it to rewrite IKEA furniture instructions in iambic pentameter or something equally vital; venture-capital funds are pouring money into AI startups; established firms are rushing to explain how they will use the technology to do everything from customer service to coding.

Hype need not end in disappointment. Some technologies are less speculative than others; the metaverse is still largely notional, for example, whereas AI is an established field. Even when bubbles burst, they can leave world-changing companies behind. The hype cycle, popularised by Gartner, a consultancy, is real. In essence, it describes a period of uncontrolled

enthusiasm for a new idea followed by a backlash.

That makes hype bittersweet for entrepreneurs. Excitement can help unlock funding and attract users. Some think of hype as a public good, vital in enabling new technologies to get going. But it can also lead to problems. The question is how to manage hype for the best.

An obvious temptation for entrepreneurs is to take advantage of the hype by making wild—even deceitful—promises. A paper from 2021 by Paul Momtaz of UCLA Anderson School of Management looked at the once-faddish field of initial coin offerings (ICOs), in which new cryptocurrencies are issued directly to the public. Mr Momtaz found that not only did issuers systematically overplay their tokens' prospects but that investors fell for it. Exaggerated claims raised more money in less time than accurate ones. ICOs are far less hyped these days, but the opportunity to trick investors apparently remains: over 100 new cryptocurrencies have been created that have ChatGPT in their name.

Wilful exaggeration might be a perfectly logical strategy if entrepreneurs are raising money once. But if they want to build a business, tap capital in repeated funding rounds or maintain a close relationship with investors and users, hype might become a liability. Some dangers are obvious: disappointment and damaged credibility if things do not turn out as well as promised. Other dangers are more subtle: being too associated with a specific technology can reduce the room that startups have to pivot to a new product or business model.

So hype calls for care. A recent paper by Danielle Logue of University of Technology Sydney and Matthew Grimes of Judge Business School looked at the different paths taken by a number of social-investment stockmarkets that were set up in 2013 as the buzz over impact investing grew. The authors contrast the glitzier approach of an exchange in London, which attracted

high-profile endorsements, promised a financial revolution and subsequently collapsed, with its more successful Canadian peer, which has relied more on expert advice and incrementalism.

The pros and cons of hype have also been apparent in the short public life of ChatGPT. Hype helped make it the fastest-growing consumer technology in history. But the flaws in the technology now attract as much attention. Microsoft, which has integrated a souped-up version of the chatbot into its Bing search engine, has restricted access to the new version and set limits on how many questions users can ask it in a row (an idea well worth adopting in all meetings). As Mr Grimes points out, entrepreneurs who are pushing entirely new products are expected to distort reality without overinflating expectations. How they handle hype can help determine whether they can pull off this difficult balancing act. ■



高处晕眩

中国城市站在债务危机边缘

如果不干预，可能引发更多抗议和债券市场混乱

从几公里外看过去，世界第六高楼——中国的117大厦——气势非凡，可以媲美迪拜、香港或纽约的任何一座摩天大楼。然而，走近些看就会发现，天津的这座高楼极其碍眼。当地人口中的“117”是一座烂尾楼。它的很多部分都没有完工，大片混凝土骨架裸露在外。多年来，它非但没有成为一块吸引来商业和财富的磁铁，反倒一直把繁荣排斥在外。加上它周围的其他一些烂尾楼，这里成了中央商务区的一块墓地。如果可能的话，当地政府恨不得把这整个区域都掩盖起来。

多年来，由于中国各省市为建设基础设施和提高GDP累积债务，有关严重铺张浪费的传闻不绝于耳。这些债务已经达到了非常高的水平——而现在还债的期限到了。借债的通常是地方政府融资平台，它们是地方官员为规避一些限制其借款能力的规定而建立的实体。截至去年年底，这些实体的未偿债券达到13.6万亿元，约占中国企业债券市场的40%。而通过不透明的非官方渠道放贷意味着实际债务要高得多。2020年的一项估计认为实际数字将近50万亿元。

即便在中国经济快速增长的年代，如此规模的借贷似乎也难以维继。但灾难性的决策已经把地方政府推到了悬崖边缘，在仓促重新开放之后，中国经济增长的长期前景已经变得更黯淡。中国的新冠清零政策损害了消费，削减了工业产量，并让各省市在检测和隔离设施上花掉了数千亿元。与此同时，去年的房地产危机导致土地销售减少了50%，而这是地方政府依赖的收入来源。尽管随着清零政策的废止以及房地产政策的放松，这两个问题目前都有所缓解，但一连串灾难性的连锁反应可能已经触发。最近的一项调查显示，约三分之一的地方政府难以偿还债务。这种困境危及到了政府服务，并且正在引发抗议。债务违约可能会给中国的债券市场带来混乱。

为了维持收支平衡，地方政府进入了债务市场中成本更高、更隐秘模糊的角落。据银河-联昌证券（CGS-CIMB）的张保勇称，目前超过一半的地方政府融资平台未偿债券是无评级债券，比例为2013年以来最高。许多地方政府融资平台不能再在中国国内市场发行债券，也不能为即将到期的债券进行再融资。在2022年的最后三个月，债券的偿还额超过了通过发行新债券募集到的资金，这是四年来的首次。为避免违约，现在许多地方政府都在考虑非正规渠道借款，这类借款通常被称为“隐性债务”，因为审计人员难以查清具体数额。与债券市场相比，这些债务的利息要高得多，还款期限也更短。也有一些地方政府向海外发债。去年地方政府融资平台发行了创纪录的395亿美元的美元计价债券，其中许多目前支付的利率超过7%。

这些更高的利率可能酝酿危机。研究公司荣鼎咨询（Rhodium）的冯晓东和洛根·赖特（Logan Wright）在其撰写的报告中估计，在所调查的319个地方政府中，有109个连债务利息都难以偿还，更不用说本金了。对于这些地方政府来说，利息至少占到其支出的10%，如此高的比例相当危险。而在天津，这一比例达到了30%。这座位于中国繁荣的东部沿海的城市拥有1400万人口，是最有可能因债务违约引发市场恐慌的城市。尽管天津毗邻北京，但它的财政状况与偏远的西部和西南部省份类似。自2019年以来，至少有170万人离开了天津，人口外流规模与东北三个老工业区省份相当。卖地换来的惨淡收入只能偿还天津地方政府融资平台短期债务的20%左右。

在中国各地，地方政府的预算压力开始显现。2月23日，河南省商丘市一家民营公交公司表示，由于缺乏政府财政支持，公司将暂停服务。其他地方也有公交公司发出类似的通告。在大连和武汉等城市，削减医保福利引发了抗议活动，引来了大批警察出动。地方政府难以向民营企业结清检测设备等与新冠疫情相关的费用。在一些地方，它们也付不起农民工工资，这引发了更多抗议。

为避免违约，一些地方政府已经开始出售资产。不久前对证券交易所的管制有所放宽，这可能有助于地方通过上市向公众筹集资金。政府也可以开始在私人交易中抵押资产。不过，目前尚不清楚地方官员愿意走多远，或

者谁会来购买这些待售资产。比如，天津的一个新商务区看上去一派成功发达的景象，尤其是那好几排光鲜亮丽的新高楼和街对面的一家保时捷经销店。该项目由一家当地政府下属公司和一家民营企业共同拥有，但一楼的店面大多处于空置状态。当地政府已经开始拍卖其中一些楼层。但不久前一场这样的拍卖却因为没有买家而流拍。

中央政府正在以前所未有的规模向地方拨款。根据冯晓东和赖特的报告，2020年至2022年期间，拨款金额超过30万亿元。在负债累累的西南省份贵州的遵义市，一家地方政府融资平台最近与当地银行达成了降低利率的协议，将本金偿还期推迟十年，并将其债务展期至20年。这样的操作在未来可能会变得更加普遍。支持者认为，这表明地方政府有偿还债务的诚意，并且是承认这只是需要比预期更多的时间。

但评级机构穆迪的袁人杰表示，过去十年日益增长的债务表明，许多项目永远不会真正盈利。比如，遵义陷入困境的地方政府融资平台自2016年以来一直处于负现金流状态，并且看起来没有什么好转的希望。正如荣鼎咨询的分析师发出的疑问，如果这些政府在当地GDP高速增长（通常超过7%）的时候都无法偿还债务，那么在未来十年，经济增长可能只有3%的情况下，它们将如何做得到？■



Vertiginous views

China's cities are on the verge of a debt crisis

Without intervention, the result could be more protests and bond-market chaos

FROM SEVERAL kilometres away China 117 Tower, the world's sixth-tallest skyscraper, is an extraordinary sight—rivaling anything Dubai, Hong Kong or New York has to offer. On closer inspection, however, the building in Tianjin is revealed to be an eyesore of epic proportions. Construction on “117”, as locals call it, was never completed. Large sections remain unfinished; patches of the tower's concrete skeleton are exposed to the outside world. Instead of becoming a magnet for business and wealth, it has been repelling prosperity for years. Other derelict towers surround the building, forming a graveyard of a central business district. Local officials would hide the entire area if they could.

Tales of extravagantly wasteful spending have circulated in China for years, as cities and provinces accumulated debts to build infrastructure and boost the country's GDP. These debts have reached extraordinary levels—and the bill is now arriving. Borrowing often sits in local-government-financing vehicles (LGFVs), firms set up by officials to dodge rules which restrict their ability to borrow. These entities' outstanding bonds reached 13.6trn yuan (\$2trn), or about 40% of China's corporate-bond market, at the end of last year. Lending through opaque, unofficial channels means that, in reality, debts are considerably higher. An estimate in 2020 suggested a figure of nearly 50trn yuan.

Borrowing on this scale appeared unsustainable even during China's era of rapid growth. But disastrous policymaking has pushed local governments to the brink, and after the rush of reopening the long-term outlook for Chinese growth is lower. The country's zero-covid policy hurt consumption,

cut factory output and forced cities and provinces to spend hundreds of billions of yuan on testing and quarantine facilities. Meanwhile, a property crisis last year led to a 50% fall in land sales, on which local governments rely for revenue. Although both problems are now easing—with zero-covid abandoned and property rules loosened—a disastrous chain of events may have been set in motion. About a third of local authorities are struggling to make payments on debts, according to a recent survey. The distress threatens government services, and is already provoking protests. Defaults could bring chaos to China's bond markets.

To make ends meet, local governments have entered costlier and murkier corners of the market. More than half of outstanding LGFV bonds are now unrated, the highest share since 2013, according to Michael Chang of CGS-CIMB, a broker. Many LGFVs can no longer issue bonds in China's domestic market or refinance maturing ones. Payouts on bonds exceeded money brought in from new issuances in the final three months of 2022, for the first time in four years. To avoid defaults many are now looking to informal channels of borrowing—often referred to as “hidden debt” because it is difficult for auditors to work out just how much is owed. Interest on these debts is much higher and repayment terms shorter than those in the bond market. Other officials have gone offshore. LGFVs last year issued a record \$39.5bn in dollar-denominated bonds, on which many are now paying coupons of more than 7%.

These higher rates have the makings of a crisis. A report by Allen Feng and Logan Wright of Rhodium, a research firm, estimates that 109 local governments out of 319 surveyed are struggling to pay interest on debts, let alone pay down principals. For this group of local authorities, interest accounts for at least 10% of spending, a dangerously high level. In Tianjin, the figure is 30%. The city on China's prosperous east coast, home to 14m people, is a leading candidate to be the default that kicks off a market panic. Although Tianjin neighbours Beijing, its financial situation is akin to places

in far-flung western and south-western provinces. At least 1.7m people have left the city since 2019, a scale of outflows that resembles those from rust-belt provinces. Dismal income from land sales can only cover about 20% of the city's short-term LGFV liabilities.

Across China, pressure on local budgets is starting to be felt. On February 23rd a private bus company in the city of Shangqiu, in Henan province, said it would suspend services owing to a lack of government financial support. Several others elsewhere have said the same. Cuts to health-care benefits have prompted protests in cities including Dalian and Wuhan, where they were met with a heavy police presence. Local governments have struggled to pay private firms for covid-related bills such as testing equipment. In places, they are also failing to pay migrant workers, which has led to more protests.

Some local governments have started to sell assets to try to avoid defaults. A recent loosening of rules on stock exchanges could help localities raise capital from the public through listings. Governments could also start hocking assets in private transactions. It is unclear, though, how far officials are willing to go, or who will buy the assets on offer. A new business district in Tianjin appears to have many of the hallmarks of success, for instance—not least several rows of sparkling new towers and a Porsche dealership across the street. But most of the shops on the ground floor of the project, which is jointly owned by a local-government company and a private firm, are empty. Local officials have started to auction off individual floors. One such sale recently ended without a buyer.

The central government is transferring funds to localities on a grander scale than ever before. More than 30trn yuan was made available between 2020 and 2022, according to Messrs Feng and Wright. An LGFV in the city of Zunyi, in the indebted south-western province of Guizhou, recently agreed with local banks to lower rates, defer principal payments for ten years and extend the maturity of its debt to 20 years. Such arrangements could become

more common in future. Proponents argue they indicate a genuine willingness on the part of local officials to pay their debts, and are an acknowledgment that it will simply take more time than expected.

But ever-growing debt over the past decade suggests that many projects will never become truly profitable, says Jack Yuan of Moody's, a ratings agency. The troubled LGFV in Zunyi, for instance, has had negative cashflows since 2016, and seems to have little hope of a turnaround. As Rhodium's analysts ask, if these governments could not make payments when local GDP growth was high, often above 7%, how will they manage in the forthcoming decade, with growth of perhaps 3%? ■



美联储

一本新书追溯了美联储超凡能力的演进

在拯救了经济之后，这家强大的央行触碰到了自身极限【《无极限》书评】

《无极限》，珍娜·斯米亚力克著。克诺夫出版社，384页，30美元。

“美联储有无限量的现金。”美联储分行明尼阿波利斯联储主席尼尔·卡什卡里（Neel Kashkari）在2020年3月的讲话意在安抚人心。当时，随着新冠肺炎来袭，市场陷入崩溃，经济灾难迫在眉睫。为了避免一场危机，央行迅速进入紧急模式，向金融体系注入的现金之多，就算谈不上无限量，也堪称海量。

行动的效果有点好过了头。没过多久，经济增长开始复苏，市场一派繁荣，价格压力也在积聚。到头来，美联储不得不奋起抗击美国几十年来最严重的通货膨胀——这场战斗如今仍在继续。

这种鲜明的双重性让人在评估美联储在疫情期间的功过时陷入两难。是否应该把重点放在早期暗中涌动的混乱，以及美联储拿出勇气制定史无前例的解决方案上？抑或应该多着笔墨阐述救助行动的后果，以及美联储迟迟未能意识到通胀才是它新的可怕敌人？在抗击通胀之战最激烈的时刻，人们很容易紧盯美联储的失误不放。《纽约时报》的珍娜·斯米亚力克（Jeanna Smialek）的《无极限》（Limitless）是一个有益的纠正。她的讲述令人强烈感受到，当新冠之下的停摆导致千百万人一夜之间失去工作，并将金融体系推到崩溃边缘时，事情原本可能会变得多么糟糕。

在一个段落中，她描述了2020年2月底的一次会议，当时离大多数美国人开始密切关注疫情还有几周的时间。美联储主席杰罗姆·鲍威尔（Jerome Powell）问他的副手理查德·克拉里达（Richard Clarida）这回是否可能重蹈2007到2009年全球金融危机的覆辙。“不会，”克拉里达回答说，“最坏的情况意味着事情基本上会像大萧条那样。”

这个警告很快就显得很有预见性。全球商贸陷入停滞，股价暴跌，食品银行前排起了长队。信贷市场深度冻结，预示着一场还要更严重的灾难将冲击金融体系的核心部分，而这些部分即使是在2008年最黑暗的日子里也安然无恙。到2020年3月底，美联储宣布将首次下场购买公司债券。最终，美联储的资产负债表膨胀至近9万亿美元，增幅惊人，规模达到疫情开始时的两倍多。

美联储之所以走到这一步，是因为它在之前20年里的迅速演变——斯米亚力克清晰明快地描绘了这段历史。如今鲍威尔部署和扩大的工具中有许多是在全球金融危机期间担任美联储主席的本·伯南克（Ben Bernanke）开创的。不过，更重要的是，一种思想上的变化使官员们相信，他们可以让劳动力市场运转得比从前认为合理的水平更加火热，却不会引发通胀螺旋式上升。

斯米亚力克生动刻画了这些辩论的主要参与者，从一个近乎自由意志主义者的监管者，到他更倾向干预主义的拍档，各色人物跃然纸上。2020年底，鲍威尔推出了一个新的政策框架，实际上让美联储相较于它从前可能的做法在更长时间内保持低利率。批评人士在做回顾时把这一点单拎了出来，认为这是一个危险的错误。

这本书的书名指的不仅是当灾难来临时，美联储对经济似乎无休无止的支持，还点出了它在多年里的任务蠕变。一些人希望它力争提升种族平等，或者将气候变化作为一种金融风险来对待。另一些人认为它应该创造一种新的数字货币。这些都是重要的议题。但与外界对它权力无边的观感相反，美联储实际上面对两种非常切实的限制。

首先是政治上的：央行的独立性是历经艰辛才获得的宝贵遗产，只有尽可能保持超脱于意识形态争斗之外才能得以维护。其次是经济上的：顽固的高通胀清楚地提醒人们，宽松的货币政策是会走过头的。从今天的视角来看，美联储更像是有极限，而非无极限。 ■



America's Federal Reserve

A new book traces the evolution of the Fed's extraordinary powers

After saving the economy, the mighty central bank confronts its limits

Limitless. By Jeanna Smialek. Knopf; 384 pages; \$30

"THERE'S AN INFINITE amount of cash at the Federal Reserve." This comment, made in March 2020 by Neel Kashkari, president of the Fed's branch in Minneapolis, was intended to provide reassurance. As covid-19 struck, markets were in meltdown and economic disaster loomed. The central bank swung into emergency mode, injecting vast, if not quite infinite, sums of cash into the financial system in order to avert a crisis.

The actions worked a little too well. Before long, growth was recovering, markets were booming and price pressures were building. The Fed ended up having to fight America's worst outbreak of inflation in decades—a fight that is ongoing.

This sharp duality poses a dilemma for any appraisal of the Fed's record during the pandemic. Should the focus be on the potential chaos early on and its courage in devising unprecedented solutions? Or on the aftermath of its rescue operations and the bank's slowness to realise that its new and formidable foe was inflation? In the thick of the inflation battle, it is tempting to emphasise the Fed's missteps. "Limitless" by Jeanna Smialek of the New York Times is a useful corrective. She provides a bracing account of just how badly things could have turned out when covid shutdowns led millions to lose their jobs overnight—and pushed the financial system to the brink of collapse.

In one passage she describes a meeting in late February 2020, a couple of weeks before most Americans started paying close attention to the

pandemic. Jerome Powell, the Fed's chairman, asked Richard Clarida, his second-in-command, whether this might turn into a repeat of the global financial crisis of 2007-09. "No," Mr Clarida replied, "the worst-case scenario means it basically looks like the Great Depression."

That warning soon seemed prophetic. Global commerce ground to a halt, stocks plunged and long queues formed at food banks. A deep freeze in credit markets portended a still graver calamity, striking at core parts of the financial system that had remained safe even in the darkest days of 2008. By the end of March 2020 the central bank had announced that it would buy corporate bonds for the first time in its history. Ultimately, the Fed's balance-sheet swelled to nearly \$9trn, a breathtaking increase, and more than double its size at the start of the pandemic.

It only got to that point because of the institution's rapid evolution over the previous two decades—a history crisply laid out by Ms Smialek. It was Ben Bernanke, the Fed's chairman during the global financial crisis, who pioneered many of the tools deployed and enlarged by Mr Powell. More than that, though, an intellectual shift had persuaded officials that they could let the labour market run hotter than once believed without triggering an inflationary spiral.

Ms Smialek paints nicely textured portraits of the main participants in these debates, spanning the gamut from one near-libertarian regulator to his more interventionist sparring partner. In late 2020 Mr Powell ushered in a new policy framework which, in effect, committed the central bank to keeping interest rates lower for longer than it might have previously done. In retrospect critics have singled that out as a dangerous mistake.

The title of the book refers not just to the Fed's seemingly endless support for the economy when disaster strikes but also to its mission creep over the years. Some want it to aim for greater racial equality or to treat climate

change as a financial risk. Others think it should craft a new digital currency. These are important issues. But contrary to the perception of boundless powers, the fact is that the Fed faces two kinds of very real constraints.

The first are political: central-banking independence is a precious inheritance from hard experience and can be preserved only by staying, as far as possible, above the ideological fray. The second are economic: stubbornly high inflation is a stark reminder that loose monetary policy can go too far. From today's perspective, the Fed looks more limited than limitless. ■



【首文】吃饭、打针，循环往复 新药物可能终结全球肥胖流行病

药物的长期影响必须仔细研究，但值得为之兴奋

一类新型药物面世，让有钱和有颜的人兴奋不已。只要每周打一针，体重就能下降。马斯克大力推荐；网红们在TikTok上交口称赞；突然变苗条的好莱坞小明星否认使用了它。然而，这种最新的减肥药并非仅为塑形美体之用。其最大的受益者将不是洛杉矶或迈阿密的名人，而是全世界数十亿因肥胖而影响健康的普通人。

减肥手段一直都是五花八门，有的是用心良苦但毫无效果，也有的是彻底的招摇撞骗。而这类名为胰高血糖素样肽1受体激动剂（GLP-1 receptor agonists，以下简称GLP-1受体激动剂）的新药物似乎确实有效。由丹麦制药公司诺和诺德（Novo Nordisk）开发的司美格鲁肽（Semaglutide）在临床试验中已被证明可减重约15%。这款药已经以Wegovy的品牌名在美国、丹麦和挪威销售，很快还将在其他国家上市；低剂量版的同类药物诺和泰（Ozempic）本来是一种糖尿病药物，也被按照“超说明书用药”用于减肥。由美国药企礼来（Eli Lilly）生产的竞品GLP-1受体激动剂药物将于今年晚些时候上市，药效更强。分析师认为，到2031年，GLP-1受体激动剂药物的市场可能高达1500亿美元，跟癌症药物目前的市场规模相差不远。有人认为它们可能会变得像β受体阻滞剂或他汀类药物一样普遍。

这种减肥药的问世适逢其时。2020年，全球五分之二人口有超重或肥胖的问题。非政府组织世界肥胖症联合会（World Obesity Federation）表示，到2035年，超重或肥胖人群可能升至占全球人口的一半以上，也就是惊人的40亿人。世界各地的人口都在变得更胖。人口长胖速度最快的不是富裕的西方国家，而是埃及、墨西哥和沙特阿拉伯等国。

这些趋势令人不安，因为肥胖会导致诸多健康问题，包括糖尿病、心脏病、高血压，以及中风、痛风和各类癌症等几十种疾病。超重人士感染新

冠肺炎的死亡率更高。此外还有与肥胖关联的耻感所带来的痛苦，这对校园里和游乐场上的孩子们影响最为深重。

肥胖对公共财政和整体经济有着巨大的影响。据学者建模计算，到2035年，人口超重给世界经济带来的年度成本可能达到四万亿美元（占全球GDP的2.9%，高于2019年的2.2%），这里面包括医疗保健支出、因肥胖相关疾病和早逝带来的工时损失。

全球人口日渐肥胖并不意味着数十亿超重人士缺乏道德自控力，这其实源自生理机制。有的基因在帮助人类捱过寒冬和饥荒上发挥了重要作用，如今它们依然促使人体紧紧护住脂肪不放。近几十年来，让人难以抗拒的加工食品极大丰富，饮食变得更方便、价格更低廉，这引发了过度进食的问题，与此同时人们在生活中久坐不动的时间又越来越多。脂肪一旦积聚，身体就会抗拒任何试图饿瘦的努力。尽管去年全球消费者在节食和减肥上花费了2500亿美元，但这场瘦身之战基本是失败了。

这些减肥新药的出现纯属巧合，是人们发现原本用来治疗糖尿病的药物会导致体重减轻。司美格鲁肽能模拟身体释放激素，产生饱腹感并减低食欲，还能抑制潜藏大脑中的强大进食冲动（哪怕最坚定的节食者也难以招架）。

对这些新药的需求高涨，让投资者兴奋得堪比最近瘦身成功的人士。处于这股淘金热前沿的诺和诺德在两年内市值翻了一番，达到3260亿美元，成为全球市值第二大的上市制药商。分析师预计，到2030年，求医的美国肥胖患者中将有半数会用上GLP-1药物。然而，和任何引众人无限憧憬的新药一样，GLP-1药物也存在不确定性。其中两大顾虑是安全性和用药成本。

先看安全性。这些药物之“新”意味着其长期后果尚不清楚。用于糖尿病的低剂量版药物的副作用（如呕吐和腹泻）一直较轻微。但随着这些药物被更广泛且更高剂量应用，可能会出现其他副作用。动物实验显示甲状腺癌发病率升高，而且司美格鲁肽与一种罕见的胰腺炎存在关联。对妊娠期或

孕前使用这些药物的影响也知之甚少。所有这些都需要通过纵向对照研究仔细分析。

了解这些风险很重要，因为使用这些药物的许多病人可能需要终生用药。和放弃节食一样，一旦停用高剂量司美格鲁肽，减掉的体重往往会大幅反弹。有些人反弹的体重甚至比当初减掉的还要多。

政策制定者关注的另一点是用药成本。在美国，Wegovy的用药开支约为每月1300美元，Ozempic约为900美元。按这样的价格计算，终身用药的费用似乎贵得吓人。但长远来看，情况相对乐观。假以时日，制药公司也许能与政府和医疗机构达成协议，向全民供药，以低价确保高销量。这样的盈利前景已在引发竞争、刺激创新。安进（Amgen）、阿斯利康和辉瑞都在研发竞品药物，而诺和诺德也在研发一系列后续药物。再长远些看，专利会到期，届时便可以开发低价仿制药。

在这一切实现之前该怎么做？政府必须确保最需要这类药物的患者能用上药，让想要美体的用药者自掏腰包。必须仔细研究这类药物的长期影响。各国应继续推动其他措施对抗肥胖，如运动、健康饮食和更清晰的食品成分标示，这些也许能帮助人们从一开始就避免长胖。但也让我们欢呼一下吧：这些新药意味着全球的赘肉阻击战可能终将取得胜利。■



Eat, inject, repeat

New drugs could spell an end to the world's obesity epidemic

The long-term effects must be carefully studied. But the excitement is justified

A NEW TYPE of drug is generating excitement among the rich and the beautiful. Just a jab a week, and the weight falls off. Elon Musk swears by it; influencers sing its praises on TikTok; suddenly slimmer Hollywood starlets deny they have taken it. But the latest weight-loss drugs are no mere cosmetic enhancements. Their biggest beneficiaries will be not celebrities in Los Angeles or Miami but billions of ordinary people around the world whose weight has made them unhealthy.

Treatments for weight loss have long ranged from the well-meaning and ineffective to the downright dodgy. The new class of drugs, called GLP-1 receptor agonists, seems actually to work. Semaglutide, developed by Novo Nordisk, a Danish pharmaceutical firm, has been shown in clinical trials to lead to weight loss of about 15%. It is already being sold under the brand name Wegovy in America, Denmark and Norway and will soon be available in other countries; Ozempic, a lower-dose version, is a diabetes drug that is also being used “off label” for weight loss. A rival GLP-1 drug, made by Eli Lilly, an American firm, is due to come on sale later this year and is more effective still. Analysts think the market for GLP-1 drugs could reach \$150bn by 2031, not far off the market for cancer drugs today. Some think they could become as common as beta blockers or statins.

The drugs could not have arrived at a better time. In 2020 two-fifths of the world's population were overweight or obese. By 2035, says the World Obesity Federation, an NGO, that figure could swell to more than half, with a staggering 4bn people overweight or obese. People everywhere are getting fatter. The populations putting on pounds the fastest are not in the rich

West but in countries like Egypt, Mexico and Saudi Arabia.

These trends are alarming because obesity causes a host of health problems, including diabetes, heart disease and high blood pressure, as well as dozens of illnesses such as stroke, gout and various cancers. Carrying extra weight made people more likely to die of covid-19. And then there is the misery that comes from the stigma associated with being fat, which affects children in schools and playgrounds most cruelly of all.

The consequences of obesity for the public purse and the wider economy are large. According to modelling by academics the annual cost to the world economy of excess weight could reach \$4trn by 2035 (2.9% of global GDP, up from 2.2% in 2019). That includes both spending on health care and working time lost to illness and premature deaths tied to obesity.

The world's expanding waistlines are not a sign of the moral failure of the billions who are overweight, but the result of biology. The genes that were vital to helping humans survive winters and famine still help the body cling on to its weight today. The superabundance of hard-to-resist processed foods in recent decades has brought greater convenience and lower costs, but also triggered overeating just as lifestyles became more sedentary. Once the fat is on, the body fights any attempt to diet away more than a little of its total weight. Despite the \$250bn that consumers around the world spent on dieting and weight loss last year, the battle to get slim was largely being lost.

The new obesity drugs arrived by serendipity, after treatments meant for diabetics were observed to cause weight loss. Semaglutide mimics the release of hormones that stimulate a feeling of fullness and reduce the appetite. They also switch off the powerful urge to eat that lurks inside the brain, waiting to ambush even the keenest dieter.

With the jabs already in high demand, investors are nearly as giddy as newly

slim users. The market capitalisation of Novo Nordisk, the firm at the front of the gold rush, has doubled in two years, to \$326bn, making it the second-most-valuable listed drugmaker in the world. Analysts expect half of obese Americans who seek help to be on GLP-1 drugs by the turn of the decade. But, as with any new medicine that holds so much promise for so many, there are uncertainties. Two big ones will be safety and affordability.

Consider safety first. The newness of these drugs means that their long-term consequences are not yet known. For the lower-dose forms prescribed for diabetes, the side-effects, such as vomiting and diarrhoea, have been mild. But others could crop up as the drugs are used more widely and at higher doses. Animal studies have shown a higher incidence of thyroid cancer, and semaglutide is associated with a rare pancreatitis. Little is known about the effects of using them during or just before pregnancy. All this will require careful analysis through controlled longitudinal studies.

Understanding these risks will be important, because many patients who take the drugs may need them for the rest of their lives. As with ditching a diet, stopping a high dose of semaglutide is associated with much of the lost weight piling back on. Some people even gain more weight than they lost in the first place.

Another preoccupation for policymakers is cost. In America the bill for Wegovy runs at around \$1,300 a month; for Ozempic about \$900. Judged by such prices, lifelong prescriptions look forbiddingly expensive. The longer view, however, is more encouraging. In time, companies may strike deals with governments and health providers to cover the whole population, ensuring high volumes in return for low prices. The prospect of profits is already luring competition and spurring innovation. Amgen, AstraZeneca and Pfizer are all working on rival drugs; Novo Nordisk has a full pipeline of follow-on drugs. Further ahead still, patents will expire, enabling the development of lower-priced generics.

What to do in the meantime? Governments must ensure that those who most need the drugs get them, leaving those taking them for cosmetic purposes to pay out of their own pockets. The long-term effects must be carefully studied. States should keep pressing other anti-obesity measures, such as exercise, healthy eating and better food labelling, which may help prevent people from getting fat in the first place. But spare a moment to celebrate, too. These new drugs mean that the world's fight against flab may eventually be won. ■



自由交流

一个理想的气候变化贷款机构是什么样的?

欢迎来到第二个布雷顿森林

想象一下，你受邀来到位于美国新罕布什尔州滑雪胜地布雷顿森林的华盛顿山酒店（Mount Washington Hotel）。你来这里既不是为了滑雪，也不为了享用酒店的18洞高尔夫球场，而是参加一个类似于当年二战结束时重新构想国际金融体系的会议。这一次有一个绿色的转折点。你的任务是为在布雷顿森林双双诞生的国际货币基金组织和世界银行再添一个新姐妹——一个理想的气候变化贷款机构。

按经济学家尼古拉斯·斯特恩（Nicholas Stern）和维拉·松圭（Vera Songwe）的说法，到2030年，贫困国家每年将需要大约2万亿至2.8万亿美元的投资来应对气候变化。智库气候政策倡议组织（Climate Policy Initiative）估计，2021年，富国和穷国在气候上的投资总额达到了6500亿美元。气候变化领域一个流行的说法是，金融体系需要“把数十亿变成数万亿”。想办法让这些资金流动起来，就是你要新建的“绿色银行”的使命。

第一个问题很棘手：谁来为这家银行掏钱？建立气候金融框架的努力始于1992年的地球峰会（Earth Summit）。那次峰会把世界分成了两个阵营——附件二国家和其他国家。由于历史排放量高，以富国为主的附件二国家被要求承担掏钱的义务。

这样划分的问题不在于它所遵循的“谁污染谁买单”的原则——而在于它停留在过去。以色列、新加坡和卡塔尔现在变富裕了，它们的碳排放量比许多最初的附件二国家还要大。根据另一家智库海外发展研究院（ODI）的分析，科威特、阿联酋和韩国也应该被纳入某种更新版本的附件二国家划分。新的气候变化贷款机构应该就人均历史排放量设定一个明确的门槛。一旦有国家冲破这一门槛，它就应该掏钱，没有其他选择。

有待讨论的第二个问题是：如何充分利用绿色银行的资产负债表。无论最初募集到多少资金，都肯定不足以应对大规模的气候变化。绿色银行将不得不利用杠杆。不过，如果借贷过多，银行可能会发现自己惹上麻烦。一些穷国已经在谴责认为世界银行可以借更多钱来应对气候变化的想法。这样做会提高世行自身的资金成本，使其无法再以优惠条件发放贷款，也就可能破坏它作为一家发展银行的初衷。世界银行AAA的评级高于美国政府，但对于我们新的气候贷款机构而言可能还是有点过于谨慎了。绿色银行有提高杠杆率的空间。

必须好好利用这张庞大的资产负债表。充分发挥其财力的一个选择是给穷国提供债务减免，让它们有投资自己的财政空间。但正如国际货币基金组织在向深陷负债的国家提供援助时所做的那样，作为交换，新的气候贷款机构将不得不坚决要求这些国家实施一定程度的改革。绿色银行不会采取措施去纠正它们的财政政策，而是希望确保资金被用于环境保护，而不是施舍或政治资助。

可以采取“债务换自然”或“债务换气候”的模式，这种模式提供债务减免以换取环境保护或气候变化方面的承诺，如今引起了出资者的兴趣。该模式的问题是效率低下：它们实际上补贴了那些没有参与交换的债权国，因为这些债权国受益于自己的借款国有更多资源来偿债。绿色银行应该转而专注于环保专家们所说的“解锁私人融资”。清洁技术投资属于资本密集型投资，问题是穷国面临高得多的资金成本。气候政策倡议组织（Climate Policy Initiative）估算，要让一座太阳能发电厂能运营下去，在多云的德国需要7%的回报率，在阳光充足的埃及却需要28%。更好的天气条件带来的好处被汇率波动和风险较高的投资环境抵消了。

在这方面，世界银行的工具箱或许能够提供帮助。绿色银行可以提供优惠贷款。或者，新的贷款机构甚至可以通过入股项目来承担稍多一些的风险。这将意味着，如果事情进展不顺利，它就要接受“第一损失”，但如果进展顺利，就能获得一些好处。但让金融家们常常感到沮丧的是，世界银行没有采取更多行动来抓住这种“混合金融”的机会，把高尚的慈善事业与一定程度的旧式敛财结合起来。

不过，最激进的选择是完全放弃绿色银行。对减少碳排放而言，一个理想的气候变化贷款机构很可能是一个根本不存在的机构。乐善好施的社会规划者不必担心政治约束，对他们来说，实现净零排放的最高效方法就是在全世界征收某种碳税，然后根据各国人口将收益分配出去。减排将不是由一个布雷顿森林式机构来规定，而是由市场逻辑决定：选用成本最低的减排方法，无论是在索马里兰还是瑞典。税收收益将主要流向人口众多的穷国，如果它们愿意，可以用这些钱来让自己适应变暖的地球环境。

与建立新的布雷顿森林体系或改革现有体系相比，这样的构想可能听起来更像是乌托邦。有关《巴黎协定》第六条的谈判仍在进行中，该条款的构想是在联合国的支持下创建一个国际性的碳抵消市场。欧盟、中国和印度——世界四个排放大户中的三个——已经或者即将在今年实施碳排放交易计划。根据世界银行的数据，全球近四分之一的碳排放已经被纳入某种形式的碳定价。即使没有一个新的机构，改变气候的梦想也在迅速变成现实。 ■



Free exchange

What would the perfect climate-change lender look like?

Welcome to a second Bretton Woods

IMAGINE, FOR a second, that you are a guest at the Mount Washington Hotel in the ski resort of Bretton Woods, New Hampshire. You have arrived to enjoy neither the slopes nor the hotel's 18-hole golf course. Instead, you are here for the sort of conference that reimagined the international financial system at the end of the second world war. This time there is a green twist. Your job is to give the Bretton Woods twins—the IMF and the World Bank—a sister in the form of a perfect climate-change lender.

According to Nicholas Stern and Vera Songwe, two economists, by 2030 poor countries will need somewhere in the region of \$2trn-\$2.8trn a year of investment to combat climate change. The Climate Policy Initiative, a think-tank, estimates that in 2021 total climate investments, in both rich and poor countries, amounted to \$650bn. In the catchphrase of the climate-change world, the financial system needs to “turn billions into trillions”. Getting these funds to flow, somehow, is the mission of your new Green Bank.

The first question is a vexed one: who coughs up to pay for the lender? The struggle to create a climate-finance framework started at the so-called Earth Summit in 1992. The summit divided the world into two groups, the Annex II countries and the rest. Because of their historic emissions, the mostly rich Annex II countries were given the responsibility of paying up.

The problem with the division is not the principle—that polluters should pay—but that it is stuck in the past. Israel, Singapore and Qatar are now affluent, and more responsible for emissions than many of the original Annex II gang. According to analysis by the ODI, another think-tank, Kuwait,

the United Arab Emirates and South Korea are also candidates for a revamped Annex II-style grouping. The new climate lender should establish a clear threshold for historic emissions per person. Once a country breaches this, it should have no choice but to pay up.

Next on the agenda: how to get the most out of the Green Bank's balance-sheet. The initial capital subscription, however generous, will never be enough for the vast scale of climate change. The Green Bank will have to turn to leverage. Too much borrowing, though, and the lender could find itself in hot water. A group of poor countries has railed against the idea that the World Bank could borrow more to tackle climate change. Such a policy risks undermining the rationale for the development bank, by raising its own cost of capital to the point where its loans can no longer be made on advantageous terms. The AAA-rating of the World Bank, higher than the American government, may be a tad too cautious for our new climate lender. The Green Bank can afford to lever up.

This big balance-sheet will have to be used well. One option to get the most out of its firepower is to offer debt relief, allowing poor countries fiscal space to invest themselves. But just as the IMF does when it provides assistance to highly indebted countries, the new climate lender would have to insist on some degree of reform in exchange. Instead of measures to right the fiscal ship, the Green Bank would want to ensure the firepower is used for environmental good, not giveaways or political patronage.

One model could be "debt-for-nature" or "debt-for-climate" swaps, which currently excite donors, and involve offering debt relief in exchange for environmental protections or climate-change pledges. The problem with such arrangements is that they are inefficient: they in effect subsidise creditors which do not take part in the swap, since these creditors benefit from a borrower with more resources to repay them. Instead, the Green Bank should focus on "unlocking private finance", to return to the phraseology

of green wonks. Clean-tech investment is capital-intensive; the problem is that poor countries face a much higher cost of capital. The Climate Policy Initiative calculates a solar farm in cloudy Germany needs a return of 7% to be viable, compared with 28% for one in sunny Egypt. Exchange-rate fluctuations and the riskier investment climate offset gains offered by better weather.

Here is where the toolbox of the World Bank may be able to help. The Green Bank could offer concessional loans. Or perhaps the new lender could even take on a bit more risk, by taking stakes in projects. This would mean accepting the “first loss” if things did not work out, but also gaining some of the upside if they went well. Financiers are often frustrated that the World Bank has not done more to seize the opportunity of such “blended finance”, which combines high-minded philanthropy with a degree of old-fashioned money-grubbing.

The most radical option, though, would be to give up on the Green Bank entirely. When it comes to cutting out carbon dioxide, the perfect climate lender may well be no climate lender at all. For the benevolent social planner, who does not have to worry about political constraints, the most efficient way to get to net zero would be some sort of global carbon tax, with the proceeds distributed to countries based on their population. Emissions reductions would not be dictated by a Bretton Woods-style institution but by the logic of the market: going to the lowest-cost opportunities to reduce emissions, whether in Somaliland or Sweden. The proceeds of the tax would mostly flow to the populous poor world, which could use them to adapt to a warmer planet, if it desired.

Such a vision might sound more utopian than a new Bretton Woods institution, or reforming ones already in existence. Yet talks over Article 6 of the Paris agreement, which would create a version of an international market in carbon offsets under the UN’s auspices, are ongoing. The EU,

China and India—three of the world's four big emitters—already have an emissions-trading scheme in place, or will implement one this year. According to the World Bank, nearly a quarter of the world's emissions are covered by some form of carbon pricing. Even without a new institution, climate-change dreams are fast turning into reality. ■



翻新董事会议室

对公司董事会的要求比以往任何时候都高

填补董事会席位也前所未有地难

在大众的想象中，公司董事看起来像是商界最轻松的闲职。董事们似乎只要每年参加几次会议，在首席执行官大谈战略时会意地点点头就能得到报酬，往往还很丰厚。他们很少登上新闻版面，除非偶尔因为不满而把CEO扫地出门，或者有维权投资者发起行动在一家知名公司里努力谋求董事席位（就像最近几个月在迪士尼、Salesforce和特斯拉发生的事）。一旦犯错的老板走人或维权运动结束（无论是因为它成功实现了目标，还是像迪士尼那样做出一些让步而安抚了挑战者），董事会就会再次隐入幕后，回到令人安心的默默无闻的状态。

事实上，这些低调的股东代表从未像现在这般忙碌过。他们被寄望能帮助老板应对战争、地缘政治冲突、卷土重来的高通胀、气候变化和技术颠覆，而这一切都还是在一场百年一遇的疫情之后。公司治理规则越来越严格，公司董事不得不承担起更多责任。他们也比过去更有可能得到股权薪酬，这让他们有了与其他股东一致的驱动力。

也许正因为如此，他们眼下比以前工作更卖力、时间更长，而他们往往还在其他公司担任高管的正职，工作强度本来就很高了。“现在一开会就开两天的情况并不少见，”英国巴克莱银行（Barclays）董事会主席克劳福德·吉利斯（Crawford Gillies）说，“十年前很少这样。”不过，至少他们开会还有晚餐享用。

对董事所有的新要求都可以从一个理想的董事会构成上看出来。特拉华大学（University of Delaware）的公司治理专家查尔斯·埃尔森（Charles Elson）长期担任公司董事，他回忆说，三十年前董事不过是装点门面而已。管理团队“基本上说了算”，他说。能进董事会的人都是管理层或其他董事的朋友。如今，一个自重的董事会应该包含供应链、美联储、中国、

ESG、AI等方面的专家，涉及的专业领域还在不断扩大。除此之外，董事会构成还要满足“多元化、公平和包容性”的要求，也就是确保避免全体成员都是白人男性。如今拼凑一个董事会已经成为高风险的企业数独游戏。

咨询公司普华永道在2022年对美国700多家上市公司董事的一项调查显示，许多董事都认同董事会的表现并不达标。在被问及对其他董事会成员有何评价时，近一半的董事表示至少有一名董事需要被换掉。五分之一的受访者表示有两个或更多的董事应该被换掉。不到一半的人认为他们的同行对环境、社会和公司治理问题（即ESG）或网络安全有深入理解。五分之一的人认为其他董事会成员不愿挑战管理层，而这明摆着是他们的主要职责之一。

董事会在另一项关键任务上也一直碌碌无为，那就是确保合适的人坐进高管办公室。近几年，董事会对继任安排踩下刹车，最初是因为疫情带来的不确定性，后来又是因为对地缘政治和经济的担忧加剧。根据研究机构世界大型企业联合会（Conference Board）和分析公司ESGAUGE的数据，2021年，在由美国公司构成的罗素3000指数中，CEO被董事会罢免的公司占比1.4%，低于近6%的历史平均水平。那一年，在涵盖美国最大公司的标准普尔500指数中，没有一家公司的老板被解雇。计划离任的CEO也被劝说推迟卸任。

在那些确实任命了新CEO的公司里，内部提拔的数量激增。自2022年6月起，标普500指数公司任命的CEO中约九成是内部提拔，是自2011年有记录以来的最高比例。去年11月，迪士尼重新请回曾担任该公司老板多年、本已退休的鲍勃·艾格（Bob Iger）掌舵，以求为魔力王国带回一些魔力（虽然当初正是艾格本人挑选了他那个没有魔力的继任者）。

对于董事会本身而言，应对这类挑战需要新鲜血液。而注入新鲜血液绝非易事。其中一个问题是要为新来者腾出位置。很少有公司愿意限制董事任期，标普500指数公司中只有6%的公司有这样的规定。若要说退休政策有什么变化，那就是相比以前更不受欢迎了些。2022年，67%的美国大公司

有退休政策，少于2018年的70%。2019年离开标普500指数公司董事会的董事中，超过四分之一的人任职15年以上，有些人甚至坚持做了几十年。今年1月迎来99岁生日的查理·芒格（Charlie Munger）自1978年以来一直担任工业集团伯克希尔哈撒韦（Berkshire Hathaway）的董事。哄这些老前辈退出是一桩棘手的事情。

另一种方法是增加董事人数。从2018年到2022年，标普500指数公司中董事人数超过12人的公司占比从不到16%上升到近18%。这样做的明显弊端就是董事变多可能会降低效率。

那些在积极招募替补人选或增加董事的公司面临着另一个问题。许多有用的新专业知识涉及的领域本身就是新的，比如ESG或AI。这意味着具备这种专长的潜在人选很少。因此，许多公司都是在同一群人才中找人。这可能有助于解释为何董事薪酬越来越高。罗素3000指数公司董事的薪酬中位数从2019年的17.7万美元上升到了2022年的20.5万美元。脚踏几条船的情况也更多了：标普500指数公司中，约65%的非执行董事至少兼任着另一家公司的董事，2018年这一比例是58%（见图表）；十分之一的非执行董事至少身兼三家公司的董事。在2022年初，动画公司皮克斯工作室（Pixar Studios）的前首席财务官安·马瑟（Ann Mather）同时任八个公司的董事。

资深的非白人或非男性董事尤其抢手。在英国，一项政府委托的对富时指数公司董事会多元化情况的调查发现，大多数公司仍未能任命有色人种担任董事。莫尼·曼宁斯（Moni Mannings）曾是一名律师，在多家英国大公司担任过各种非执行董事。她说，乔治·弗洛伊德（George Floyd）遇害在美国引发种族正义抗议活动，并在大西洋两岸引发少数民族裔董事招聘热潮之后的几个月里，她不断接到猎头公司的电话。“他们就找不到其他人了吗？”她不胜其烦又疑惑不解。

投资者开始意识到，身兼数职的董事可能会精力太过分散。去年5月，推特的股东投票免去了风投家埃贡·德班（Egon Durban）在董事会的职务，此前两家投票顾问公司警告说，他当时身兼七个董事会的职位，可能太多

了。（10月，新东家伊隆·马斯克干脆解散了董事会，推特的董事会问题得到最终解决。）全球最大的资产管理公司贝莱德（BlackRock）发起行动抵制董事“过多兼任”其他公司董事，6月，它投票反对任命马瑟为谷歌母公司Alphabet的董事。马瑟保住了自己的席位，但此后退出了房屋租赁服务公司爱彼迎和计算机网络公司Arista Networks的董事会。

结果是公司将不得不在更大范围内撒网。招聘董事也就可能要花更长时间，尤其是如果你拒绝叫板竞争对手的猎头，看谁能开出更高的薪水，曾在多家跨国公司担任董事长的彼得·傅赛（Peter Voser）指出。他任董事长的瑞士工程巨头ABB为填补一个董事空缺就花了很长时间，确切说来是两年。但最终，它找到了拥有合适技能和经验的理想人选。董事会也继续在幕后兢兢业业地忙碌。 ■



Refurbishing the boardroom

Demands on corporate boards are more intense than ever

And filling board seats has never been harder

IN THE POPULAR imagination, a corporate board seat looks like the cushiest sinecure in business. Board members appear to get paid—often handsomely—to attend a few meetings a year and to nod knowingly as the chief executive pontificates on strategy. They seldom make the news unless the occasional tut-tut results in the CEO being shown the door, or an activist investor campaigns for a seat at an iconic company (as has happened in recent months at Disney, Salesforce and Tesla). Once the errant boss is out or the activist campaign is over, either because it succeeded or, as in Disney's case, the challenger is placated with concessions, the board slinks back into comforting obscurity

In fact, these low-key shareholder representatives have never been busier. They are expected to help bosses navigate war, geopolitical strife, the return of high inflation, climate change and technological disruption, all in the aftermath of a once-in-a-century pandemic. Stricter corporate-governance rules have forced company directors to be more accountable. They are also more likely than in the past to be compensated in stock, aligning their incentives with those of other shareholders.

Perhaps as a result, they are working harder and longer than before, often on top of their demanding day jobs as executives at other firms. “It’s not uncommon to have two-day meetings,” says Crawford Gillies, who chairs the board of Barclays, a British bank. “That would have been very unusual ten years ago.” At least they get dinner.

All the new demands on directors are reflected in what counts as a desirable

make-up of a board. Thirty years ago directors amounted to little more than window dressing, recalls Charles Elson, a boardroom veteran and corporate-governance expert at the University of Delaware. Management teams “basically ran the show”, he says. Boards were stuffed with friends of the managers or of other board members. These days a self-respecting board ought to contain an expert on supply chains, the Federal Reserve, China, ESG, AI—the list goes on. Layer on top of that requirements for “diversity, equity and inclusion”—ie, ensuring that not everyone is a white male—and cobbling together a board has become high-stakes corporate sudoku.

Many directors agree that board performance is not up to snuff, according to a survey of more than 700 public company directors in America in 2022 by PwC, a consultancy. Asked to rate fellow board members, nearly half of directors said at least one needed to be replaced. One in five respondents would replace two or more. Less than half thought their peers had a strong grasp of environmental, social and governance issues (which is what ESG stands for) or cybersecurity. A fifth thought other board members were reluctant to challenge management, which is ostensibly one of their main jobs.

Boards have also been acquitting themselves without distinction in another critical task: ensuring that the right person sits in the corner office. Directors hit the brakes on successions in recent years, first amid the uncertainty of the covid-19 pandemic and then amid rising geopolitical and economic concerns. The share of CEOs ousted by boards in 2021 from the Russell 3000 index of American companies was 1.4%, down from a historical average of nearly 6%, according to data from the Conference Board, a research organisation, and ESGAUGE, an analytics firm. No boss in the S&P 500 index of America’s biggest firms got the boot that year. CEOs planning an exit were urged to postpone it.

Where new chief executives were named, insider appointments soared. As

of June 2022 around nine in ten CEO appointments in the S&P 500 were of insiders, the highest rate since records began in 2011. In November Disney reappointed its retired longtime boss, Bob Iger, to bring some magic back to the Magic Kingdom (never mind that it was Mr Iger who hand-picked his mojo-less successor).

For boards, dealing with such challenges requires new blood. Injecting it is no easy task. One problem is making room for the newcomers. Few companies are willing to impose term limits on directors; only 6% of firms in the S&P 500 do so. If anything, retirement policies are becoming a bit less less popular: 67% of large American firms had them in 2022, down from 70% in 2018. Over a quarter of directors who left S&P 500 boards in 2019 had served for more than 15 years. Some stick around for decades. Charlie Munger, who in January turned 99, has served on the board of Berkshire Hathaway, an industrial conglomerate, since 1978. Easing out such old-timers is a delicate business.

An alternative is to increase the board's size. Between 2018 and 2022 the share of S&P 500 companies with more than 12 directors has risen from less than 16% to nearly 18%. The obvious downside is that bigger boards can get unwieldy.

Where boards are actively recruiting substitutes or additions, they face another problem. Much of the newly relevant expertise concerns areas that are themselves, like ESG or AI, new. This means few prospective candidates possess it. Many companies therefore fish in the same talent pool. That may help explain why boards are getting more expensive: median compensation of Russell 3000 directors rose from \$177,000 in 2019 to \$205,000 in 2022. And more incestuous: around 65% of S&P 500 non-executive directors sit on at least one other board, up from 58% in 2018 (see chart); one in ten sits on at least three. Ann Mather, former chief financial officer of Pixar Studios, an animation firm, sat on eight boards at the start of 2022.

Experienced directors who are not white or male are in especially high demand. In Britain, a government-commissioned review into boardroom diversity at FTSE firms has found that most were still failing to appoint people of colour to boards. Moni Mannings, a former lawyer who has held various non-executive positions in big British firms, says she was inundated with calls from recruiters for months after the murder of George Floyd sparked racial-justice protests in America—and caused a hiring boom for directors from ethnic minorities on both sides of the Atlantic. “Do they not know anybody else?” she would wonder in exasperation.

Investors are waking up to the risks of overstretched directors spreading their time too thinly. In May Twitter’s shareholders voted to strip Egon Durban, a venture capitalist, of his board seat after two proxy-advisory firms warned that the seven board positions he was juggling at the time may have been too many. (Twitter’s board problem was solved conclusively in October when its new owner, Elon Musk, disbanded it altogether.) In June BlackRock, the world’s biggest asset manager, voted against Ms Mather’s board appointment at Alphabet, Google’s parent company, as part of its campaign against “overboarding”. Ms Mather maintained her seat but has since stepped down from Airbnb, a home-rental service, and Arista Networks, a computer-networking firm.

The upshot is that companies will have to cast their net more widely. Recruitment may take longer as a result, especially if you decline to enter a bidding contest with rival recruiters over directors’ compensation, notes Peter Voser, a seasoned chairman of multinational firms. ABB, a Swiss engineering giant Mr Voser chairs, took its time finding a director to fill one opening—two years to be precise. But in the end, it found the right person with the right skills and experience. And the board beavers away in the background. ■



巴托比

低调能干有利也有弊

老实人也有不满

在职场上，高调张扬、一心往上爬的人往往招人厌憎。他（研究表明男性往往更具有这种自恋特质）在会议上出尽风头，特别能邀功请赏，还是自我推销的行家。他往往是老板的宠儿。但他是踩着公司里另一类不起眼的人晋升的——那些能干、勤勉但低调的人。

研究发现，许多自信的极端利己主义者不适合做微妙的管理工作，他们被扶上马靠的正是做一个自信的极端利己主义者。公司更多时候会晋升自恋的人。研究人员发现，大概五分之一的首席执行官属于这一类型，远高于在整体人口中的比例。自恋的CEO会打击士气，而且有证据表明他们会产生产糟的财务业绩。

在2015年发表在《哈佛商业评论》上的文章《最好的管理者是无趣的管理者》（The best managers are boring managers）中，伦敦大学学院（University College London）的心理学家托马斯·钱莫罗-普雷姆兹克（Tomas Chamorro-Premuzic）为沉闷的奋斗者做了有力辩护。低调能干并不能直观突显领导力。从银行家到科技公司创始人，现代很多标志性老板都有着妄自尊大、高调张扬和反复无常的脾性。马斯克有很多地方可被指摘，呆板无趣却在其列。尽管如此，钱莫罗-普雷姆兹克认为勤勉但不张扬的性格往往有一些不被注意但很宝贵的优势。可以依赖有这样性格的人冷静决策、巧妙娴熟地管理团队，他们在情绪上也很成熟。他们应该先于“高调敢想，大胆展示自信”的同事得到晋升。

2002年，当时在佛罗里达大学工作的蒂莫西·贾奇（Timothy Judge）及其同事对领导力特征研究做了开创性的统合分析并发表了文章。他们发现，管理成效与情绪稳定、亲切友善和诚实可靠等性格特质之间存在关联。一个解释是，清醒的头脑可以更冷静地处理由人产生的诸多微妙问题（情绪

起伏更大的管理者可能就太容易被人激怒）。情绪成熟也是可靠度的一个指标。研究发现具有自恋等不健全特质的管理人员更可能做出不好的事情。相比之下，勤勤恳恳的老板在正直方面得分很高。

沉闷但勤勉在如今可能尤其宝贵。随着公司越来越要求重视软技能，比如能很好地与各种人沟通，情商高的员工应该会很抢手。商业环境复杂多变，公司在其中面临经济衰退、气候变化、疫情和战争等种种问题，让沉稳的领导者更受青睐。

当股东们在一旁紧张观望之时，首席执行官面对着为追求增长要冒多大风险的棘手决策。曾经以快速行动、打破陈规为傲的创业公司老板现在争相让自己看起来严肃稳健。“我们是一家非常乏味的公司。”杂货配送创业公司的老板奥利弗·默克尔（Oliver Merkel）最近对《金融时报》夸耀道。这种趋势在政界也很明显。拜登在美国、苏纳克在英国的上台一定程度上是因为他们的乏味但可靠能让人们摆脱其前任的聒噪而无能。充满考验的年代需要冷静的头脑。

尽管如此，低调能干的人如果希望得到更多欣赏（和薪酬），就不应该静坐等待。要想往上爬，低调的人最好还是高调一些，无论是在会议上大声发言，还是大胆宣扬自己的成绩。一旦拿下更高的职位，他们总归还是需要掌握抛头露面的本领，例如殷勤招待客户、主持会议和大谈特谈战略。尽管贾奇的分析显示情绪稳定和普遍勤勉对管理效果至关重要，但善于交际等外向型性格特质也有很大影响。

尽管有管理理论学家的告诫，公司还是乐此不疲地晋升错误的人。一般情况下，掌管晋升决策的人当中有很多本身就是自恋狂，靠惊艳他们的上司上位。而且高调的人不羞不臊的自我夸耀还给老板提供了便利，让他们有了一条捷径去找到晋升候选人，且不管这路径有多么误导。许多管理人员太忙了，没有耐性发掘真正的人才。毕竟，他们有很多其他重要的事情要做——比如在自己的上司那里卖力表现。 ■



Bartleby

Unshowy competence brings drawbacks as well as benefits

Dullness and its discontents

THE CHARISMATIC corporate climber is a common target for resentment in office life. He—and research suggests men are particularly given to such narcissism—hogs the spotlight in meetings, is adept at grabbing undeserved glory, and is a pro at self-promotion. More often than not, he is the boss's pet. But he rises on the back of another, unsung, corporate archetype: the competent, diligent but unexciting achiever.

Studies find that plenty of confident egomaniacs, unsuited to the subtleties of management, get a leg-up for being, well, confident egomaniacs. Companies disproportionately promote narcissists. Perhaps a fifth of chief executives fit the description, researchers have found, a far higher proportion than within the wider population. Self-absorbed CEOs can sap morale and, evidence suggests, produce poor financial results.

A strong case for the dull striver was made by Tomas Chamorro-Premuzic, a psychologist at University College London, in an article for the Harvard Business Review in 2015 entitled “The best managers are boring managers”. Understated competence does not intuitively scream leadership. Many totemic bosses of the age, from bankers to tech founders, come with big egos, showy antics and volatile tempers. Elon Musk may be accused of many things. Dullness is not one of them. Even so, Mr Chamorro-Premuzic argued, conscientious but unprepossessing characters tend to have little-noticed but precious advantages. They can be depended on to make decisions calmly, manage teams deftly and be emotionally mature. They deserve promotion ahead of co-workers with “flash and vision, and bold displays of confidence”.

A seminal meta-analysis of research on leadership characteristics, published in 2002 by Timothy Judge, then at the University of Florida, and colleagues, indeed found a link between managerial effectiveness and personality traits such as being stable, agreeable and dependable. One explanation is that level-headedness makes it easier to deal coolly with the many subtle problems thrown up by human beings (who may all too easily infuriate a more volatile manager). Emotional maturity is also an indicator of trustworthiness. Studies have found that managers with dysfunctional traits such as narcissism are likelier to get up to no good. Conscientious bosses, by contrast, score highly for integrity.

The dull but diligent could be especially valuable now. As companies claim increasingly to prize soft skills, such as being able to communicate well with all sorts of people, emotionally intelligent workers ought to be in demand. A volatile business environment in which firms face problems from recession to climate change, pandemics and war, favours the steady leader.

Chief executives face tricky decisions about how much risk to take in pursuit of growth, as shareholders look on nervously. Startup bosses who proudly moved fast and broke things are now falling over themselves to look demure. “We are a very boring company,” Oliver Merkel, head of Flink, a grocery-delivery startup, bragged to the Financial Times recently. The trend is visible in politics, too. Joe Biden in America and Rishi Sunak in Britain rose to their countries’ top jobs partly because their boring dependability promised relief from their predecessors’ noisy incompetence. Testing times call for cool heads.

For all that, quietly competent types hoping for greater appreciation (and remuneration) should not sit still. To rise up the ranks, the boring would do well to raise their profiles, whether by speaking up in meetings or talking up their accomplishments. If they bag bigger jobs they will anyway need to

master show-offy things like glad-handing clients, chairing meetings and holding forth on strategy. Though Mr Judge's analysis revealed emotional stability and general diligence were crucial to managerial effectiveness, extrovert qualities such as sociability were also telling factors.

Companies' penchant for promoting the wrong people is deeply ingrained, despite management theorists' admonitions. By default, many of those dishing out promotions are themselves narcissists who advanced by wowing their superiors. And showy sorts' shameless self-aggrandisement fulfils a convenient function for bosses, giving them a shortcut—no matter how misleading—to finding candidates for elevation. Many managers are too busy to patiently unearth genuine talent. After all, they have other important things on their plates—like impressing their own bosses. ■



男性避孕

向男性避孕药迈进了一步？

一种快速、暂时起效的避孕药在雄性小鼠身上显示出成功希望【新知】

人们会多常在更衣室里详细讨论有哪些避孕方法，分别有什么优缺点？在女更衣室，答案是这种讨论“出乎意料地频繁”。而在男更衣室则是“几乎没有”。长期以来，避孕一直主要是女性的事情。

这其中至少有一部分原因是男人没什么可讨论的。他们只有避孕套和输精管结扎这两种选择。而女性选择众多，包括避孕药、阴道环、含铜宫内节育器、含孕激素宫内节育器、避孕海绵、宫颈帽、杀精剂、子宫帽、女用避孕套和输卵管结扎等。因此，几十年来，研究人员一直在想办法扩大男性的选择范围，让两性都有多种选择。但迄今为止，由此产生的注射剂、凝胶剂和荷尔蒙药丸都还没有走过临床试验阶段。

在纽约威尔·康奈尔医学院（Weill Cornell Medicine）工作的约亨·巴克（Jochen Buck）和朗尼·莱文（Lonny Levin）现在派出了一名新选手参加这场竞赛。他们的避孕药无需像药丸和凝胶那样长期定量使用，而是可以快速且暂时奏效。他们在《自然-通讯》（Nature Communications）上发表的一篇论文中表明，至少在小鼠身上，该药能在半小时内起作用，可以让精子暂停游动，从而暂时抑制小鼠的生育能力，而它们的行为或性表现没有可观测到的变化。重要的是它们的生育能力一天之内就恢复了。

这种叫TDI-11861的药属于一类称为可溶性腺苷酸环化酶（sAC）抑制剂的分子。sAC本身几乎存在于每个体细胞中。它是一种名为cAMP的信使分子的来源，其活性受碳酸氢盐离子的调节。这些离子数量增加会加快sAC产生cAMP的速度，反之会减慢这个速度。

不同组织中的碳酸氢盐浓度差别不大，只有一个明显的例外。在储存成熟精子的附睾中，它只有正常水平的五分之一。其重要性在于，在射精过程中，一小团精子被推向前并与精液混合，会突然让碳酸氢盐浓度升至原本

的五倍，导致sAC产生大量cAMP。

cAMP的增加会激活精子，让它们开始游动，寻找卵子进行受精。TDI-11861阻断了碳酸氢盐在sAC上常见的结合位点，使sAC对碳酸氢盐浓度的快速变化没有反应。这就阻止了精子的游动。

尽管TDI-11861会抑制身体各处的sAC，但巴克和莱文说无需为此担心。有些男性由于某个基因突变而缺乏能起作用的sAC。这会导致不育，以及肾结石的发病率略微升高，但除此之外他们是完全正常的。因此，虽然sAC似乎是精子激活链条中的一个独特环节，但人体还是有很多方式产生cAMP的。

人们寻求男性避孕药的努力由来已久，巴克和莱文的发现能否真的成为突破还有待观察。在进入人体临床试验之前还需要更多动物试验。不过两位研究人员已经在研究其他抑制sAC的化合物，以确定哪种效果最好。

他们用的方法之一是X射线晶体学，能够在原子尺度上显示分子的结合情况。凭借这种方法，他们已成功让化合物更好地在sAC上正确的位置结合，并保持在那里，未来他们还希望能做得更好。

目前，与女性相比，男性在生育计划方面的掌控性要少，有时觉得自己对此没什么责任。根据联合国人口基金（United Nations Population Fund）的数据，每年有1.21亿次怀孕是计划外的，占总怀孕次数的近一半，这想必与上述情况不无关系。“这（sAC抑制）让男性真正扮演起伴侣的角色。”莱文说。谁知道呢？有些男性说不定会尝试一下。■



Male contraceptives

A step towards a contraceptive pill for men?

A fast-acting, time-limited drug shows promise in male mice

HOW OFTEN does locker-room talk involve nuanced discussion of the various types of contraceptives available, and the merits and difficulties associated with them all? In women's locker rooms, the answer is "surprisingly frequently". In men's, "hardly ever". Contraception has long been an overwhelmingly female issue.

At least in part, that is because men have little to discuss. Their choice is between condoms and vasectomy. Women, by contrast, may pick from a range which includes the Pill, vaginal rings, copper intrauterine devices, hormonal intrauterine devices, contraceptive sponges, cervical caps, spermicides, diaphragms, female condoms and tubal ligation. For decades, therefore, researchers have hunted for ways to level the playing field by extending men's options. But none of the resulting injections, gels and hormonal pills has so far advanced beyond clinical trials.

Jochen Buck and Lonny Levin, who work at Weill Cornell Medicine, in New York, have now entered a new runner into the race. Their candidate, rather than requiring the consistent and long-term application associated with pills and gels, is fast-acting and temporary. In a paper published in *Nature Communications* they show that, in mice at least, it works within half an hour, rendering the animals temporarily infertile by stopping their sperm swimming, but with no perceptible changes in their behaviour or sexual performance. Importantly, within a day, their fertility returns.

The substance concerned, TDI-11861, belongs to a class of molecules called soluble adenylyl cyclase (sAC) inhibitors. sAC itself is found in nearly every

body cell. It is a source of a messenger molecule called cAMP, and its activity is regulated by bicarbonate ions. A preponderance of those ions speeds up the rate at which sAC produces cAMP. A dearth slows it down.

The concentration of bicarbonate varies little from tissue to tissue with one notable exception. In the epididymis, the tube in which mature sperm are stored, it is a fifth of the usual level. The significance of this is that, at ejaculation, a tiny pellet of sperm is pushed forward and mixed with seminal fluid, suddenly quintupling the bicarbonate concentration. That causes sAC to produce a bunch of cAMP.

This increase in cAMP then activates the sperm, and lets them start swimming and searching for an egg to fertilise. TDI-11861 blocks the places on sAC where bicarbonate would normally bind, rendering it unresponsive to this rapid change in concentration. That stops them swimming.

Although TDI-11861 inhibits sAC everywhere in the body, Dr Buck and Dr Levin say this is not a cause for concern. Some men lack functioning sAC because of a mutation. That results in infertility and a slightly raised incidence of kidney stones, but otherwise they are completely normal. So, while sAC appears to be a unique link in the chain of sperm mobilisation, the body has built plenty of redundancy into its means of generating cAMP.

Whether Dr Buck's and Dr Levin's discovery will actually prove to be the long-sought breakthrough in the search for a Pill for men remains to be seen. More animal tests will be needed before trials on people can go ahead. The two researchers are, however, already looking at other sAC-inhibiting compounds, to determine which performs best.

One approach they use is X-ray crystallography, which shows how molecules fit together at an atomic level. With it, they have improved how well their compound binds to the right spot on sAC, and stays there—and

they hope to do better still.

Right now, men have less control over family planning than women do, and sometimes feel little responsibility for it. That is surely not unconnected with the fact that, according to the United Nations Population Fund, nearly half of pregnancies—121m each year—are unplanned. “This”, Dr Levin says, referring to sAC inhibition, “gives men the ability to be a partner.” Who knows? Some of them might even give it a try. ■



熊彼特

Alphabet是时候把YouTube分拆出去了

它可能比奈飞更值钱

鲍勃·艾格（Bob Iger）重新执掌迪士尼，里德·哈斯廷斯（Reed Hastings）宣布卸任奈飞（Netflix）CEO，相比这两起人事变动在当时引发的热议，在YouTube任CEO已有九年的苏珊·沃西基（Susan Wojcicki）2月16日宣布即将辞职的消息在媒体版面几乎是波澜不兴。这表明两件事：一是华尔街分析师和娱乐产业的笔杆子们对YouTube的业务关注甚少，尽管它已成为全球视频流播的枢纽及代名词；二是母公司Alphabet阵脚大乱遮蔽了YouTube的动静。从微软凭借ChatGPT叫板谷歌的搜索业务，到反垄断机构和美国最高法院的纠缠，多线作战让这家科技巨头的老板桑达尔·皮查伊（Sundar Pichai）疲于招架，以致YouTube的人事变动显得只是枝节小事。

这对沃西基不大公平。她做出让位给副手尼尔·莫汉（Neal Mohan）的决定也许并没有赶上YouTube成功的颠峰期。广告业减速再加上TikTok（一款令人上瘾的短视频应用）的竞争，导致YouTube的广告收入连续第二个季度同比下降。然而在沃西基任内，YouTube已成为娱乐景观不可或缺的一部分。对许多人来说，它集DIY手册、烹饪书、保姆、点唱机、瑜伽教练、新闻频道和消遣工具于一身。其月活跃用户达26亿，采用的收入分成模式简单高效，千百万创作者依赖该模式持续大量产出视频内容。为抗衡TikTok而推出的YouTube Shorts单日浏览量平均达500亿次。

科技评论员本尼迪克特·埃文斯（Benedict Evans）上月公布的数据突显出这个平台已远不止于生产社交媒体视频，而是更多地在制作主流内容。在美国，YouTube的电视收视份额最近已经超越奈飞。据埃文斯估计，去年YouTube向创作者支付的费用与奈飞投入大预算作品的资金几乎相当。MrBeast等YouTube网红博主的观众量堪比奈飞的最大爆款。

YouTube还是一个广告巨头。虽然去年它290亿美元的广告销售额仅占Alphabet收入的约十分之一，但研究公司安培分析（Ampere Analysis）的理查德·布劳顿（Richard Broughton）指出，这在全球广播电视广告市场1400亿美元的总值中是“相当大的份额”。此外，YouTube在音乐和播客上与Spotify争锋，在YouTube TV上像有线电视那样销售频道套餐，而且跟亚马逊和苹果一样，YouTube会从其他媒体公司的流媒体服务订阅中获取分成。据报道，YouTube甚至刚砸下140亿美元买下周日时段的美式橄榄球流媒体直播权。总之，在中国的防火墙之外，YouTube希望成为全球所有小屏幕视频——包括用户生成视频、流媒体以至体育内容等——的舞台入口。

沃西基不姓布林或佩奇，却是最接近山景城贵族圈的人；谷歌创始人谢尔盖和拉里当年就是在她家车库里捣弄出后来的谷歌搜索引擎。她无疑帮助把谷歌的专业精神带到了YouTube。YouTube在经历早年间信马由缰的混乱日子后（2006年被谷歌收购时它创立仅一年），沃西基入主高层，在里面扮演“大人”的角色及广告业务负责人。如今她要离开了，值得一提的是，现在已过了青春期的YouTube还能像以前那样靠依赖母公司获益吗？另一家研究公司MIDiA的蒂姆·穆里根（Tim Mulligan）认为，Alphabet事实上可能更多是在阻碍而非帮助YouTube成长。是时候分拆了吗？

对YouTube来说，支持分拆的理由很充分。首先是聚焦。从TikTok到流媒体大战，再到人们纷纷取消订阅付费电视，娱乐业动荡之大，让高度聚焦变得至关重要。Alphabet还有太多其他业务，无法对YouTube投入全部精力。然后是商业模式的问题。没有广告巨头的手压在肩头，YouTube将有更大的自由去实验如何支配订阅收入。第三个理由与监管机构有关。2月21日，美国最高法院就YouTube运用算法推荐极端主义视频是否违反反恐法规举行听证，法官们质疑了YouTube的立场。Facebook在内容方面也遭受了相当大的政治压力。但Alphabet比Facebook的母公司Meta规模更大，YouTube作为子公司也就成了更肥美的打击目标，特别是在反垄断机构眼中。它的YouTube TV等服务的全球扩张可能会因监管部门担忧Alphabet规模过大而受阻。

Alphabet也可能因分拆YouTube获益。皮查伊对ChatGPT（微软与创业公司OpenAI合作开发的人工智能）的慌乱反应令人们质疑其领导能力。把YouTube分拆出去将发出强烈的信号：他正在加倍押注这类“生成式”AI。这也将使Alphabet在与美国司法部的对阵中占得先手，司法部已于1月提告谷歌涉嫌垄断数字广告技术。Alphabet否认自己是垄断者。但假如法院得出了相反的判定，自愿拆分（哪怕与广告技术关联不大）也比被司法部按着脖子强拆要好。

YouTube作为一家独立上市公司的估值可能令人瞠目。它的广告销售额与奈飞320亿美元的收入接近，这还没算上它的8000万名音乐及付费订户或电视收入。投资银行Needham的劳拉·马丁（Laura Martin）认为YouTube至少价值3000亿美元，是迪士尼市值的1.5倍、奈飞市值的两倍。

如果这一切听起来太过简单，那是因为情况很可能就是如此。佩奇和布林控制着Alphabet超过半数的投票权，他们不希望成为第一个开始变卖家当的科技巨头。但是，既然中国公司拥有的TikTok不急于上市，投资者可能乐于购入一家美国同类公司的股份，尤其是一家挑战世界电视巨头的公司。在创作者经济中发家的新晋富豪们也可能同样趋之若鹜。 ■



Schumpeter

It's time for Alphabet to spin off YouTube

It could be worth more than Netflix

COMPARED WITH the attention heaped on Bob Iger's return to the helm of Disney and the stepping back of Reed Hastings at Netflix, news on February 16th that Susan Wojcicki would resign from YouTube after nine years as CEO caused barely a rustle in the media pages. That is a sign of two things. First, how little attention Wall Street analysts and entertainment-industry scribblers pay to the business of YouTube, even though it has become a hub—as well as a byword—for global video. Second, how overshadowed it is by the teetering ramparts of its parent company, Alphabet. Sundar Pichai, the tech giant's beleaguered boss, is fighting wars on so many fronts, from Microsoft's ChatGPT-inspired encroachment on Google search to trustbusters and the Supreme Court, that the goings-on at YouTube must seem like a sideshow.

That does a disservice to Ms Wojcicki. Her decision to hand over to her lieutenant, Neal Mohan, may not have come at the pinnacle of YouTube's success. A combination of an advertising slowdown and competition from TikTok, an addictive short-video app, has helped lead to its second consecutive quarter of year-on-year decline in ad revenues. Yet on her watch, YouTube has become so integral to the entertainment landscape that to many it is DIY handbook, cookbook, childminder, jukebox, yoga instructor, news channel and time sink, all rolled into one. It has 2.6bn monthly active users and a simple but effective revenue-sharing model that millions of creators rely on to keep pouring stuff out. Its response to TikTok, YouTube Shorts, averages 50bn views a day.

Data published last month by Benedict Evans, a tech commentator,

underscored just how far the platform has gone beyond social-media video to more mainstream content. In America, YouTube's share of TV viewing has recently eclipsed Netflix. Last year, according to Mr Evans's estimates, it paid its creators almost as much as Netflix paid for its big-budget productions. Star YouTubers like MrBeast command similar audiences to a top Netflix hit.

It is an advertising juggernaut to boot. Though its \$29bn of ad sales last year were roughly a tenth of Alphabet's revenues, Richard Broughton of Ampere Analysis, a research firm, points out that they are equivalent to a "sizeable chunk" of the global \$140bn broadcast-TV advertising market. Moreover, YouTube gives Spotify a run for its money in music and podcasts, sells cablelike bundles of channels on YouTube TV, and, like Amazon and Apple, takes a cut on subscriptions to other media companies' streaming services. And it has even just shelled out a reported \$14bn for the rights to stream live American football on Sundays. In short, putting China's great firewall to one side, it is hoping to become the stage door for all the world's small-screen video, from user-generated clips and streaming to sport.

Ms Wojcicki is as close to Mountain View aristocracy as you can get without being surnamed Brin or Page; Sergey and Larry first set up the search engine that would be Google in her garage. She no doubt helped bring Google's professionalism to bear on YouTube. After the freewheeling chaos of YouTube's early days—it had been founded only a year before Google bought it in 2006—she became the adult, and ad-executive, in the room. As she departs it is worth asking whether YouTube, now past adolescence, benefits from its attachment to the mother ship as much as it used to. Tim Mulligan of MIDiA, another research firm, thinks Alphabet may in fact be hindering YouTube more than helping it. Is it time for a spin-off?

For YouTube, there are many arguments in favour. One is focus. Such is the upheaval in the entertainment industry, from TikTok and the streaming

wars to cord-cutting in pay-TV, that laserlike concentration is essential. Alphabet has too much else on its plate to give YouTube full attention. Then there is the business model. Without the hand of an advertising behemoth on its shoulder, it would have greater freedom to experiment with subscription revenues. A third argument has to do with regulators. A case heard on February 21st at the Supreme Court on whether YouTube violated anti-terror laws by using algorithms that recommended extremist videos was met with scepticism by justices. And Facebook has suffered plenty of political heat over content. But being part of a bigger firm than Meta, Facebook's parent, makes YouTube a juicier target, especially for trustbusters. Its ability to expand services like YouTube TV globally may be hindered by regulatory concerns about Alphabet's size.

Alphabet could reap benefits, too. Mr Pichai's panicky response to ChatGPT, an artificial-intelligence (AI) partnership between Microsoft and a startup called OpenAI, has raised doubts about his leadership. A spin-off of YouTube would send a strong signal that he is doubling down on such "generative" AI. It would also enable Alphabet to get ahead of the Department of Justice (DoJ), which in January sued Google over its alleged monopoly of digital-advertising technologies. Alphabet denies it is a monopoly. But if courts decide differently, a voluntary break-up, even loosely related to ad-tech, would be preferable to a DoJ-imposed half-Nelson.

YouTube's valuation as an independent public company could be eye-popping. Its ad sales are close to Netflix's revenues of \$32bn, not counting its 80m music and premium subscribers or TV revenues. Laura Martin of Needham, an investment bank, reckons that it could be worth at least \$300bn, more than half as much again as Disney and double Netflix's market capitalisation.

If it all sounds too simple, that's because it probably is. Messrs Page and Brin control more than half of Alphabet's voting rights, and would not like

to be the first titans of tech to start selling off the family silver. Yet with TikTok, which is Chinese-owned, in no apparent rush to go public, investors would probably relish getting their hands on the shares of an American equivalent—especially one taking on the world's TV giants. The freshly minted plutocrats of the creator economy might, too. ■



经济学人视频

商业界如何运用元宇宙？（下）

增强现实设备使元宇宙技术能够真正改变关键设备，例如医疗服务的实现方式。



The Economist Film

How will business use the metaverse? Part 3

Augmented reality devices are enabling metaverse technologies to make a real difference to how vital devices, such as medical care, are delivered.



新生

城市中心：从办公室到家庭住房

曼哈顿下城改造的经验

曼哈顿下城的天际线长久以来都是美国企业界运势的象征。在上世纪的“咆哮的二十年代”，摩天大楼雨后春笋般涌现，预示着塞满转椅和办公桌的现代办公室的兴起。随着企业巨头的出现和华尔街公司的繁荣，上世纪70年代对办公空间的需求爆发，催生了一波兴建新高层建筑的热潮，比如世界贸易中心。现在，由于混合工作制导致对实体工作场所需求骤减，另一种建筑热潮正在积聚动力，它由豪华公寓而不是办公室驱动。

在纽约金融区的沃特街25号，美国有史以来最大规模的办公室转住宅改造项目正在进行中。该建筑位于纽约证券交易所附近，将把一座占地110万平方英尺（102,193平方米）的摩天办公大楼改造成1300套公寓，户型从单间到四居室不等。改造后的建筑将包含一个篮球场、一个水疗中心，还有室内和室外游泳池。它还将有一个屋顶露台、一个娱乐休闲厅和一些联合办公空间。

这座建筑是一个更广泛趋势的缩影，而引发这一趋势的是新近空置下来的大楼。在新冠疫情发生前，白领工作空间的需求量就已经在下降，但居家办公大幅增加导致更多建筑空置。根据房地产公司世邦魏理仕（CBRE）的数据，2022年第三季度，美国的办公室空置率飙升至近30年来最高水平，超过17%。伦敦约有8.4%的办公室处于闲置状态，远高于5%左右的长期平均水平。

世邦魏理仕估计，今年将有近2000万平方英尺的办公室改造项目投放美国的房地产市场。这占总供应量的一小部分，但几乎是2016年该公司开始收集数据时的五倍。在此期间，所有办公室改造项目中有三分之一是改成了住宅（其他受青睐的改造方向包括酒店，以及越来越多的生命科学实验室）。尽管最近的改造大多发生在美国东海岸的大城市，但在整个富裕

世界都可以看到办公室变身住宅。

不过，若不是存在一系列挑战，改造的速度原本还会更快。有些是非常实际的困难。公寓需要每个房间都要有自然光和窗户，而现代办公大楼的大面积平面规划往往只得到一批光线不足、通风不良的房间。办公楼里的卫生间往往集中在一个区域，这让管道工程成了一场噩梦。其他挑战与繁琐的手续有关。分区规划法限制了许多商务办公区内的住宅建设。在某些情况下，对建筑高度和密度的规定或是对经济适用房的要求会导致成本增加。咨询公司穆迪分析（Moody's Analytics）估计，在它追踪的纽约的1100栋办公楼中，符合各种标准的不到3%。

与此同时，计划改造办公楼的开发商必须买断或重新安置现有租户。因此，改造在财务上的划算程度往往不尽如人意。只有以大幅折价交易的写字楼改造起来才有可能有利可图。在某些案例中，改造一栋旧办公楼的成本可能比建造一栋全新的公寓楼还要高。

一些政策制定者正试图让流程变得更顺畅。随着办公室空置威胁到房东的盈利、商业地产税收收入以及附近商店和餐馆的生意，城市正在放松分区规则，并尝试税收减免激励。纽约市长埃里克·亚当斯（Eric Adams）预测，到2033年，此类激励措施将在纽约造就两万套新公寓。伦敦计划到2030年利用伦敦金融城的空间创造1500套新住宅。有三分之一的办公室空置的卡尔加里（Calgary）是拿出更雄心勃勃的计划的城市之一。2021年，这座加拿大城市为愿意尝试参与改造的开发商推出了一项资助计划。官员们此后已经承诺提供超过1.53亿加元（1.15亿美元）的拨款。

目前，办公楼改造是一个日益多见但相对仍然小众的项目。但是，房地产价值大跌、办公室格子间日益空空荡荡以及政治支持增加表明这一进程将会加速。穆迪分析预计，美国的办公室空置率将在2023年达到约19%的峰值，并将在至少五年内保持高位。即使经济稳健，对办公空间的需求看起来也不太可能回到疫情前水平。调查公司盖洛普估计，从事可远程办公的职业的美国人花在办公室里的时间将比新冠来袭前减少37%。

事实上，未来看起来可能会蛮像曼哈顿下城。虽然沃特街25号是个新项目，但在它所在的城区，办公室改建这一现象久已有之。1987年股市崩盘后，纽约近三分之一的办公室人去楼空，政府推出了税收激励来吸引开发商把老旧的办公楼改造成住宅。911袭击事件加速了这一进程，因为企业转移到了市区的其他地方。今天大约有83,000人居住在曼哈顿下城，而在1970年还不到700人。

这造就了一个对家庭友好的聚集地，以及一个为别处难以为继的办公中心提供了蓝图的社区。在游乐场上荡秋千的孩子和遛狗的居民改变了这个从前朝九晚五的金融中心的结构。夏季，附近的一家船屋提供免费的哈德逊河皮划艇之旅。在寒冷的月份，在毗邻滨水区的购物中心布鲁克菲尔德广场的室外溜冰场上，滑冰的人们在冰面上飞驰。这边厢金融公司刚搬走，包括传媒巨头康泰纳仕（Condé Nast）和群邑集团（GroupM）在内的更有创意的租户又搬了过来。写字楼的消亡不必意味着城市中心的消亡。■



New lease of life

City centres: from offices to family homes

Lessons from the transformation of Lower Manhattan

LOWER MANHATTAN'S skyline has long symbolised the fortunes of corporate America. A skyscraper boom in the roaring 1920s heralded the rise of the modern office, crammed with swivel chairs and desks. As corporate giants emerged and Wall Street firms flourished, office-space requirements exploded in the 1970s, fuelling a wave of new tower blocks such as the World Trade Centre. Now, as hybrid work slashes demand for physical workplaces, a different type of boom—driven by luxury flats, not offices—is gathering steam.

At 25 Water Street, in New York's financial district, America's biggest ever office-to-residential conversion is under way. The building, located near the New York Stock Exchange, will transform an office skyscraper, covering 1.1m square feet (102,193 square metres), into 1,300 apartments ranging from studios to four-bedroom homes. The revamped building will include a basketball court, a spa, and indoor and outdoor pools. It will also feature a rooftop terrace, an entertaining lounge and co-working spaces.

The building is part of a broader trend—one prompted by a glut of newly empty office buildings. The amount of space required for white-collar workers was already in decline before the covid-19 pandemic, but the vast increase in working-from-home has left even more buildings vacant. In the third quarter of 2022, office vacancies in America soared past 17%, the highest in nearly three decades, according to CBRE, a property firm. Some 8.4% of offices in London sit unoccupied, well above the long-term average of around 5%.

CBRE estimates that nearly 20m square feet of office conversions will hit America's property market this year; a small fraction of total supply, but nearly five times as much as in 2016, when the firm started to collect figures. In the intervening years, a third of all office conversions have been into homes (other favourites include hotels and, increasingly, life-science labs). Although much of the recent development has taken place in America's big east-coast cities, offices are becoming homes across the rich world.

Yet the pace of conversions would be higher were it not for a range of challenges. Some are practical. Flats require natural light and windows in each room—the large floor plans of modern office blocks often leave them stuck with poorly lit and badly ventilated spaces. Bathrooms in office buildings tend to be clustered in just one area, making plumbing a nightmare. Other challenges are related to red tape. Zoning laws restrict housing in many office districts. In some cases, height and density rules or affordable-housing requirements raise costs. Moody's Analytics, a consultancy, reckons that less than 3% of the 1,100 office buildings it tracks in New York meet the various criteria.

Meanwhile, developers planning to convert offices must buy out or relocate existing tenants. As such, the financial case for conversions is often unsatisfactory. Only office buildings that trade at a steep discount are likely to make profitable transformations. In some cases, converting an old office tower can cost more than building a brand new block of flats.

Some policymakers are trying to make the process smoother. With office vacancies threatening landlords' bottom-lines, commercial-property-tax revenues, and the businesses of nearby shops and restaurants, cities are relaxing zoning rules and experimenting with tax breaks. Eric Adams, New York's mayor, has predicted such incentives will lead to 20,000 new apartments in his city by 2033. London plans to use space in its Square Mile to create 1,500 new homes by 2030. Calgary, where one in three offices sits

vacant, is home to one of the more ambitious plans. In 2021 the Canadian city launched a funding scheme for developers willing to try their hand at conversions. Officials have since pledged more than C\$153m (\$115m) in grants.

For now, conversions are a growing but relatively niche pursuit. Yet plummeting property values, increasingly empty office cubicles and growing political support suggest things will accelerate. Moody's Analytics expects office-vacancy rates in America to peak at about 19% in 2023 and to stay high for at least five years. Even with a healthy economy, demand for office space looks unlikely to return to pre-pandemic levels. Gallup, a research firm, estimates that Americans with jobs that can be done remotely will spend 37% fewer days in the office than they did before covid struck.

The future may, in fact, look something rather like lower Manhattan. Although 25 Water Street is new, office conversions in this part of town are an older phenomenon. After the stockmarket crash of 1987, which left nearly one in three offices in New York vacant, tax incentives were used to entice developers to convert ageing office buildings into homes. The September 11th attacks sped up the process, as businesses moved to other parts of town. Today around 83,000 people live in Lower Manhattan, up from fewer than 700 in 1970.

The result is a family-friendly enclave, and a neighbourhood which offers a blueprint for struggling office hubs elsewhere. Children on swings in playgrounds and residents walking their dogs have altered the fabric of the former nine-to-five financial centre. A nearby boathouse provides free kayak trips on the Hudson river during the summer. In the colder months, ice skaters whizz around an outdoor rink in Brookfield Place, a shopping mall near the waterfront. Even as financial firms have relocated, a more creative collection of tenants, including Condé Nast and GroupM, two media giants, have moved in. The death of office blocks does not have to

mean the death of city centres. ■



绿化钢铁

净化钢铁行业的新方法

也许能减少90%以上的碳排放【新知】

炼钢是高污染行业。每生产一吨钢，就会向大气中排放约1.8吨二氧化碳。因此，炼钢产生的碳排放占全球人为温室气体排放的7%至9%。

人们正在探索更清洁的制钢法。这些方法大多使用氢气而不是焦炭作为还原剂，把氧从氧化铁矿石中提取出来。但相关技术基本上还处于起步阶段。再加上每家工厂原有设备的更新换代可能要花费高达数十亿美元，炼钢厂走向环保可能需要几十年时间。

不过，英国伯明翰大学的丁玉龙和哈丽特·基尔达尔（Harriet Kildahl）认为他们找到的方法或许可以改变这一局面。他们研发出一种工艺，可以快速又经济地应用到现有钢厂，将其二氧化碳排放量减少大约90%。已经有炼钢厂与他们洽谈，计划在五年内启动示范工厂。

丁玉龙和基尔达尔提出采用闭环碳循环系统取代大部分焦炭。目前的做法是把焦炭和矿石以交替叠加的方式铺设在塔状高炉内，鼓入被加热至超过 1200°C 的热空气。焦炭中的碳与空气中的氧在此高温下发生反应，生成一氧化碳。之后这些一氧化碳又与矿石中的氧发生反应，在被叫作“还原”的过程中释放出铁。各种相关反应产生的热量让高炉的温度超过铁的熔点（ 1538°C ），由此产生的铁水从炉底流出。与此同时，二氧化碳和其他气体，包括之前注入的空气（一开始是21%的氧气和78%的氮气）中残留的氮气，从高炉顶部排出。

丁玉龙和基尔达尔提出的改进方法（见图）是直接向高炉中注入一氧化碳，从而免去了在循环中使用焦炭。其高明之处在于这些一氧化碳的来源。它们是通过捕获高炉中产生的二氧化碳并将其回收（通过分解为一氧化碳和氧）而来的。如此释放出来的氧气可以用于炼钢的第二道工序，即向一个另外设计的熔炉中的铁水吹入氧气，脱除溶解在铁水中的部分碳，

以达到最佳的铁碳比例，制造出所需的那一类钢材。

这一切之所以可行，离不开一种叫作钙钛矿（perovskite）的新奇材料。它被放在该循环系统的一个核心反应室中。钙钛矿最早是1839年在俄罗斯乌拉尔山脉发现的一种矿物，以俄罗斯矿物学家列夫·佩洛夫斯基伯爵（Lev Perovski）的名字命名。如今钙钛矿已经被用来泛指具有该矿物那种独特晶体结构、但不一定具有相同化学成分的一类材料。

研究人员正在发现钙钛矿的各种用途。其中有一种被用来制造效率更高的太阳能电池板。另一种可用来生产几乎摔不碎的手机屏幕。还有些钙钛矿被用于燃料电池和其他清洁能源系统。丁玉龙和基尔达尔将碳酸钡、碳酸钙、氧化铌和氧化铁磨碎后混合，再放入烤炉中烘烤，结果便得到了自己的钙钛矿材料—— $Ba_2Ca_0.66Nb_0.34FeO_6$ （简称BCNF1）。

当循环系统将二氧化碳泵入反应室时，BCNF1从二氧化碳中夺取氧原子，并将氧原子吸收到自己的晶体结构中，留下一氧化碳。不过，这个过程不会一直持续下去。大约一天后，BCNF1中的氧原子达到饱和，就必须再复原。

再复原需要捕获高炉排放出的氮，然后将其泵入反应室。这使得反应室处于一个低氧环境，从而促使BCNF1释放所含的氧。这些氧用来炼钢时也会排放二氧化碳，但这些二氧化碳也可以通过反应室回收。

让整个过程高效的诀窍是这套系统中设有两个反应室，这样一个可用来制造一氧化碳，另一个进行再复原并产生氧气。一天后，两个反应室的角色互换，这样它们就可以连续不停地工作。基尔达尔表示，这一想法已经在实验室测试成功，且BCNF1性能没有任何退化。“系统的这一块是可行的，”她补充道，“接下来只需扩大规模。”

不过试验工厂要运转起来还必须克服一些障碍。其一是焦炭不仅为铁还原过程提供了一氧化碳，还为高炉中的矿石提供了结构上的支撑，使得气体透过焦炭上升，铁水向下流动。因而仍然需要用到一些焦炭。该团队的设计之一是改用陶瓷材料来实现这种支撑。

因此，这从技术上看很有前景。但经济上是否划得来呢？为了算这笔账，研究人员考察了英国的钢铁行业，该行业每年生产约760万吨钢。印度塔塔钢铁（Tata Steel）和英国钢铁（British Steel）这两家公司每年分别在各自位于塔尔伯特港（Port Talbot）和斯肯索普（Scunthorpe）的工厂生产300万吨钢，使用的都是高炉加吹氧转炉的传统方法。它们的二氧化碳排放占到了英国钢铁行业排放的94%。其余的排放则来自电弧炉，它们主要使用废钢，可以用可再生能源发电来运行。

该研究小组在不久前发表于《清洁生产期刊》（Journal of Cleaner Production）的一篇论文中预测，塔尔伯特港和斯肯索普的工厂要改造为使用BCNF1的工厂分别要花费大约3.6亿英镑（4.35亿美元）。其中2.1亿英镑将用于购买各自所需的4.25万吨钙钛矿。钙钛矿可能每五到十年就要更换一次。不过研究人员估计，除了不断累积的绿色效益，初期投资将在22个月内收回，因为不再需要购买昂贵的冶金焦了，同时还可以出售多余的氧气。

即使把耗电量的小幅增长算在内，采用该系统也会让这两个工厂在五年左右的时间里总共节省约13亿英镑。研究人员得出结论，这还会让碳排放减少88%，从而让全国总排放下降2.9%。

用氢气取代焦炭应该是为了在还原铁矿石时产生水而不是二氧化碳，从而消除温室气体排放。此外，氢气能以可再生能源电解水来制造，从而实现可持续生产。但是制造、储存和运输“绿氢”所需的基础设施还不存在。而且需求端都在争抢氢气，比如既要用它来替代天然气作为锅炉燃料，又要用它来生产绿色航空燃料等。因此，丁玉龙和基尔达尔看起来确实提出了一个不可小觑的替代方案。

丁玉龙认为，如果再进一步完善，BCNF1有可能取代高炉中的所有焦炭，从而将碳排放降到几近于零。如果与炼钢厂的洽谈取得成功并且试验厂建成，下一步就是检验该系统是否能证明自身价值了。如果能，那么BCNF1这种奇特的晶体将开始成为“绿氢”的劲敌。 ■



Greening steel

A new way to clean up the steel industry

Carbon dioxide emissions could be cut by more than 90%

MAKING STEEL is a dirty business. For every tonne of it some 1.8 tonnes of carbon dioxide (CO₂) are emitted into the atmosphere. As a result, steelmaking accounts for 7-9% of the world's anthropogenic greenhouse-gas emissions.

Cleaner ways of producing steel are being explored. Mostly, these are based on the use of hydrogen instead of coke as the reagent which extracts the oxygen from iron-oxide ore. But much of the pertinent technology is in its infancy. That, together with the cost of converting from old to new equipment, which might run to several billion dollars per plant, means it could take decades for steelmakers to go green.

Yulong Ding and Harriet Kildahl of the University of Birmingham, in Britain, have, however, come up with something they think might change things. They have developed a process which could be fitted quickly and cheaply to existing plants, and would cut their emissions by around 90%. Steelmakers are talking to them about getting a demonstration version up and running within five years.

Drs Ding and Kildahl propose employing a closed-loop carbon-recycling system to replace most of the coke. At the moment, coke and ore are packed in alternate layers inside a tower-like blast furnace and, as the name implies, blasted with air that has been heated to more than 1,200°C. At this temperature the carbon in the coke reacts with the oxygen in the air to yield carbon monoxide (CO). This gas then goes on to react with the oxygen in the ore, liberating the iron in a process called reduction. Heat from the various

reactions involved pushes the furnace's temperature above iron's melting point (1,538°C), and the resulting liquid metal flows out of the bottom of the tower. Meanwhile, CO₂ and other gases, including residual nitrogen from the injected air (which starts as 21% oxygen and 78% nitrogen), are vented from the top.

The modification Drs Ding and Kildahl propose (see diagram) cuts coke out of the loop by pumping CO directly into the blast furnace. The clever bit is where this gas comes from. It is made by capturing the CO₂ produced in the furnace and recycling it by splitting it into CO and oxygen. The oxygen thus released can then be used in the second part of the steelmaking process, in which that gas is blown through molten iron in a differently designed furnace, to burn off part of the carbon now dissolved in it and arrive at the optimum ratio of iron to carbon to create the type of steel required.

What makes all this possible is an intriguing material called a perovskite. This sits in a reaction chamber at the heart of the recycling system. The original perovskite was a mineral discovered in the Ural mountains, in Russia, in 1839, and named after Count Lev Perovski, a mineralogist from that country. The name has now been generalised to refer to a group of materials which share this mineral's distinctive crystal structure without necessarily sharing its chemical composition.

Researchers are finding a variety of roles for perovskites. One type is used to make solar panels more efficient. Another can produce phone screens that are almost unbreakable. Further variants are employed in fuel cells and other clean-energy systems. Drs Ding and Kildahl made their version by grinding up barium carbonate, calcium carbonate, niobium oxide and iron oxide, mixing the resulting powders, and then baking the mixture in an oven. The result is Ba₂Cao.66Nb_{0.34}FeO₆ (BCNF1, to its friends).

When the recycling system pumps the CO₂ through the reaction chamber,

the BCNF₁ grabs oxygen atoms from the gas and absorbs them into its crystalline structure, leaving behind CO. This cannot go on for ever, though. After about a day, the BCNF₁ becomes saturated with oxygen atoms, and so has to be rejuvenated.

That works by taking nitrogen emitted from the blast furnace and pumping it through the reaction chamber. This creates a low-oxygen environment inside the chamber, encouraging the BCNF₁ to release its oxygen. When the oxygen is used to make steel, that also emits carbon dioxide. But this, too, can be recycled through the reaction chamber.

The trick to making things efficient is to plumb two reaction chambers into the system. One can then be used to make CO while the other is rejuvenating and producing oxygen. After a day, their roles are reversed, allowing round-the-clock operation. The idea has been tested successfully in a laboratory without any degradation of the BCNF₁, says Dr Kildahl. “That part of the system works,” she adds. “It just needs to be scaled.”

For the trial plant to get under way, some hurdles will have to be overcome. One is that besides being a source of CO for the iron-reduction process, the coke also provides a structural support for the ore in a blast furnace, allowing the gas to rise up through it and the molten iron to flow down, so some is still required. One idea the team have is to replicate this support using ceramic materials.

The science thus looks promising. But what about the numbers? To evaluate those, the researchers looked at Britain’s steel industry, which makes some 7.6m tonnes of the stuff a year. Two firms, Tata Steel and British Steel, each turn out 3m tonnes at their plants in Port Talbot and Scunthorpe respectively, using the conventional approach of blast furnace followed by oxygen furnace. This accounts for 94% of the sector’s British emissions. The remainder comes from electric-arc furnaces, which use mainly scrap steel

and can be run on renewable electricity.

The Port Talbot and Scunthorpe plants could be adapted to use BCNF1 at a cost of around £360m (\$435m) each, the team calculate in a recent paper in the Journal of Cleaner Production. Of this, £210m would pay for the 42,500 tonnes of perovskite needed by each plant. That material might have to be replaced every five to ten years. However, the researchers estimate that, besides the green benefits accruing, the initial investment would be repaid in 22 months by the elimination of expensive metallurgical coke from the process, and from selling any oxygen that was surplus to requirements.

Even allowing for a small increase in electricity consumption, implementing the system on both sites would save about £1.3bn over the course of about five years. There would also, the researchers conclude, be a reduction in carbon-dioxide emissions of 88%, resulting in a countrywide fall in overall emissions of 2.9%

The point of replacing coke with hydrogen would have been to reduce the ore in a way that created water rather than CO₂, thus eliminating climate-warming emissions. Hydrogen can, moreover, be produced sustainably, using renewable electricity to electrolyse water. But the infrastructure required to make, store and transport green hydrogen does not yet exist. And there are competing demands for the gas, including as a replacement for natural gas as a fuel for boilers, and in the production of green aviation fuel. So Dr Ding's and Dr Kildahl's proposal does look like a serious alternative.

Given more work, it might be possible for BCNF1 to replace all of the coke in a blast furnace, cutting emissions down close to zero, reckons Dr Ding. If the talks with steelmakers are successful and a trial plant is built, the next step is to see whether the system proves its worth. If it does, then a curious crystal will start to give green hydrogen a serious run for its money. ■



巴托比

为什么是时候戒掉“咖啡馆约见”了

一条将会历久弥香的效率妙诀

现在人们花很多时间阅读有关提升生产率的妙诀的书，如果他们能把这些时间用来做些实事，他们的效率问题也就解决了。但这些书偶尔也还是有些真知灼见的。阿曼莎·因贝尔（Amantha Imber）的《善用时间》（Time Wise）一书中有个简短的章节，其标题就闪现着良好的决断力，叫“为什么要对咖啡馆约见说‘不’”。对于任何与以下场景有共鸣的人来说，这是一个极好的建议。

一个素不相识的人发来一封邮件，请你喝个咖啡见个面。这种请求经常出现。对方可能是刚进入职场的新人，想向你求教如何在你从事的这个行业里发展。也可能是一个四下找活的自由职业者。在我们的例子中，一个叫凯西的发件人从一个你隐约有点印象的同事那里知道了你，觉得你们所在的两家公司也许会有合作的空间。

你并不真想去见凯西。但是，说你不想见谁总归感觉有些粗鲁。离会面时间还有几周，看起来那时也有空闲。你也有喝咖啡的习惯。如果你哪天想跳槽，说不定她能帮上忙。你也听说过她的公司，也许聊一聊能得到什么有用的信息。你没有理会直觉，回说“好”。

会面的那天来了，早上你在日程表里看到“和凯西喝咖啡”的提示。谁啊这是？你找到了那一串邮件，骂自己为什么会同意，一度考虑取消它。就在这时，凯西发来一封邮件，说她很期待和你喝咖啡。见鬼。你确认了时间和地点，但说自己只有半个小时的时间。

你到了咖啡厅，才想起来根本不知道凯西长什么样。你问了几个人，他们明显也是在等待类似的令人茫然的会面。之后你才收到凯西的信息，道歉说她迟到了，5分钟后到。既然是咖啡碰头会，至少得喝到咖啡吧，所以你自己点了杯咖啡，找了张桌子。希望战胜了经验，所以你还是带了个记

事本：你在页面上方写下了日期、凯西的名字和公司。

你发信息告诉凯西你坐在一个穿粉色套衫的男人旁边，但你刚发完他就离开了。十分钟后，你看到一个人进来东张西望地打量人们的上衣。你们互相用嘴型默念着对方的名字，活像鱼缸里的孔雀鱼。那是凯西。她去点了咖啡，又花了五分钟。现在咖啡会面完成一半了，剩下的就是会面了。

凯西坐下来。你们例行公事地寒暄一番。你们交换了一些对任何人都不会有什用的信息：你一天内最晚何时喝咖啡不会影响睡眠，现在你每周在办公室几天，她和你那个同事怎么认识的。然后你又确认了你们都已知道的事情（你的职务是什么），再加上一些无关紧要的细节（你干这份工作多久了）。

现在离预定时间还剩差不多十分钟。你催凯西多讲一点她之前提到的那些机会，当时你正是因为这个才觉得见个面也不错。她就一个你可能有兴趣的数据集说了点什么。你扯了一些关于分析的东西，就为了让自己看起来还算锐意创新。她抛回来关于AI的东西。你寻思你俩其实都不知道自己究竟在说什么。你意识到面前的记事本上还是一片刺眼的空白，于是写下了“数据分析”和“AI”，只是为了表示这有可能引向一些合作机会。

你的咖啡见底了，30分钟也到了。你说你必须走了。在左等右等买单时，你又讲了一些无用的东西：你们接下来各自要去哪里，凯西准备在市区待多久。你甚至能感到脑细胞断定这里没有任何值得记忆的东西。你们两人说这次会面很好，尽管根本不是这么回事，你们还说要保持联系，尽管不会再见。

不是每一次会面请求都只会让人做无用功。比如给年轻人建议通常都值得一做（虽然会寻求建议的那类年轻人通常并不是需要帮助的那类）。问题是咖啡。因贝尔的建议是别去喝咖啡，而是在做不了其他事的时间安排一次通话，比如通勤时。这可能会让这段时间很有成效；如果没有，也不会感到浪费时间。就咖啡和会面而言，问题就出在把两者搅拌在一起。■



Bartleby

Why it's time to get shot of coffee meetings at work

A productivity hack for the ages

IF PEOPLE USED the time they currently devote to reading books about productivity hacks to do some actual work, their productivity problem would be solved. But occasionally these books contain nuggets of wisdom. In “Time Wise”, Amantha Imber has a short chapter whose title alone gleams with good sense. It is called “Why you need to say ‘no’ to coffee meetings”. That is splendid advice for anyone who can identify with the following situation.

An email arrives from someone you do not know, asking to meet for coffee. Such requests arrive fairly often. It might be someone starting out on their career who wants guidance on how to progress in your field. It might be a freelancer hunting for work. In this instance the sender, who is called Cassie and got your name from a colleague whom you vaguely know, thinks there may be a way for your two companies to work together.

You don't really want to meet Cassie. On the other hand, saying that you don't want to meet someone, ever, feels a little rude. The meeting is weeks away, and the diary looks clear. You do drink coffee. She might be a useful contact if you want to move jobs. And you have heard of her company: it is just possible something useful might come of a discussion. You ignore instinct and say “yes”.

The morning of the meeting arrives and you see “Coffee with Cassie” in your calendar. Who the hell is Cassie? You find the email chain, curse yourself for agreeing to meet and wonder briefly about cancelling. Just then an email arrives from Cassie saying how much she is looking forward to coffee.

Bollocks. You confirm the time and place, but say you only have time for half an hour.

You arrive at the coffee shop, and remember you have no idea what Cassie looks like. You introduce yourself to several other people, who are plainly all waiting for similarly aimless meetings, until you receive an apologetic text from Cassie to say that she is running late and will be there in five minutes. The one thing you are determined to get out of this coffee meeting is a coffee, so you order for yourself and find a table. In a victory of hope over experience you have brought a notepad: you write the date and Cassie's name and company at the top.

You text Cassie to say that you are sitting by the man in the pink sweater, who leaves almost immediately. Ten minutes later you see someone who is scanning the room at sweater height. You mouth each other's names like guppies in an aquarium. It's Cassie. She goes to get her own coffee, which takes another five minutes. The coffee meeting is halfway done and there has yet to be a meeting.

Cassie sits down. Ritual demands an exchange of platitudes. You swap information that will be of no use to anyone ever: how late in the day you can drink coffee before it disrupts your sleep, how many days a week you now spend in the office, how she knows your colleague. Then you confirm things that were already known to both of you (what roles you are in) and add unnecessary detail (how long you have been in your job).

There is now about ten minutes left on the clock. You prompt Cassie to say a bit more about those opportunities she raised back when this seemed like a good idea. She says something about a data set that you might be interested in. You say something about analytics, just because it makes you seem mildly innovative. She volleys back a reference to AI. You suspect that neither of you really knows what is going on. You are aware that the notepad

in front of you is still damningly blank, so you write down “data analytics” and “AI” just to signal that this could be leading somewhere.

Your coffee is drained and the 30 minutes have passed. You say you have to go. While you wait—and wait—to pay, you share a bit more useless information for good measure: where you are both going next, how long Cassie is in town for. You can almost feel your neurons deciding that there are no memories here that are worth forming. You both agree that it has been really good to meet, even though it hasn’t, and that you will be in touch, even though you won’t.

Not every meeting request is a dud. Giving advice to youngsters, say, is usually the right thing to do (though the types of youngsters who ask for advice are not usually the ones who need help). The problem is the coffee. Ms Imber’s recommendation is to forgo the caffeine and schedule a call during a period of dead time such as a commute. The time may be used fruitfully; if it is not, it will not feel as wasted. In the matter of coffee and meetings, the blend is the problem. ■



娱乐即理财

为什么中国游客增多意味着资本外逃增加

千百亿美元在假期的掩护下流出

坐火车游老挝，去俄罗斯边陲看北极光，或乘邮轮探险北极极地。随着中国重新开放，这类探索之旅成了该国市场上的热门推广路线。人们似乎有很强烈的旅行冲动。据旅行社携程网称，他们接受的咨询量在一个月内翻了两番。学生也在寻找更多的出国留学机会。在赌城澳门，两家顶级酒店本月客房已全部订满。法国外贸银行（Natixis）称，如果疫情前的模式重现，中国今年的旅游支出可能会增加1600亿美元。

经过三年的疫情封控，急着往外走是可以理解的。但除了阳光、大海、沙滩和留学这些显而易见的出行理由，还另有一个不能明说的动机——偷偷将资金带出国门。由于有资本管制，中国公民购汇受限。人员跨境流动为资金流动提供了掩护。例如，2017年，根据中国有关部门公布的情况，一名天津人“以境外留学等名义”，持39张银行卡提取了超过240万加元（180万美元）。

2017年，当时在美联储任职的安娜·黄（Anna Wong，音译）发表了一篇论文，试图计算有多少资金通过这条途径从中国流出。她研究了20个热门目的地的多种原始资料，包括这些地方的收支平衡状况、游客人数统计，以及对典型中国游客消费金额的调查。这让她能够将中国国际收支报告的出境支出与目的地国报告的对应的入境支出进行比较。原则上来说，出入支出数据应该相匹配。但从2014年开始，两者之间出现了巨大的差距。2015年差距达到1000亿美元，相当于中国GDP的1%。作者发现，中国报告的旅行支出与一个经济模型预测的水平之间也存在类似的巨大差距，该模型基于目的地国的GDP、它们与中国大陆的距离、以及中国自身的经济规模等因素构建。

自那以后，政策制定者收紧了中国的资本管制，更严格地审查交易。他们

还修改了过去的数据，从旅行支出数据中删除了一些非法金融交易。但让人生疑的差距仍然存在。中国自己的旅游支出数据仍然超过根据目的地国和全球原始资料得出的数据。法国外贸银行在2月14日发布的一份报告中估计，2020年的数据差距接近680亿美元（约相当于中国GDP的0.5%），尽管当年旅游人数急剧下降。

随着中国重新开放，绕开资本管制的机会将增加。目前人民币稳定，今年经济有望实现强劲增长，但中国家庭在疫情期间积累了大量存款。历来是中国人财富主要去向的房地产业仍处于垂死状态。因此许多人将积极分散资产。世人旅游多为开阔眼界，中国人同时也想扩大他们的投资组合。■



Mixing business with pleasure

Why more Chinese tourism means more capital flight

Many billions of dollars escape under the cover of holidays

A RAILWAY TOUR of Laos, a trip to the far corner of Russia to see the Northern Lights, or a polar cruise in the Arctic. These are some of the adventurous options being marketed in China as the country reopens. The urge to travel seems strong: Ctrip, a travel agent, has reported a quadrupling of inquiries in the space of a month; students are searching more for study-abroad opportunities, too. In Macau, a gambling centre, two of the fanciest hotels are fully booked this month. If pre-pandemic patterns reassert themselves, China's travel spending could increase by \$160bn this year, according to Natixis, a bank.

After three years of covid-19 restrictions, this wanderlust is understandable. But alongside the obvious motives—sun, sea, sand and study—is another unstated one: spiriting money out of the country. Capital controls limit the foreign currency Chinese citizens can buy. The movement of people across borders creates cover for the movement of money. In 2017, for example, China's authorities reported how an individual from Tianjin got hold of 39 bank cards and withdrew more than C\$2.4m (\$1.8m) “in the name of studying abroad”.

A paper published in 2017 by Anna Wong, then at America's Federal Reserve, tried to calculate how much money was leaking out of China by this route. She examined a variety of sources in 20 popular destinations, including their balance of payments, their tallies of visitor numbers and surveys of how much a typical Chinese visitor spends. This allowed her to compare outbound spending reported in China's balance of payments with its mirror image: inbound spending reported by countries of destination. In principle,

the inbound and outbound measures should have matched. From 2014, though, a large gap emerged between the two. It reached \$100bn in 2015, or 1% of China's GDP. Ms Wong found a similarly large gap between China's reported travel expenditure and the level predicted by an economic model, based on factors like the GDP of destination countries, their distances from the mainland and China's own economic size.

Since then, policymakers have tightened the country's capital controls and scrutinised transactions more closely. They have also revised past data, removing some illicit financial transactions from figures for travel spending. But a suspicious gap persists. China's own figures for travel spending still exceed those derived from destination countries and global sources. In a report released on February 14th Natixis estimated that the gap was almost \$68bn in 2020 (roughly 0.5% of China's GDP), despite the sharp drop in travel.

As China reopens, chances for circumventing capital controls will increase. The country's currency is stable and growth this year looks likely to be strong, but Chinese households accumulated a large stash of deposits in the pandemic. The property market, historically a favoured destination for the country's wealth, remains moribund. Thus many will be keen to diversify their assets. Most people travel to broaden their horizons. The Chinese also like to broaden their portfolios. ■



【首文】即插即付款

除非可再生能源能真正赚钱，否则全球脱碳快不起来

政府必须接受绿色能源的高价

在乌克兰战争和全球能源危机的愁云惨雾中，闪现了一丝曙光。绿色转型已经提速。诚然，天然气价格飙升刺激了对煤炭这一污染最严重的化石燃料更大的需求。但它也使得消费者开始更高效地使用能源。更重要的是，它刺激了世界各地对可再生能源的投资。去年全球对风能和太阳能资产的投资首次超过了对新建和现有油气井的投资。未来十年，美国和欧洲政府将花费数十亿美元补贴清洁技术；中国也在提供丰厚的激励措施。

令人欣喜的结果是，绿色转型可能加快了五到十年。然而值得注意的是，这一转型本来还可以推进得更快。就在政府打开钱袋子的同时，它们也开始减少对投资的激励。再度强化激励措施至关重要，因为按照目前的发展轨迹，全球不太可能在2050年实现净零碳排放——这是到2100年将气温升幅控制在比工业化前平均水平高1.5°C的关键节点。

问题之一是拿到许可。无休止的延迟让想投资的公司无法破土动工。长久以来这都是在美国和欧洲启动新项目的障碍；但令人担忧的是，一些地方正在开倒车。丹麦是海上风能的明星。但在意识到这可能违反欧盟法律后，丹麦从2月6日起停止处理所有此类项目的申请。削减繁文缛节会有巨大收益。据官方预测机构国际能源署估算，如果消除官僚程序和融资方面的障碍，到2027年可再生能源发电量将再增加25%。

更大的问题是，一些可再生能源供应商现在正在重新全盘考虑它们的投资，因为能源项目的吸引力正在下降。最高限价和各种各样的税收，再加上不断上涨的成本，都让它们望而却步。

2021年1月至2022年4月期间，在物流不畅、封城结束后的反弹和战争引起的中断的共同作用下，从航运到工业金属等各种商品和服务的价格都在上涨，进而推高了太阳能电池组件和风力涡轮机的价格。高利率让资金成本

更高，这令绿色发电厂的建造商感到头疼，因为这些电厂所需的资金要比化石燃料发电厂多得多。

如果这些成本可以转嫁出去，那还能应付。但各国政府正日益多地对电力市场实施微观管理，以求保持低价或提高自身收入。欧盟已经对可再生能源发电厂设定了价格上限，许多欧洲国家也已对它们的利润征收暴利税。在全球各地，拍卖可再生能源合同就是为了保持电价低廉——低到让发电厂很难赚到钱。这导致它们转而到现货市场上售电，而这个市场风险更大，对投资者的吸引力也更小。有些招标怂恿开发商竞争，看它们愿意支付多少费用来获得运营资格，这一机制被称为“负向竞标”。这可能让成本进一步膨胀。

结果是利润被挤压。西方四大风力涡轮机制造商正在亏损。今年1月，全球最大的海上风能开发商沃旭能源（Orsted）在美国的一个大型项目上支出3.65亿美元；2月8日，挪威国有能源巨头挪威国家石油公司（Equinor）的可再生能源部门报告称，尽管收入比2021年同期增长了81%，但2022年第四季度的亏损仍在扩大。同一周，两家美国公司杜克能源（Duke Energy）和道明尼能源（Dominion Energy）也分别在其风能和太阳能投资组合上记上了13亿美元和15亿美元的支出。

这阻碍了新项目的启动。从美国到亚洲，风能开发商正试着修改它们的投标或是就融资协议重新谈判，推迟了项目建设。一些公司正在退出大型招标，炮轰项目“不具可投资性”。在美国，很多太阳能项目都陷入停滞，而在欧洲，可再生能源购电协议的签约也减少了。

政府现在热衷于把电价保持在低位，但如果这减少了为了未来而需要的可再生能源支出，就可能是一种虚假的划算。而随着风能和太阳能发电装机容量增加，开发商可能还要承受更多的成本增长。比如，铜短缺会推高电缆和电线的价格，而缺少维护和操作涡轮机的熟练工人会推高工资。

所有这些都意味着，如果要让投资保持吸引力，绿色能源的售价就要高于政府的心理价位。如果要迅速实现能源转型，一定不能搞逐底竞争。■



Plug and pay

The world won't decarbonise fast enough unless renewables make real money

Governments must accept that green power is pricey

AMID THE misery of war in Ukraine and the global energy crisis, there is a glimmer of good news. The green transition has speeded up. True, a spike in natural-gas prices fuelled greater demand for coal, the dirtiest of fossil fuels. But it also led consumers to use energy more efficiently. And, more significantly, it spurred investment in renewables around the world. Last year global capital spending on wind and solar assets was greater than investment in new and existing oil and gas wells for the first time. Governments in America and Europe are spending billions on subsidies for clean tech over the next decade; China is offering juicy incentives, too.

As a happy consequence, the green transition may have accelerated by five to ten years. Yet the remarkable thing is that the transition could have proceeded at a faster pace still. Even as governments have loosened the purse-strings, they have begun to blunt the incentives to invest. Sharpening them again will be vital, as on today's trajectory the world is unlikely to reach net zero carbon emissions by 2050, the milestone for limiting temperature rises to 1.5°C above pre-industrial averages by 2100.

One problem is obtaining permits. Endless delays stop firms that want to invest from breaking ground. This has long been an obstacle to new projects in America and Europe; the worrying thing is that some places are going backwards. Denmark is a star in offshore wind. But on February 6th it stopped processing all applications for such projects, after a dawning realisation that it may be in breach of EU law. The gains from cutting red tape are large. The International Energy Agency, an official forecaster,

estimates that renewables generation would rise by an extra 25% by 2027 if bureaucratic and financing barriers were removed.

The bigger problem is that some renewables providers are now rethinking their investments altogether, because energy projects are becoming less attractive. Price caps and various taxes, together with rising costs, are putting them off.

Between January 2021 and April 2022 logistical hiccups, post-lockdown rebounds and war-induced disruptions together buoyed the prices of everything from shipping to industrial metals, which in turn raised the prices of solar modules and turbines. Higher interest rates have made money dearer—a headache for builders of green plants, which are much hungrier for capital than their fossil-fuel-fired counterparts.

Such costs would be manageable if they could be passed on. But governments are increasingly micromanaging power markets to keep prices low, or to raise revenue of their own. The EU has imposed a price cap on renewable generators, and many European countries have implemented a windfall tax on their profits. Around the world, auctions for renewables contracts are being designed to keep electricity cheap—so cheap that generators will struggle to make money. That leads them to sell electricity on the spot market instead, which is riskier and less appealing to investors. Some tenders entice developers to compete over how much they are willing to pay to run projects, a system known as “negative bidding”. This may bloat costs yet more.

The result has been squeezed profits. The four largest Western turbine-makers are losing money. In January Orsted, the world’s largest offshore-wind developer, took a \$365m charge on a big American project; on February 8th the renewables arm of Equinor, Norway’s state-owned energy giant, reported a widening loss for the fourth quarter of 2022—despite an 81%

jump in revenue compared with the same period in 2021. That week Duke Energy and Dominion Energy, two American firms, also booked charges of \$1.3bn and \$1.5bn, respectively, on chunks of their wind and solar portfolios.

This is clogging up project pipelines. From America to Asia, wind developers are trying to revise their bids or renegotiate financing deals, delaying construction. Some are withdrawing from big tenders, decrying projects as “uninvestible”. In America many solar projects are stalled, and in Europe fewer agreements to buy the power they generate are being signed.

Governments are keen to keep power prices low today, but that may be a false economy if it reduces the renewables spending needed for tomorrow. And as more wind and solar capacity is built, developers will probably need to withstand even bigger cost increases: a shortage of copper, say, would push up the prices of cables and wires, and a scarcity of trained workers needed to maintain and operate turbines would boost wages.

All this means that, if investing is to stay attractive, green power will need to be sold at higher prices than governments would like. If the energy transition is to happen fast, there must not be a race to the bottom. ■



上。下。横向震荡？

从腾讯的反弹看中国科技大厂的前景

一个曾经势不可挡的行业正在适应一种新常态

也许没有哪家公司比中国第一大科技公司腾讯更能体现中国科技巨头的兴衰起伏。两年前，这个网络帝国似乎势不可挡。超过10亿中国人用其无所不在的各色服务来支付、娱乐和做其他许多事情。它出品的电子游戏，如《英雄联盟》，在全球大受欢迎。腾讯的市值一度超过9000亿美元，有望成为中国首家万亿美元公司。

接着共产党发话了：够了。中国最高领导人习近平认为，大型科技公司让青少年分心，令资本从半导体等战略部门分流出去，种种副作用不可接受。腾讯和一度繁荣的中国数字行业里的其他公司一样，受困于长达18个月的全面整治行动。监管机构断言电子游戏是“精神鸦片”，禁止18岁以下青少年每周玩游戏超过三小时。腾讯的新游戏被审查机构叫停。与此同时，反垄断官员迫使它拆除自家应用程序的围墙，放开其他支付处理工具接入。去年，它将所持两家电子商务公司京东和美团价值360亿美元的股份作为股息转让给股东，一定程度上可能是为了支撑自己的股价，但也可能是为了减轻官方对自己的业务无孔不入的担忧。让局面变得更糟糕的是，习严厉的新冠清零政策导致中国消费者害上了“节俭症”。2022年第三季度，腾讯的收入同比下降2%，是有记录以来的最差业绩。到去年10月，其市值暴跌至不足2500亿美元。

最近，中国互联网公司的境遇在好转。摆脱了清零政策的购物者正在“报复性消费”。监管机构正在放松对企业旧业务的管控，还给予它们空间试探新业务。腾讯的市值在过去三个月里翻了一番（见图表1），再一次体现了这种氛围上的变化。如果你想了解这一切对中国数字经济的未来意味着什么，这个低下头颅的冠军企业是个参考。

在西方或中国以外的任何地方都找不到类似腾讯的公司。它一部分是

Meta，一部分是PayPal，一部分是Epic Games（它拥有这家游戏公司的大量股份），还带了点亚马逊和软银的成分——腾讯和这家美国巨头一样，也提供电子商务和云服务，还和这家日本巨头一样，在全球范围内进行了数百项科技投资。尽管第三季度业绩令人失望，该公司3月将公布的2022年销售额预计会超过800亿美元。游戏、商业服务（包括支付、电子商务和云计算）、社交媒体和广告三大块大约分别贡献了三分之一。预计其税前利润将轻松超过300亿美元。如果排除在2022年回报颇丰的银行和能源公司，世界上只有少数几家公司业绩比腾讯更好。

腾讯的财富密码是它的超级应用微信。多年来，世界各地的公司都试图模仿它将支付（交易经济）和玩乐（注意力经济）巧妙结合起来的做法，然而很少有公司能在结合的顺畅程度上比肩腾讯，更没有哪一家能达到类似的规模。上个月的农历新年庆祝活动就是个很好的例子。在为期一周的欢庆中，微信用户向亲友发送了40亿个数字红包，在微信的新视频平台“视频号”上观看春晚的人数（1.9亿）比在抖音上观看的人数（1.3亿）还要多。抖音是TikTok在中国的大热姊妹视频应用。

这一顿新年大餐预示着腾讯的发展方向。就像TikTok在西方一样，抖音的崛起将数字生活推向了短视频分享。在过去的一年里，一般中国人花在这类平台上的时间比花在网上其他任何地方的时间都多（见图表2）。短视频应用正成为中国注意力经济的中心，也成为其数字广告业务的中心。根据经纪公司盛博（Bernstein）的数据，去年第三季度，中国的数字广告业务的销售额达到350亿美元。7月至9月间，短视频平台赚取了这些广告收入的四分之一；它们的广告销售额同比增长了34%。

腾讯也打算从这一增长中分一杯羹。它表示，视频号的用户数量去年增长了两倍。尽管它拒绝透露具体数字，但从其春晚直播量猜测，目前的数字应该数以亿计。腾讯偶尔会请大咖来吸引新观众：去年6月，美国流行组合后街男孩在视频号上的演唱会吸引了4400万粉丝观看。但它采用了比抖音更联合一般创作者的模式。就算只有10个粉丝的内容创作者也能从视频号的广告收入中分成。在抖音，他们要有一万名粉丝才能开始用这种方式赚钱。腾讯希望它的策略能够吸引更多的创作新秀、更多的观众——还

有更多的广告主。盛博的朱镇估计，在未来几年内，腾讯的广告收入将再增加300亿元。

腾讯也在围绕视频号重新定位微信经济的“交易”部分。值得注意的是，它正在为了“社交商务”而武装该平台。今年，这种把直播和购物结合起来的中国特有的消费形式预计将推动价值7200亿美元的交易。在这方面，短视频应用同样也在从老平台那里夺取市场份额，比如京东和中国最大的电子商务商城阿里巴巴。

腾讯过去会避开购物业务，可能是担心进入这一领域会损害自己所持的京东股权的价值。大规模减持后，腾讯到网购领域碰碰运气的意愿似乎大大增加了。它不愿透露其电商平台的交易额，但表示到2022年这一数字同比增长了八倍。微信支付一如既往从每笔交易中抽取0.6%的提成。而尽管政府责令引入竞争对手的支付系统，但微信上的大多数交易用的还是微信支付：腾讯和运营另一个热门支付服务的阿里巴巴都支持跨平台支付，但操作起来很麻烦。

转向视频号对腾讯来说至关重要。当局反对游戏的立场使得寻找其他增长点成为迫切任务。腾讯创始人马化腾最近将视频号形容为“全厂（公司）的希望”。它最近的成功表明这种希望不一定会落空。腾讯来自非游戏业务的收入份额一直在小幅上升。但在政府已经限制了一些数字活动，并随时准备施加更多限制的新常态下，腾讯必须应对三个挑战——中国其他数字巨头也是如此。

第一个挑战是确保具有能够适应新现实的灵活的企业文化。马化腾和一般的科技公司创始人相比算是低调而松弛的。这赋予了下属（比如微信的创始人张小龙）自主权，并带来了许多成功的业务。但当这些下属有不同的想法时，也会产生摩擦。例如，张小龙一直抵制对微信的商业化侵蚀，担心这会破坏用户体验。结果就是微信的主屏幕十年来一直没有变化，要进入视频号看视频需要点击两次——倒不是一件苦差事，但跟抖音比起来就显得麻烦了，抖音是一打开应用就给你播放视频。对变化的抗拒同样也可以解释为什么电子商务业务也只会逐步推出，研究公司标普全球的克利福

德·库尔茨（Clifford Kurz）指出。

第二个挑战是科技公司彼此间会有更多的竞争，有鉴于此，任何拖拉之举都可能造成问题。习对科技公司的整治铲平了数字经济领域大片的竞技场。这正在制造出新的竞争关系。美团正从送餐业务向网约车和二手货网店进军，这两个领域一直是拼多多等竞争对手的地盘。抖音的母公司字节跳动很快将推出自己的送餐服务，并正在试验一款消息应用，看起来与微信惊人地相似。阿里巴巴、腾讯和中国最大的搜索引擎百度都在开发类似ChatGPT的人工智能聊天机器人，ChatGPT堪比真人的对话能力近期已经迷住了西方的互联网用户。

最后一个可能绊倒腾讯或其竞争对手的因素是政治。尽管政府宣布对科技行业的整顿已经结束，但它仍像个盘旋其上的幽灵。政府正在购入几大科技巨头的子公司的少量股份，包括阿里巴巴，据报道还有腾讯。随着中西方紧张关系加剧，与政府关系密切可能会损害海外收益，比如腾讯的国际游戏业务的收益。在国内，网络空间和媒体监管机构以及反垄断机构掌握了新的权力，并且很愿意行使手中大权。随着习巩固其强人统治，向来是中国人生活一部分的审查制度正在加强，这可能意味着腾讯的游戏发布会出现更多的推迟。党能让一家企业的发展陷于瘫痪的危险挥之不去。2月9日，在官方媒体警告“一些新概念”（如聊天机器人）受到过多关注后，中国的人工智能相关公司股价下跌。

到目前为止，短视频暂且躲过了党的棍棒。尽管它们面临的限制比游戏少，但如果习断定改刷抖音或视频号（年轻的前游戏玩家们多出来的空闲时间有三分之二都花在了抖音或视频号上）并不利于培养优秀的共产主义战士，这种情况可能就会改变。

马化腾一再强调腾讯旗下的众多应用是如何“服务社会”和“助力实体经济”的。这些话应该会博得习和他的干部们的欢心。投资者无疑很是开心满足。然而，更激烈的竞争和善变的政府很可能会令腾讯的前景受限。在中国，已经没有更多空间造就数字赢家——只有劫后余生的幸存者。■



Up. Down. And sideways?

What Tencent's rebound says about prospects for China's big tech

A once unstoppable sector is getting used to a new normal

PERHAPS NO COMPANY embodies the ups and downs of Chinese big tech better than its biggest tech firm of all—Tencent. Two years ago the online empire seemed unstoppable. More than a billion Chinese were using its ubiquitous services to pay, play and do much else besides. Its video games, such as “League of Legends”, were global hits. Tencent’s market value exceeded \$900bn, and the firm was on track to become China’s first trillion-dollar company.

Then the Communist Party said: enough. Xi Jinping, China’s paramount leader, decided that big tech’s side-effects, from distracted teenagers to the diversion of capital from strategic sectors such as semiconductors, were unacceptable. Tencent was, along with the rest of China’s once-thriving digital industry, caught up in a sweeping 18-month crackdown. Regulators declared video games to be “spiritual opium”, and barred under-18s from playing more than three hours a week. Tencent’s new titles were held up by censors. At the same time, it was forced by trustbusters to tear down the walls of its apps to let other payment processors in. Last year it transferred all \$36bn-worth of its stakes in JD.com and Meituan, two e-commerce firms, to shareholders as a dividend—in part perhaps to prop up its share price but possibly also to allay official concerns about its ubiquity. To make matters worse, Mr Xi’s draconian zero-covid policy infected Chinese consumers with a bad bout of thrift. In the third quarter of 2022 Tencent’s revenues declined by 2% year on year, its worst performance on record. By October its market capitalisation had collapsed to less than \$250bn.

These days things are looking up for China’s internet companies. Shoppers

are “revenge spending” their way out of zero-covid. Regulators are easing off firms’ old businesses and giving them room to toy with new ones. And Tencent, whose market value has doubled in the past three months (see chart 1), is once again the embodiment of the changing mood. If you want to understand what all this says about the future of China’s digital economy, look to its humbled champion.

Tencent has no equivalent in the West, or anywhere else outside China. It is part Meta, part PayPal, part Epic Games (in which it owns a big stake), with a bit of Amazon and SoftBank thrown in (Tencent offers e-commerce and cloud services, like the American giant, and, like the Japanese one, has made hundreds of tech investments globally). The disappointing third quarter notwithstanding, it is expected in March to report annual sales for 2022 of more than \$80bn. Roughly a third each comes from gaming, business services (which include payments, e-commerce and cloud computing), and social media and advertising. Its pre-tax profit is expected handily to exceed \$30bn. If you exclude banks and energy companies, which had a bumper 2022, only a handful of firms in the world did better.

The linchpin of Tencent’s riches is its WeChat super-app. Companies around the world have for years attempted to ape its astute marriage of pay (the transaction economy) and play (the attention economy). Few have succeeded in doing so as seamlessly as Tencent—and none on anything like the same scale. Last month’s lunar-new-year celebrations are a case in point. During the weeklong festivities WeChat users sent loved ones 4bn digital hongbao (red envelopes that in the real world come stuffed with cash), and more people tuned in to the annual new-year gala on WeChat’s newish Channels video platform (190m) than on Douyin, TikTok’s popular Chinese sister video app (130m).

The new-year blowout hints at where Tencent is headed. The rise of Douyin has, like that of TikTok in the West, pushed digital life towards short-video

sharing. In the past year the average Chinese spent more hours on such platforms than anywhere else online (see chart 2). Short-video apps are becoming the centre of China's attention economy—and of its digital-ads business, which generated \$35bn in sales in the third quarter of 2022, according to Bernstein, a broker. Between July and September short-video platforms claimed a quarter of those ad dollars; their ad sales jumped by 34%, year on year.

Tencent is eyeing a slug of that growth. The ranks of Channels users trebled last year, it says. Although it declines to give a total figure, its new-year-gala streaming tally suggests they now number in the hundreds of millions. Tencent occasionally hires big names to draw in new viewers; last June the Backstreet Boys, an American pop group, entertained 44m fans at a Channels concert. But it has adopted a more ecumenical approach to talent than Douyin. Content creators with as few as ten followers can get a slice of Channels' ad revenues. On Douyin, they need 10,000 fans to start earning money this way. Tencent hopes its strategy will attract more up-and-comers, more viewers—and more advertisers. The firm could bring in another 30bn yuan (\$4.4bn) in ad sales within a few years, reckons Robin Zhu of Bernstein.

Tencent is reorienting the “transaction” parts of the WeChat economy around Channels, too. Notably, it is equipping the platform for “social commerce”. This peculiarly Chinese form of consumerism, which combines live-streamed shows with shopping, is expected to fuel \$720bn-worth of transactions this year. Here, too, short-video apps are taking market share from incumbents, such as JD.com and China's biggest e-emporium, Alibaba.

Tencent used to steer clear of this business, perhaps worried that its entry would hurt the value of its stake in JD.com. Rid of it, Tencent has appeared much more willing to try its luck in online shopping. It will not disclose how much money changes hands on its e-commerce platform. But, it says,

the figure ballooned nine-fold, year on year, in 2022. WeChat Pay takes its usual 0.6% cut from each transaction. And despite the government's edict on letting in rival payments systems, most transactions on WeChat involve WeChat Pay: both Tencent and Alibaba, which operates the other popular service, have made cross-platform payments possible but cumbersome.

The shift to Channels is crucial for Tencent. The authorities' anti-gaming stance makes it urgent to look elsewhere for growth. Pony Ma, Tencent's founder, recently described Channels as "the hope of the company". Its recent success suggests this hope might not be forlorn. Tencent's share of revenues from its non-gaming businesses has been edging up. But to thrive in the new normal, where the government has put limits on some digital activities, and stands all too ready to place more, Tencent must deal with three challenges—as will China's other digital giants.

The first of these has to do with ensuring a nimble company culture that can adjust to the new reality. As tech founders go, Mr Ma is low-key and laid-back. This has empowered subordinates, such as WeChat's creator, Allen Zhang, and led to many successful businesses. But it also introduces friction when those subordinates have different ideas. Mr Zhang, for instance, has resisted the app's encroaching commercialisation, fearing it will spoil the user experience. As a result, WeChat's home screen has remained unchanged for a decade and accessing videos on Channels requires two taps—not a chore, but a drag compared with Douyin, which plies you with clips as soon as you open the app. The same resistance to change explains why the e-commerce operations, too, will be rolled out only gradually, notes Clifford Kurz of S&P Global, a research firm.

Any foot-dragging could prove a problem, considering that tech firms will find themselves competing with each other more—the second challenge. Mr Xi's techlash has bulldozed the playing-field in swathes of the digital economy. This is creating new rivalries. Meituan is pushing from food

delivery into ride-hailing and e-thrift-stores, which have been the preserve of rivals such as Pinduoduo. Douyin's owner, ByteDance, will soon launch a food-delivery service of its own and is experimenting with a messaging app that looks strikingly similar to WeChat. Alibaba, Tencent and Baidu, China's biggest search engine, are all developing artificial-intelligence (AI) chatbots similar to ChatGPT, whose humanlike conversational powers have beguiled Western internet users of late.

The last thing that could trip up Tencent, or its rivals, is politics. Although it has declared the tech crackdown over, the state remains a spectral presence. It is taking small stakes in subsidiaries of the biggest tech titans, including Alibaba and, reportedly, Tencent. As Sino-Western tensions mount, closeness with the state could hurt foreign earnings, for example from Tencent's international gaming business. At home, cyberspace, media and antitrust agencies have gained new powers—and are willing to wield them. Censorship, always part of Chinese life, is intensifying as Mr Xi entrenches his strongman rule, which could mean more delays to Tencent's games launches. And the danger of the party paralysing a firm's growth is ever present. On February 9th share prices of Chinese AI firms fell after state media warned that "some new concepts" (like chatbots) were getting too much attention.

Short videos have so far been spared the party's rod. Though they face fewer restrictions than games, this could change if Mr Xi concludes that being glued to Douyin or Channels instead, which is how young erstwhile gamers spend two-thirds of their newly free time, is not conducive to moulding good communists.

Mr Ma has repeatedly stressed how Tencent's universe of apps "served society" and "assisted the real economy". Such words should be catnip to Mr Xi and his cadres. Investors are certainly purring. Yet greater competition and fickle government are likely to constrain Tencent's prospects. In China

there is no more room for digital winners—only survivors. ■



【首文】依然高企

抑制通胀比市场预计的更难

投资者押注前景光明。但未来更可能是一片动荡

考虑过去一年左右的时间里股票和债券投资组合的表现之糟糕，你可能没有注意到眼下金融市场正在一片乐观情绪下走高。但今天的投资者正是如此。自去年秋季以来，他们越来越多地押注于通胀这个世界经济最大的问题将会顺利消退。许多人认为这将导致在2023年底降息，而这将有助于世界主要经济体——最重要的是美国——避免衰退。投资者给股票的定价反应了对“金发姑娘经济”的期待——公司盈利稳定增长，资金成本降低。

出于对这一可喜转折的憧憬，标普500指数自今年初以来上涨了近8%。公司估值约为远期盈利的18倍——以疫情后的标准来看虽然偏低，但仍处于2002至2019年普遍区间的上端。预计2024年的公司盈利将飙升近10%。

跃升的不仅仅是美国市场。欧洲股市上涨得更多，原因之一是暖冬抑制了能源价格。资金已大举涌入新兴经济体，它们正在享受双重红利——中国放弃了清零政策，同时对美国货币政策趋宽松的预期导致美元贬值。

图景很美好。不幸的是，这种期盼恐怕是错付了。世界与通胀的斗争远未结束。而这意味着市场可能遭遇可怕的回调。

要想知道是什么让投资者重燃希望，可以看看美国2月14日发布的最新消费者价格数据。数据显示，在截至1月的三个月里，通胀处于2021年初以来的最低水平。许多最初导致通胀上升的因素已经消散。全球供应链不再因商品需求激增而不堪重负，也不再被疫情扰乱。随着对庭院家具和游戏机的需求降温，商品价格正在下跌，微芯片也出现了过剩。现在的油价比一年前俄罗斯入侵乌克兰之前还要低。世界各地均出现了通胀回落的景象：在经合组织（OECD）的36个富裕成员国中，有25个的整体通胀正在下降。

然而，整体通胀的波动往往会掩盖基本趋势。仔细观察，很容易看出通胀问题并未得到解决。美国的“核心”价格（不包含波动较大的食品和能源）在过去三个月的年化增幅达到4.6%，而且还开始缓慢加速。服务业是当前通胀的主要来源，它更容易受到劳动力成本的影响。在美国、英国、加拿大和新西兰，工资增长仍然远远高于与各自央行2%的通胀目标匹配的水平；欧元区的工资增速较低，但在西班牙等重要经济体也在增长。

考虑到劳动力市场需求强劲，这并不奇怪。由大型富裕经济体组成的七国集团（G7）中，有六个国家的失业率达到或接近本世纪以来的最低水平。美国的失业率为1969年以来最低。很难想象，在劳动力市场保持如此紧张的情况下，基础通胀如何能够回落下来。这样的失业率水平使得许多经济体的通胀率很可能保持在3%至5%左右。与过去两年的情况相比，这并不算太糟。但对央行官员来说却是个大问题，因为他们的工作成绩直接与通胀目标挂钩。这也会让投资者的乐观愿景落空。

无论接下来发生什么，市场动荡似乎都很可能发生。最近几周，债券投资者开始倾向于预测央行不会降息，而是会让利率保持在高位。在通胀持续降低的同时，利率维持在高位而又不会严重影响经济——这种情况并非不可想象（只是想象）。如果这真的发生，那么稳健的经济增长将提振市场。不过，利率持续走高将给债券投资者造成损失，而无风险回报持续高企之下，股票价格也将难以获得高市盈率。

然而，高利率将损害经济的可能性要大得多。进入现代以来，央行在实现“软着陆”上的表现并不成功——软着陆就是完成一个加息周期而不引致衰退。在一轮货币紧缩即将结束时，投资者往往错误预判经济即将迎来强劲增长，结果却遭遇衰退来袭，历史上这样的例子比比皆是。即便是在通胀水平低于今天的情况下亦是如此。如果美国是唯一陷入衰退的经济体，大部分其他国家仍将受到拖累，如果资金避险使美元走强就更是如此。

还有一种可能性是，面对顽固的通胀问题，各国央行没有勇气接受一场经济衰退。相反，他们可能会允许通胀略高于目标。在短期内，这将带来一场经济热潮。从长远来看可能也有好处：由于通胀上升，利率最终将稳定

在更高的水平，安全地远离零利率，让央行在下一次衰退时有更多的货币弹药可用。因此，许多经济学家认为理想的通胀目标是在2%以上。

然而，要完成这样的制度转变而不招致严重破坏，对各国央行来说将是一项艰巨的任务。过去一年，他们一直在强调要坚持当前的目标，这些目标通常是由立法者制定的。抛弃一个制度而后建立另一个制度将是一代人仅遭遇一次的决策挑战。关键是要果断。1970年代，由于货币政策目标不够清晰，导致了经济剧烈波动，对公众和投资者都造成了伤害。

迄今为止，发达国家的央行官员并未表现出任何改弦易辙的迹象。但即使通胀回落或者他们放弃抗通胀之战，政策制定者也不太可能实施一次完美的转向。无论是因为利率居高不下、经济衰退来袭，还是政策进入混乱的转型期，投资者势必都要失望了。■



Still aloft

Inflation will be harder to bring down than markets think

Investors are betting on good times. The likelier prospect is turbulence

GIVEN HOW woefully stock and bond portfolios have performed over the past year or so, you may not have noticed that financial markets are floating high on optimism. Yet there is no other way to describe today's investors, who since the autumn have increasingly bet that inflation, the world economy's biggest problem, will fall away without much fuss. The result, many think, will be cuts in interest rates towards the end of 2023, which will help the world's major economies—and most importantly America—avoid a recession. Investors are pricing stocks for a Goldilocks economy in which companies' profits grow healthily while the cost of capital falls.

In anticipation of this welcome turn of events the S&P 500 index of American stocks has risen by nearly 8% since the start of the year. Companies are valued at about 18 times their forward earnings—low by post-pandemic standards, but at the high end of the range that prevailed between 2002 and 2019. And in 2024 those earnings are expected to surge by almost 10%.

It is not just American markets that have jumped. European stocks have risen even more, thanks partly to a warm winter that has curbed energy prices. Money has poured into emerging economies, which are enjoying the twin blessings of China abandoning its zero-covid policy and a cheaper dollar, the result of expectations of looser monetary policy in America.

This is a rosy picture. Unfortunately, it is probably misguided. The world's battle with inflation is far from over. And that means markets could be in for a nasty correction.

For a sign of what has got investors' hopes up, look at America's latest consumer-price figures, released on February 14th. They showed less inflation over the three months to January than at any time since the start of 2021. Many of the factors which first caused inflation to take off have dissipated. Global supply chains are no longer overwhelmed by surging demand for goods, nor disrupted by the pandemic. As demand for garden furniture and games consoles has cooled, goods prices are falling and there is a glut of microchips. The oil price is lower today than it was before Russia invaded Ukraine a year ago. The picture of falling inflation is repeated around the world: the headline rate is falling in 25 of the 36 mainly rich countries in the OECD.

Yet fluctuations in headline inflation often mask the underlying trend. Look into the details, and it is easy to see that the inflation problem is not fixed. America's "core" prices, which exclude volatile food and energy, grew at an annualised pace of 4.6% over the past three months, and have started gently accelerating. The main source of inflation is now the services sector, which is more exposed to labour costs. In America, Britain, Canada and New Zealand wage growth is still much higher than is consistent with the 2% inflation targets of their respective central banks; pay growth is lower in the euro area, but rising in important economies such as Spain.

That should not be a surprise, given the strength of labour markets. Six of the G7 group of big rich countries enjoy an unemployment rate at or close to the lowest seen this century. America's is the lowest it has been since 1969. It is hard to see how underlying inflation can dissipate while labour markets stay so tight. They are keeping many economies on course for inflation that does not fall below 3-5% or so. That would be less scary than the experience of the past two years. But it would be a big problem for central bankers, who are judged against their targets. It would also blow a hole in investors' optimistic vision.

Whatever happens next, market turbulence seems likely. In recent weeks bond investors have begun moving towards a prediction that central banks do not cut interest rates, but instead keep them high. It is conceivable—just—that rates stay high without seriously denting the economy, while inflation continues to fall. If that happens, markets would be buoyed by robust economic growth. Yet persistently higher rates would inflict losses on bond investors, and continuing elevated risk-free returns would make it harder to justify stocks trading at a large multiple of their earnings.

It is far more likely, however, that high rates will hurt the economy. In the modern era central banks have been bad at pulling off “soft landings”, in which they complete a cycle of interest-rate rises without an ensuing recession. History is full of examples of investors wrongly anticipating strong growth towards the end of a bout of monetary tightening, only for a downturn to strike. That has been true even in conditions that are less inflationary than today’s. Were America the only economy to enter recession, much of the rest of the world would still be dragged down, especially if a flight to safety strengthened the dollar.

There is also the possibility that central banks, faced with a stubborn inflation problem, do not have the stomach to tolerate a recession. Instead, they might allow inflation to run a little above their targets. In the short run that would bring an economic sugar rush. It might also bring benefits in the longer run: eventually interest rates would settle higher on account of higher inflation, keeping them safely away from zero and giving central banks more monetary ammunition during the next recession. For this reason, many economists think the ideal inflation target is above 2%.

Yet managing such a regime shift without wreaking havoc would be an enormous task for central banks. They have spent the past year emphasising their commitment to their current targets, often set by lawmakers. Ditching

one regime and establishing another would be a once-in-a-generation policymaking challenge. Decisiveness would be key; in the 1970s a lack of clarity about the goals of monetary policy led to wild swings in the economy, hurting the public and investors alike.

So far central bankers in the rich world are showing no signs of reversing course. But even if inflation falls or they give up fighting it, policymakers are unlikely to execute a flawless pivot. Whether it is because rates stay high, recession strikes or policy enters a messy period of transition, investors have set themselves up for disappointment. ■



英雄所见不同

阿那克西曼德是科学思维发展的英雄

卡洛·罗韦利认为，这位博学之士展示了挑战固有认知的功用【《极简科学起源课》书评】

《极简科学起源课》，卡洛·罗韦利著，马里昂·尼格兰娜·罗森博格译。

Riverhead Books；272页；18美元。Allen Lane；16.99英镑

在通常公认的三位哲学和自然科学的奠基人中，阿那克西曼德

(Anaximander) 排在第二位，夹在他的老师泰勒斯 (Thales) 和他的学生阿那克西米尼 (Anaximenes) 之间。结果证明，排第二至关重要。尽管这位博学之士 (生于公元前610年左右) 很钦佩他的老师，但并不害怕挑战他。泰勒斯在水中寻找万物的本原；阿那克西曼德则倾向于把更无形的“阿派朗” (apeiron) 即“无定”或“无限”作为第一本原。

理论物理学家卡洛·罗韦利 (Carlo Rovelli) 认为，愿意杀一杀大师的威风是科学实践的关键。没有了门徒对先知的那种恭敬顺从，但也没有叛教者那种愤恨蔑视，“阿那克西曼德发现了第三条路”，罗韦利写道，而“现代科学整体说来就是发现这第三条路的结果”。

罗韦利这本书最初在2009年以法语出版，最近被译成英语。这本书并不是一本纯正的传记，因为人们对阿那克西曼德的生平知之甚少，他的原作也几乎没有留存下来。相反，这本书关注的是他的革命性思想，即认为揭开自然奥秘的最好方法就是质疑一切。阿那克西曼德在过去圣贤的成果之上建立了自己的宇宙学，质疑他们的理论，在有需要的地方做出改正。他创造出一个流程，让知识一代代增长，并让人类从中受益。

阿那克西曼德的不敬行为的后果是不确定性。罗韦利认为这是值得付出的代价：“科学的可靠性不是建立在确定性的基础上，而是建立在完全缺乏确定性的基础上。”阿那克西曼德和他的追随者拒绝用神话解释世界。他们以观察代替神启，以理性代替了信仰和经文。因此，罗韦利断言，他们

将文明领上一条新的道路，在这条路上，与其说进步是靠累积事实，不如说是靠知道自己不知道什么。

对于泰勒斯、阿那克西曼德和阿那克西米尼来说，怀疑是一种与生俱来的权利。他们三人都是安纳托利亚（Anatolia）西海岸的希腊城市米利都（Miletus）的公民。这里位于更古老的埃及文明和美索不达米亚文明之间，拥有年轻的商业社会所有的天然好奇心，米利都的居民接触到的信仰五花八门。他们可以用一种学说来检验另一种学说，可以怀疑所有学说而不受制于任何一种。“文明在融合中繁荣，”罗韦利说，“在孤立中衰落。”

罗韦利拥护文化和意识形态的多样性。他坚持认为，就像米利都公民从外邦邻居的智慧中获益一样，现代社会如果鼓励思想的自由交流也会受益。在古希腊，这种博采众长的能力不仅催生了科学，还诞生了民主——阿那克西曼德对既定思维方式的不敬在政治领域的翻版。

罗韦利讨论的领域并不叫人感到陌生，虽然他也指出，对辞世已久的男性白人思想家表示崇敬在今天已经不那么流行了。不过作者仍然相信，支持从阿那克西曼德和他的同侪开始的对宇宙充满好奇的探索是值得的。他热切地捍卫这种反传统主义的传统，反对极端相对主义者（认为在特定的时间和文化之外不存在真相）和绝对主义者（认为只有一个无可辩驳的真理）。

“我们的知识，就像地球一样，漂浮在虚无之中。”罗韦利说。“它本质上暂时性和潜在的虚空并没有让生命失去意义，反而让生命愈加珍贵。”这本书适时地驳斥了某些人，他们或是为了文化敏感性，或是退回到形而上启示的安全地带，以至情愿牺牲西方科学的重要遗产，以及随之而来的进步。■



Great minds do not think alike

Anaximander is a hero in the development of scientific thinking

The polymath demonstrated the utility of challenging perceived wisdom, argues Carlo Rovelli

Anaximander. By Carlo Rovelli. Translated by Marion Lignana Rosenberg. Riverhead Books; 272 pages; \$18. Allen Lane; £16.99

OF THE THREE men usually credited with founding the disciplines of philosophy and natural science, Anaximander comes second, sandwiched between his teacher, Thales, and his student, Anaximenes. Being second, it turns out, was crucial. Though the polymath (who was born around 610BC) admired his teacher, he wasn't afraid to challenge him. Thales sought the origin of all things in water; Anaximander preferred as his first principle the less tangible apeiron, the "indefinite" or "infinite".

A willingness to take the master down a peg or two, according to Carlo Rovelli, a theoretical physicist, is key to the practice of science. Lacking the deference a disciple owes to a prophet, but without the bitter contempt of an apostate, "Anaximander discovered a third way," he writes, and "modern science in its entirety is the result of the discovery of this third way."

Mr Rovelli's book, first published in French in 2009 and newly translated into English, is not a straight biography, as little is known of Anaximander's life and hardly any of his original writing survives. Instead, it focuses on his revolutionary idea that the best way to uncover nature's secrets is to question everything. Anaximander built his own cosmology on the work of past sages, interrogating their theories and making corrections where needed. He invented a process that allowed knowledge to grow from generation to generation, and enabled humanity to reap the benefits.

The consequence of Anaximander's irreverence was uncertainty. Mr Rovelli argues that is a price worth paying: "The reliability of science is based not on certainty but on a radical lack of certainty." Anaximander and his followers rejected mythological explanations. They replaced revelation with observation and faith and scripture with reason. As a result, Mr Rovelli avers, they set civilisation on a new course, one in which progress is made less by accumulating facts than by knowing what it is you do not know.

For Thales, Anaximander and Anaximenes, all citizens of Miletus, a Greek city on the western coast of Anatolia, doubt was a birthright. Positioned between the more ancient civilisations of Egypt and Mesopotamia, and possessing all the natural curiosity of a young, mercantile society, the residents of Miletus were exposed to a variety of beliefs. They could test one doctrine against another, while being beholden to none and sceptical of all. "Civilisations flourish when they mingle," Mr Rovelli says. "They decline in isolation."

Mr Rovelli is a champion of diversity, both cultural and ideological. Just as the citizens of Miletus profited from the wisdom of their foreign neighbours, modern societies benefit when they encourage the free exchange of ideas, he insists. Among the ancient Greeks, this capacity to assimilate a variety of traditions led not only to the birth of science, but of democracy—a translation of Anaximander's irreverence for established ways of thinking into the realm of politics.

The territory Mr Rovelli covers is not unfamiliar, though he notes that these days it is less fashionable to venerate long-dead white male thinkers. Still, the author believes it is worth championing the inquisitive exploration of the universe that began with Anaximander and his colleagues. He is eager to defend this anti-traditionalist tradition against both extreme relativists, who believe there is no truth outside a particular time and culture, and absolutists who believe there is only one incontrovertible truth.

"Our knowledge, like the Earth, floats in nothingness," Mr Rovelli says. "Its provisional nature and the underlying void do not make life meaningless; they make it more precious." This book offers a timely rebuttal to those who would sacrifice the vital legacy of Western science—and the progress that comes with it—on the altar of cultural sensitivity or by retreating to the safety of metaphysical revelation. ■



熊彼特

挥舞AI武器的科技公司正在重塑现代战争

乌克兰成为安杜里尔和帕兰提尔等公司的试验场

任何研究过20世纪战争的军事迷对如今乌克兰战场上使用的许多西方军事硬件都不会感到陌生：地对空导弹、反坦克武器、火箭发射器和榴弹炮。但乌克兰还使用了西方的信息技术，包括人工智能（AI）和自主监视系统，它们同样对俄军造成了强大冲击，尽管更不明显。商业厂商向乌军供应卫星、传感器、无人机及软件。这些产品提供大量战场数据并汇集到应用中，帮助战场上的士兵瞄准敌军目标。一名美国国防官员赞许地称它们是“给火炮用的优步”。

这种战争新形态的背后是美国科技界一些最标新立异的人物。家喻户晓的有马斯克，他的火箭公司SpaceX通过星链卫星为乌克兰提供服务（不过现在他已限制在战场上使用它们）。笔者最近采访了另外两位以破旧立新著称的企业家。一位是现年30岁的帕尔默·勒基（Palmer Luckey），他在2017年与他人联合创办了国防科技公司安杜里尔（Anduril），制造监控塔、无人机、无人潜艇及支持这些硬件的由AI驱动的系统Lattice。他常以人字拖、夏威夷衬衫和山羊胡子的打扮示人，一副非典型国防承包商的模样，让人想到漫威电影中痴迷科技装备的“钢铁侠”托尼·斯塔克。然而，这家创业企业已开始撼动美国传统的军火采购模式。成立短短数年，安杜里尔已在美国和澳大利亚赢得合同。如今该公司向乌克兰提供自主系统。上次融资是在去年12月，估值达到85亿美元。

另一位是亚历克斯·卡普（Alex Karp，曾任《经济学人》母公司董事），一位头发蓬乱如爱因斯坦的古怪哲学博士。他在丹佛创立了软件公司帕兰提尔（Palantir），搭建数字基础设施帮助客户管理安全威胁、医疗保健系统、工厂生产率等方面的数据。自他二十年前联合创办帕兰提尔以来，这家公司就像SpaceX一样，为军民融合企业开辟了一条道路。他撂下不少豪言壮语，例如称帕兰提尔改变了乌军瞄准敌军目标的方式，甚至改

变了反恐战争的性质。他认为自家软件在新冠疫情期间拯救了千百万人的生命。这也许并不全都是不争的事实（受访时他盯着笔者说英国记者“牙齿糟糕，问题刁钻”，也就说对了一半）。但无可质疑的是，帕兰提尔正同时在战场上以及作为北约情报网络的一部分为乌军提供支持。2月13日，该公司报告首次实现季度盈利，卡普暗示公司可能成为收购目标，其市值随之升至210亿美元。

这两人十分相似。他们是硅谷的叛徒。他们批评科技巨头抛弃了与美国国防机构的历史渊源。他们慨叹中国军民融合发展之快对西方构成潜在威胁。或多或少，他们也都与右翼风投家彼得·蒂尔（Peter Thiel）有关联。蒂尔是帕兰提尔的董事会主席，他的创始人基金（Founders Fund）是安杜里尔的早期投资方（这两家公司的名字都应和了他对现代奇幻文学之父J.R.R.托尔金的喜爱）。有些人因此觉得这两个家伙有点瘆人。不过，尽管采用的商业模式不同，两人都凸显了国防合同传统的“总承包”体系已经变得多么僵化。他们提供了有趣的替代方案。

跟总承包商一样，安杜里尔只面向军方客户销售产品，但有别于洛克希德·马丁（Lockheed Martin）和诺斯罗普·格鲁曼（Northrop Grumman）等国防巨头，安杜里尔在提供产品时会承担所有研发风险。勒基是个天生的创新者，十几岁的时候就发明了Oculus虚拟现实头显，后来以30亿美元出售给Facebook。在南加州的安杜里尔总部，他边走边向笔者讲解陈列的各式空中及海底装备，那股痴迷劲头几乎让人难以招架。

他还拥有同样敏锐的商业头脑。他和公司高管们不屑于五角大楼传统的“成本加成”采购体系。他们认为这样的体系也许对战斗机和航空母舰等大项目来说是必要的，但总的来说扭曲了激励机制，造就了厌恶风险、成本昂贵且行动迟缓的军火巨头。安杜里尔没选择坐等政府合同，而是创造自己认为国防部门需要的产品，并运用迭代制造和精益供应链以相对低廉的价格快速制造产品。

这极具竞争力。相比冗长、满是PPT展示的总承包合同竞标流程，安杜里尔喜欢面对面地“比拼枪法”，即美国国防部对相似的商业产品做对比测

评。安杜里尔的成功率很高。2020年，它赢得了在美墨边境提供监控塔的大合同。去年，它获美国国防部拨款十亿美元提供自主反无人机系统。它目前正在建造公共汽车大小的水下航行器，用于在澳大利亚附近水域巡逻。尽管勒基身上有一股为“美国优先”而战的斗士气息，他也明确表示要让安杜里尔成为一家盈利的大企业。

帕兰提尔已初步开始取得这样的地位，但采取的是“两用”商业模式，在为政府（但只限和美国交好的政府）效劳之外也服务私人客户。无论是在战场上还是在商场上，它的软件都穿透越发厚重的数据迷雾，助力快速决策。其他军民两用公司也在越来越多地赢得国防合同。成立于2015年的美国国防部国防创新部门（Defence Innovation Unit）支持大幅增加AI、自主和集成系统等商业技术的应用，以加快对全球威胁的反应速度。

乌克兰是个很好的试验场，也可以拿来做个恰如其分的比喻。好似大卫的科技公司挑战歌利亚一般的美国军工巨头，这与用科技武装的乌军对战庞大臃肿的俄军并无二致。 ■



Schumpeter

AI-wielding tech firms are giving a new shape to modern warfare

Ukraine is a testing ground for companies like Anduril and Palantir

MUCH OF THE Western military hardware used in Ukraine sounds familiar to any student of 20th-century warfare: surface-to-air missiles, anti-tank weapons, rocket launchers and howitzers. But Ukraine's use of Western information technology, including artificial intelligence (AI) and autonomous surveillance systems, has also had a powerful, if less visible, impact on Russian forces. Commercial vendors supply Ukrainian troops with satellites, sensors, unmanned drones and software. The products provide reams of battlefield data which are condensed into apps to help soldiers on the ground target the enemy. One American defence official calls them, appreciatively, "Uber for artillery".

Behind this new form of warfare are some of the most unconventional minds in American tech. Everyone knows about Elon Musk, whose rocket company SpaceX put Starlink satellites at the service of Ukraine (though he has now restricted access from the battlefield). Your columnist recently met two other iconoclastic entrepreneurs. One is Palmer Luckey, a 30-year-old who in 2017 co-founded Anduril, a maker of surveillance towers, drones, unmanned submarines and an AI-driven system that supports them, called Lattice. With his trademark flip-flops, Hawaiian shirts and goatee, he is an atypical defence contractor (Tony Stark, Marvel's gadget-obsessed "Iron Man", springs to mind). Yet the startup is already shaking up the traditional model of military procurement in America. In its short life, it has won contracts in America and Australia. It provides autonomous systems to Ukraine. When it last raised money in December, it was valued at \$8.5bn.

The other is Alex Karp, an eccentric doctor of philosophy with an Einstein-

like mop of hair. (Mr Karp used to sit on the board of The Economist's parent company.) Palantir, his Denver-based software firm, builds digital infrastructure to help clients manage lots of data, be it on security threats, health-care systems or factories' productivity. Like SpaceX, it has blazed the trail for civilian-military ventures since he co-founded it two decades ago. He makes bold claims. Palantir, he says, has changed the way Ukrainian troops target the enemy, and even the nature of counter-terrorism. He credits its software with saving millions of lives during the covid-19 pandemic. It may not all be gospel truth (the description of British journalists he delivers while staring at Schumpeter—"bad teeth, hard questions"—is only half true). Yet there is little doubt Palantir is supporting Ukraine both on the ground and as part of NATO's intelligence network. On February 13th, when it reported its first-ever quarterly profit and Mr Karp hinted that his firm might be an acquisition target, its market value rose to \$21bn.

Both men are cut from similar cloth. They are Silicon Valley renegades. They criticise big tech for abandoning its historic link with America's defence establishment. They lament the fast pace of civilian-military fusion in China, which they see as a potential threat to the West. To a greater or lesser degree, they are linked to Peter Thiel, a right-wing venture capitalist. Mr Thiel chairs Palantir and his Founders Fund was an early backer of Anduril (both names echo his love of J.R.R. Tolkien). To some that makes them creepy. Still, using different business models, both highlight how sclerotic the traditional system of "prime" defence contracting has become. They offer intriguing alternatives.

Like a prime contractor, Anduril only sells to military customers. But unlike defence giants such as Lockheed Martin and Northrop Grumman, it does so while taking all the research-and-development (R&D) risk on its own shoulders. Mr Luckey is a born innovator. As a teenager, he invented the Oculus virtual-reality headset that he later sold to Facebook for \$3bn. Walk

with him through the arsenal of airborne and subsea devices on display at Anduril's headquarters in Southern California and his wonkishness as he explains the gadgetry is almost overwhelming.

His business acumen is no less sharp. He and his executives have no time for the Pentagon's traditional "cost-plus" procurement system. Though it may be necessary for big projects like fighter planes and aircraft-carriers, they say, in general it distorts incentives, creating a risk-averse, expensive and slow-moving defence juggernaut. Rather than waiting for government contracts, Anduril creates what it thinks defence departments need, and uses iterative manufacturing and a lean supply chain to make products quickly and relatively cheaply.

It is fiercely competitive. Compared with the prolix, PowerPoint-heavy bidding processes for prime contracts, Anduril relishes the cut-and-thrust of "shoot-offs", or competitions in which the Department of Defence (DoD) tests commercial products against each other. Its success rate is high. In 2020 it won a big contract to provide surveillance towers on America's border with Mexico. Last year it secured \$1bn from the DoD to provide autonomous counter-drone systems. It is building underwater vehicles the size of buses to patrol waters off Australia. Though there is an element of the "America first" crusader about Mr Luckey, he leaves no doubt that he intends Anduril to be a big, profitable business.

Palantir has tentatively started to achieve that status, but with a "dual-use" business model. It works for private clients as well as governments (albeit only ones friendly with America). Both on the battlefield and in business, its software cuts through the thickening fog of data to enable quick decision-making. Other dual-use firms are increasingly winning defence contracts. The Pentagon's Defence Innovation Unit, set up in 2015, supports a big increase in the use of commercial technologies, such as AI, autonomy and integrated systems, to speed up the responsiveness to global threats.

Ukraine is a good testing ground. It is also a good simile. The struggle of tech Davids taking on America's military-industrial Goliath is not dissimilar to tech-enabled Ukrainian troops battling the turgid might of Russia. ■



熊彼特

如果约瑟夫·熊彼特在世，会怎样看待苹果？

这家iPhone制造商展现了创造性破坏的诸多面相

关于本专栏的“守护神”约瑟夫·熊彼特（Joseph Schumpeter），有一个略显尴尬的真相。作为一名经济学家，他最大的贡献是把创业者这个人群单独拎出来，将他们誉为商业周期的核心。在学术生涯的早期，他力挺这些人，将他们描述为反传统的历险英雄，推翻了纯粹由胆大妄为驱动的现有秩序。但当他在晚年创造出著名的“创造性破坏”一词时，他却并没有将它用到这类人身上，而是用于工业巨头，甚至垄断企业。他写道，企业家被迫创新，以求“在地位隐约不保时仍能站稳脚跟”。这与他年轻时对创业英雄的定位相去甚远。

德里克·利多（Derek Lidow）在他的新著《企业家》（The Entrepreneurs）中把这样的观点演变放在了历史大背景下。当年轻的熊彼特在1911年出版《经济发展理论》（The Theory of Economic Development）一书时，正值工业革命开启后的第一个百年的末期，在那一长段时间里企业一直不受约束地发展。但在第二次世界大战前夕熊彼特写完他最出名的著作《资本主义、社会主义与民主》（Capitalism, Socialism and Democracy）时，昔日强盗式的企业家已经演变成拥有庞大研发实验室的大型企业集团，为保持竞争力而大力投资研发。

这种视角对理解制造iPhone手机的苹果公司很有帮助。它曾是一家斗志昂扬的创业公司，其远见卓识的联合创始人渴望改变世界。如今它已成为全球最大企业，市值2.4万亿美元，有20亿台设备被世界各地的人们活跃使用，还有一系列支持这些设备的高利润服务。一些人担心它巨大的规模削弱了它的创造力，让它变得自以为是，而且太过依赖中国。2月2日，苹果公布的数据显示其收入三年半来首次同比下降。即便如此，它仍然是一个盈利的巨头，并且还在不断向创新投入资金：本季度研发费用占销售收入的比例从去年同期的5%升至6.5%。苹果恰好同时体现了熊彼特的两种看

法。他会如何看待这家公司呢？

毫无疑问，已故的苹果联合创始人乔布斯一定会让年轻的熊彼特为之赞叹。乔布斯天赋异禀，或者用熊彼特的话说是一个“卡鲁索”（Caruso，他那个时代的伟大的意大利男高音）式的人物。熊彼特罗列了一个创造新“组合”（他对创业型公司的称法）的路径清单，乔布斯用过其中多个方法。他创造了新产品（Mac、iPod等）、新生产方式（一条从苹果总部库比蒂诺延至中国的供应链）和新市场（应用程序经济）。正如熊彼特的理论所预测的那样，刚开始的时候，乔布斯也遇到了巨大的阻力。

时间快进到今天，熊彼特可能会认为乔布斯的继任者蒂姆·库克就算不是一位卡鲁索式的企业家，也算得上是个一流的管理者。一些评论人士抱怨说，在库克的领导下，苹果并没有创造出像iPhone一样具原创性的产品。但正如研究苹果的专家霍拉斯·德迪尤（Horace Dediu）指出的那样，它一直在不断改进、完善和缩小其组件，催生了Apple Watch和AirPods等新设备。

今年，苹果将此类微创新与激光、更好的相机和更高的能效相结合，预计将推出一款新设备——混合现实头显。德迪尤说，这样的发展关键不在于灵光乍现的“顿悟时刻”，而在于能否将新技术转化为最终可供千百万人使用的产品。在追求这样的发展的过程中，苹果已经成为晚年熊彼特所赞美的那种大企业创新引擎，他认为这样最能产生革命性变革。

当然了，苹果可能不喜欢这种比较。毕竟，当熊彼特谈到他所仰慕的大公司时，他明确指的是垄断企业，而这个词可能带来麻烦，尤其是在科技巨头圈子里。拜登政府迷恋反垄断。最近它对谷歌提起了重大诉讼，在针对Facebook母公司Meta的反垄断诉讼中失利，据报道也在准备对亚马逊提起诉讼。库克的竞争对手（包括Meta的扎克伯格）抱怨苹果的主导地位，包括它限制对App Store的使用以及限制数字广告公司使用跟踪技术等。苹果仍在上诉法庭与游戏开发商Epic就App Store收费的不正当竞争案对峙。尽管大部分反垄断火力都集中在Facebook和谷歌身上，但这两家公司有大量内容依赖苹果的平台，因此有人认为苹果是藏在背后的那头不受控的猛

兽。

在苹果看来，这完全是无稽之谈。它表示，App Store的政策保护其用户免受欺诈、黑客入侵等伤害。它的广告跟踪限制保护隐私。然而，如果熊彼特今天还在世，他可能会给出更高层面的辩护。其一，他鄙视完全竞争的概念。更重要的是，他认为创造性破坏会像常年大风一般席卷整个经济，摧枯拉朽，创造新结构。一切都可能被破坏。用他的话说，即使具有垄断地位也“并非高枕无忧”。

苹果可能看起来立于不败之地，但它是否也感受到地基忽然坍塌的风险？只消看看眼前，微软和谷歌的聊天机器人之战在一夕间就引发了对谷歌搜索业务未来的疑虑。但即使是微软在这场战斗中用作武器的ChatGPT也无法就创造性破坏做出比熊彼特更雄辩的描述。

先进的人工智能对苹果的语音助手Siri构成了挑战，但对苹果本身并没有造成直接威胁。更严重的麻烦是一种在创造性破坏之外的东西，那就是苹果在中国庞大且至关重要的供应链。在中美关系恶化之时，它将要艰难地去摆脱对中国供应链的依赖。在此过程中苹果小心翼翼。库克承诺在美国大举投资，以此来平衡公司对中国的风险敞口。但苹果在中国庞大的业务无论如何都是一种危险。熊彼特在他生命的最后几年里时不时会道一道资本主义的黯淡未来，他应该会同情苹果的境遇。■



Schumpeter

What would Joseph Schumpeter have made of Apple?

The iPhone maker shows the many sides of creative destruction

THERE IS AN INCONVENIENT TRUTH about Joseph Schumpeter, patron saint of this column. As an economist, his biggest contribution was to single out entrepreneurs as core to the business cycle. Early in his career he made champions of them, describing them as swashbuckling iconoclasts who overthrow the existing order motivated by sheer chutzpah. Yet later in life, when he coined his famous term “creative destruction”, he applied it not to such individuals but to industrial behemoths, even monopolies. They were compelled to innovate in order to “keep on their feet, on ground that is slipping away from under them”, he wrote. A far cry from the entrepreneurial heroes of his youth.

In his new book, “The Entrepreneurs”, Derek Lidow puts this into historical context. When the young Schumpeter wrote “The Theory of Economic Development” in 1911, it was at the end of a long period of unfettered enterprise during the first century of the Industrial Revolution. But in the run-up to the second world war, when Schumpeter wrote his most famous work, “Capitalism, Socialism and Democracy”, the buccaneers of yore had morphed into large conglomerates with vast research-and-development (R&D) labs in which they invested fortunes to remain competitive.

That is a useful way to understand Apple, maker of the iPhone. What was once a scrappy startup with visionary co-founders keen to change the world has become the world’s largest corporation, worth \$2.4trn, with 2bn devices in active use and a line of high-margin services to support them. Some worry that its size has sapped its inventive mojo, made it too big for its boots, and left it overexposed to China. On February 2nd it reported its first

decline in year-on-year earnings in three and a half years. Yet it is still a profit-making juggernaut and continues to pour money into innovation: R&D in the quarter jumped to 6.5% of sales, up from 5% a year earlier. What would Schumpeter have made of the company that so neatly encapsulates both sides of his thinking?

No doubt the young Schumpeter would have been fascinated by the late Steve Jobs, Apple's co-founder. Jobs was uniquely gifted, or as Schumpeter would have put it, a "Caruso" (after a great Italian tenor of his time). Schumpeter drew up a checklist of ways to create new "combinations", as he called entrepreneurial firms; Jobs used many of them. He created new goods (Macs, iPods, etc), a new method of production (the Cupertino-to-China supply chain) and new markets (the app economy). To start with, he also met huge resistance, as Schumpeter's theory predicted he would.

Fast forward to today and Schumpeter would probably acknowledge Tim Cook, Jobs's successor, as a top-notch manager, if not quite a Carusoesque entrepreneur. Some critics complain that under Mr Cook, Apple has not created a product as original as the iPhone. But, as Horace Dediu, an expert on Apple, points out, it relentlessly improves, refines and shrinks its components, which has given rise to new gadgets like the Apple Watch and AirPods.

This year, such micro-innovations, combined with lasers, better cameras and increased energy efficiency, are expected to come together in the launch of a new Apple device, a mixed-reality headset. Such developments, says Mr Dediu, are not about "eureka moments". They are about turning new technologies into products that eventually will be accessible to millions. In pursuing them, Apple has become just the sort of big-business innovation engine that late-in-life Schumpeter admired and perceived as best-placed to produce revolutionary change.

To be sure, Apple might flinch at the comparison. After all, when Schumpeter talked about the large companies he looked up to, he explicitly referred to monopolies—a loaded term, especially in big-tech circles. Antitrust is a fetish of Joe Biden’s administration. It has recently brought a big case against Google, lost one to Facebook’s owner, Meta, and is reportedly preparing one against Amazon. Mr Cook’s rivals, including Meta’s Mark Zuckerberg, complain of Apple’s dominance, including restrictions on the use of its App Store, as well as on tracking technologies used by digital-ad companies. Apple remains in an appeals-court battle with Epic, a games developer, in a competition case over App Store charges. Though Facebook and Google get most of the antitrust attention, so much of their content depends on Apple’s platforms that some describe it as the 800-pound gorilla in the background.

To Apple, this is all nonsense. Its App Store policies protect its users from fraudsters, hackers and the like, it has said. Its ad-tracking restrictions protect privacy. Yet Schumpeter, were he alive today, might offer a more high-level defence. For one, he ridiculed the notion of perfect competition altogether. More significantly, he believed that creative destruction blew through the economy like a perennial gale, destroying old structures and building new ones. That left no one safe from disruption. As he put it, even a monopoly was “no cushion to sleep on”.

Apple may look invincible. But does it, too, feel the risk that the rug could be pulled from under its feet? It doesn’t need to look far to see how the chatbot battle between Microsoft and Google has swiftly raised questions about the future of Google’s search business. Even ChatGPT, Microsoft’s weapon in the fight, could not describe creative destruction with more Schumpeterian eloquence.

Advanced artificial intelligence poses a challenge to Siri, Apple’s voice assistant, but not a direct threat to Apple itself. More serious is something

that goes beyond creative destruction. It is Apple's vast, and vitally important, supply chains in China, from which it will struggle to extricate itself as Sino-American relations deteriorate. Apple is playing it carefully; Mr Cook balances his firm's exposure to China with grand investment promises in America. But Apple's big Chinese presence is a danger nonetheless. Schumpeter, who spent the last years of his life musing, erratically, about the dark future of capitalism, would have sympathised. ■



控制链

美国热衷的新经济武器之历史与局限

美国加强了对华技术贸易的管制

去年10月7日上午11点15分，一位美国官员在“联邦公报”（Federal Register）网站上公布了139页的法规。从台北到南京，整个东亚的半导体行业高管都陷入了恐慌。美国政府声称对带有美国元素的每一行代码或每一个机器部件、对地球上每一个地方每一个美国公民的活动都有管辖权。使用美国代码、设备或人员制造电脑芯片销往中国的公司必须停止，否则将触犯这一法规。

这是美国最喜欢使用的新经济武器——外国直接产品规则（Foreign Direct Product Rule, FDPR）发起的一轮猛攻。有些制裁将美元的普遍使用作为武器，通过阻止目标使用美元来造成打击，而FDPR则试图将美国技术的普遍使用作为武器。美国政府借此对世界上几乎所有的芯片工厂提出了管辖权，因为几乎每一家工厂都含有难以替代的美国技术。芯片制造商台积电立即停止了向中国客户销售先进芯片。

FDPR已经成为美国与中国进行技术竞争中最重要的武器之一。一名共和党说客把负责执行该规则的工业和安全局（Bureau of Industry and Security）称为“出鞘利刃”。三年前，出口合规法律还是个让人哈欠连天的课题，而现在年轻的政策研究者正在恶补这门课。

这种全面的域外出口管制并不新鲜。有关概念早在1959年就被写入条文。但直到过去十年，FDPR才被人从监管故纸堆中翻出，成了前线的经济武器。2010年代初，时任美国商务部官员凯文·沃尔夫（Kevin Wolf）根据这一思路编写了最早的两部出口管制法规，限制了从世界任何地方对华出口任何使用美国技术制造的、将用于军事目的或制造卫星的产品。

与此同时，美国也开始着手对付华为。华为是一家蓬勃发展的中国电信设备制造商，美国一直怀疑其违反禁运，并方便中国政府开展间谍活动。

2017年初，对华持鹰派态度的特朗普政府入主白宫，对中国技术实力的不安加深。

直到2019年5月，与中国的贸易谈判破裂后，特朗普政府才转而通过出口管制来打击华为。该公司被列入了“实体清单”，该清单中的公司被禁止从美国进口技术——此前它主要用于打击空壳公司和恐怖分子的幌子公司。华为此时已被视为一个对国家安全的威胁。

华为对美国技术的购买量之大，值得美国企业下功夫钻研禁令细则。它们发现，只要从美国境外发货，就依然可以合法地向华为提供美国技术。许多科技公司继续通过海外机构向华为供货，在纸面上仍然符合法律条文。

这不仅激怒了特朗普政府，也惹恼了只在美国本土生产的公司。华为被列入实体清单让它们受到了区别对待。美国芯片制造商开始游说要求改变。如果可以阻止企业从世界任何地方使用美国技术向华为供货，那么美国本土运营的公司就不再处于不利地位了。到2020年8月，随着总统大选临近，官员们解决了这个问题。美国发布了一项FDPR，切断了华为与美国技术的联系——实际上将其排除在了全球半导体供应链之外。

世界各地的主要芯片公司都停止向华为发货。2021年，该公司的收入暴跌了29%。其广受欢迎的智能手机完全从市场上消失。美国找到了一种新方法来压制它认为对国家安全构成威胁的对手。

那之后，美国很快就有机会进一步测试这个工具。2021年底，随着俄罗斯在乌克兰边境附近集结军队，白宫就一旦发生入侵时的应对措施向各政府机构征询意见。商务部提议扩大FDPR：美国可以将对华为的做法施加于俄罗斯军队。2022年2月，在美国及其盟友实施的一揽子大规模制裁中，两项新的FDPR切断了俄罗斯军工复合体与全球技术供应链中所有美国元素的联系。

美国表示，由于缺乏半导体，俄罗斯的高超音速弹道导弹生产已大幅缩减，并被迫向伊朗和朝鲜寻求供应和设备。“制裁和出口管制正对俄罗斯国防工业基础产生重大和长期的影响。”美国国务院在10月表示。

沉浸在胜利喜悦中的白宫又将治外法权瞄准了中国的半导体行业。在华盛顿，两党已就中国构成的威胁形成强烈共识。美国国家安全顾问杰克·沙利文（Jake Sullivan）去年9月在华盛顿的一次演讲中概述了新的战略。特别是在半导体等基础技术领域，美国必须“保持尽可能大的领先优势”。

10月7日的FDPR正是朝着该目标的一次尝试。这些新规定正在打击中国本土的人工智能公司和芯片制造商。如果美国的盟友也实施自己的出口管制，用更强力、更易执行的国家层面限制取代通过供应链实施的治外法权，打击力度还会更大。1月底，拥有两家最重要的芯片生产设备制造商的日本和荷兰与美国达成了协议。如果两国都各自实施强有力的管控，中国将被牢牢封锁在先进半导体技术之外。

华盛顿正在热火朝天地谈论下一个“目标”：FDPR还有什么别的用武之地？一种可能是将矛头对准中国生产药物及其成分的生物制造产业。也可能瞄上先进电池制造业，特别是动力电池。

美国试图切断中国与先进半导体的联系，等于是激励中国专注于更成熟的芯片制造形式，这类制造相对没有那么卡脖子，且中国已经占据了很大的市场份额。电动汽车和武器对这类芯片的需求极大。如果事实证明人工智能的重要性不及美国政府的预期，那么让中国公司加大对中低端芯片的控制权可能终将成为一个错误。技术发展难以预测。半导体生产背后的供应链和制程是人类有史以来最复杂的创造之一。美国必须指望自己近期在对它们的操纵上看起来取得的成功最终不会是一场幻觉。■



Chains of control

The history and limits of America's favourite new economic weapon

America has ramped up controls on technology trade with China

AT 11:15AM ON October 7th, an American official published 139 pages of regulations on a website called the Federal Register. Across East Asia, from Taipei to Nanjing, semiconductor executives panicked. The American government was claiming jurisdiction over every line of code or machine part that had ever passed through the United States, and over the activities of every American citizen, everywhere on the planet. Companies using American code, equipment or people to make advanced computer chips bound for China had to stop, on pain of breaking the law.

It was a salvo from America's favourite new economic weapon, the Foreign Direct Product Rule (FDPR). Whereas some sanctions weaponise the ubiquity of the dollar to inflict harm by preventing targets from using it, the FDPR attempts to weaponise the ubiquity of American technology. It lets the government claim jurisdiction over almost every chip factory in the world, because almost every one contains hard-to-replace American tools. TSMC, a Taiwanese chipmaker, stopped selling advanced chips to Chinese customers immediately.

FDPR has become one of the most important weapons in America's arsenal for technological competition with China. One Republican lobbyist calls the Bureau of Industry and Security, the agency that administers it, "the tip of the spear". Young policy wonks are taking courses to study a subject that would have drawn yawns three years ago: export-compliance law.

This sweeping form of extraterritorial export control is not new. The concept was written down in 1959. But only in the past decade has FDPR

been transformed from regulatory curio into front-line economic weapon. In the early 2010s Kevin Wolf, then at the Department of Commerce, wrote the first two export-control rules to use the idea. They restricted the export of products made with American technology from anywhere in the world to China if they were to be used for military purposes or to build satellites.

Meanwhile, America was also building a case against Huawei, a booming Chinese telecoms-equipment manufacturer which it had long suspected of embargo-busting, and of being a conduit for Chinese government spying. Discomfort with Chinese technological prowess deepened with the arrival of the Trump administration's China hawks in the White House in early 2017.

Only in May 2019, after trade talks with China broke down, did the Trump administration turn to export controls to attack Huawei. It placed the firm on a list of companies to which it is illegal to export technology from America, known as the Entity List—until then mostly used for shell companies and terrorist fronts. Huawei was now seen as a national-security threat.

Huawei's purchases of American-made technology were large enough that companies found it worthwhile to pore over the details. They found that it remained legal to supply Huawei with American technology if it was shipped from outside America. Many tech companies simply carried on supplying Huawei through offshore facilities, following the letter of the law.

This not only infuriated the Trump administration, it also annoyed companies that manufactured products in America. Huawei's inclusion on the Entity List discriminated against them. American chipmakers started lobbying for changes. If firms could be prevented from using American technology to supply Huawei from anywhere in the world, operations based in America would no longer be at a disadvantage. By August 2020, with

presidential elections looming, officials had worked out the kinks. America published an FDPR which cut Huawei off from American technology—and, in effect, from global semiconductor supply chains.

Big chip companies all over the world stopped shipping to Huawei. The firm's revenues plunged by 29% in 2021. Its popular smartphones disappeared from the market altogether. America had found a new way to crimp adversaries which it perceived as a national-security threat.

It would soon have a chance to test that tool further. In late 2021, as Russia massed forces near Ukraine's border, the White House asked government agencies for ideas about how to respond in the case of an invasion. The Department of Commerce suggested an expansion of the FDPR: America could do to the Russian army what it had done to Huawei. In February 2022 two new FDPRs cut off Russia's military-industrial complex from all American elements of global technology supply chains, as part of a huge package of sanctions put in place by America and its allies.

America says Russian hypersonic ballistic-missile production has been dramatically curtailed for lack of semiconductors, and that Russia has had to turn to Iran and North Korea for supplies and equipment. "Sanctions and export controls are having significant and long-lasting consequences on Russia's defence industrial base," the State Department said in October.

Flushed with success, the White House turned its extraterritorial powers towards China's semiconductor industry. In Washington, strong bipartisan agreement had developed about the threat posed by China. The national-security adviser, Jake Sullivan, outlined the new strategy in a speech in Washington in September 2022. Particularly for foundational technologies like semiconductors America had to "maintain as large of a lead as possible".

The October 7th FDPRs were an attempt to do just that. The new rules are

hurting China's domestic artificial-intelligence companies, and its chipmakers. The hurt will increase if allies impose export controls of their own, replacing extraterritoriality enforced through supply chains with more robust, national-level restrictions that are easier to enforce. Japan and the Netherlands, which host two of the most important chipmaking-equipment manufacturers, reached a deal with America in late January. If both create strong controls of their own, China will be firmly barred from advanced semiconductors.

Washington is abuzz with talk of its next "target": what to feed into the FDPR machine? One idea is to take aim at China's biomanufacturing industry, which makes drugs and their components. Another is to go after manufacturing of advanced batteries, particularly those for electric vehicles.

By attempting to cut China off from advanced semiconductors, America is incentivising China to focus on more mature forms of chip manufacturing, where the choke points are weaker and China already has a large share of the market. These sorts of chips are required in great numbers in electric cars and weapons. If artificial intelligence turns out to be less important than the American government thinks it is, incentivising Chinese firms to take greater control over commodity chips may end up looking like a mistake. Technological development is hard to predict. The supply chains and manufacturing processing that underpin semiconductor production are some of the most complex things humans have ever created. America must hope that its apparent recent success in manipulating them does not prove illusory. ■



什么大流行？

中国经济超快复苏

中国重新开放将促进全球增长，但可能会带有一些麻烦

在刚刚过去的中国春节假期里，河南省占地广阔的太昊陵吸引了大批游客。许多人都过去抽打因陷害名将而臭名昭著的宋朝奸臣秦桧的雕像。一名参观者过于激动，甚至抄起香炉盖击打雕像。游客情绪如此高涨，是因为春节期间登上票房榜首的新片《满江红》中有反派角色秦桧。

观影、观光热情高涨，游客激动地拍打雕像，这些都表明全球第二大经济体的消费市场正在以惊人的速度复苏。太昊陵的数据显示，它在节日期间共接待游客30万人次，为三年来游客人数之最。电影票房收入不仅好于去年，还高于疫情爆发前的一年。前不久还在排队测核酸的中国人如今都在排队看电影。

由于病毒传播速度比预期更快，消费复苏也比预期更早。自从中国匆忙放弃清零政策以来，感染潮似乎过去得非常之快。政府的流行病学家估计至少80%的人口已感染过新冠。官方数据显示，医院住院人数在1月5日达到顶峰。本以为春运会把疾病从城市带到农村，导致第二波感染。但病毒比春运人流还快一步。生命科学数据公司Airfinity认为，令人担忧的第二波感染似乎已经与第一波合并发生。

尽管感染造成的死亡人数尚不清楚，但后续经济影响正日渐清晰。人们感染病毒并康复之后，中国的服务经济开始恢复生机。对采购经理的月度调查显示，制造业以外的活动指数从12月的41.6跃升至1月的54.4，升幅为有记录以来第二高。美国银行（Bank of America）的皮晓晴和乔虹指出，零售、住宿和餐饮等“受疫情打击”的服务业活动已大幅增加。

在电商平台美团上，一些餐厅等位的排号超过了1000号。过去人们是排队测核酸，现在是在香火鼎盛的寺庙排队许愿。在浙江省会杭州，人们凌晨4点就聚在灵隐寺外等着拜财神。据官方报纸《每日经济新闻》报道，在

以令人目眩的玻璃栈道闻名的湖南省天门山，登上壮观山顶的游客不得不排到晚上9点才能搭上缆车下山。

这种火爆局面能否持续？乐观主义者指出，中国家庭目前的资产流动性特别高。花旗集团的数据显示，中国家庭的银行存款目前超过120万亿元，超过去年GDP的100%，比原本按疫情前趋势得出的数字要多13万亿。这些存款可以为一轮“报复性支出”提供弹药。

然而，这些弹药可能会被留作他用。大部分存款都被缺乏安全感的家庭存在银行里，没有打算用于购买房产或投入共同基金。他们现在不太可能大笔花钱购买商品和服务。花旗集团认为，更有可能出现的会是一轮“报复性冒险”，因为家庭现在更有信心购买比银行存款安全性更低但可能回报更高的资产。这将提振金融市场，并为房地产行业提供亟需的支撑。

因此在评估即将到来的消费热潮时，更准确的方法或许是查看家庭收入与消费支出之间的差距。在疫情之前的三年里，家庭一般会将30%的可支配收入存起来。在疫情期间，储蓄比例为33%。多出来的存款累计约为4.9万亿元。如果消费者今年把多出来这部分都花掉，他们的消费支出将增加14%（在经通胀调整之前）。

这个消费热潮规模能有多大，最终将取决于更广泛的经济状况。房地产价格已经下跌，目前就业市场疲软。青年失业率仍高于16%。但中国的劳动力市场在经历了新冠疫情的挫折后快速反弹，失业青年仅占城镇劳动力的1%左右。幸运的话，一点点支出增加将促进销售和招聘，进而刺激更多的支出。所有这些都意味着消费可能将在今年中国经济增长中占最大份额：根据花旗集团的数据，如果包括政府在服务方面的支出，这一占比将达到近80%。这将是二十多年来的最高比例。

中国的支出增加将为全球增长做出可喜贡献。根据国际货币基金组织（IMF）1月30日发布的预测，中国经济今年将增长5.2%，占世界经济增长的五分之二。美国和欧元区将贡献的增长加起来不到五分之一。

美联储的经济学家近期发表了一项研究，在文章标题中就点明了一个基本

观点：《发生在中国的事情不只留在中国》（What Happens in China Does Not Stay in China）。根据他们的估计，中国由政策引发的GDP增长每提高1%，会让世界其他地区的GDP在一两年后增加约0.25%。作者没有研究中国重新开放国门的溢出效应。但从他们的研究结论中可以窥见可能的影响。如果中国重新开放令它今年的经济增速从3%提高到5%至6%，溢出效应可能是世界其他地区GDP增长0.5%至0.75%，按年化计算约为4000亿至6000亿美元。

然而，全球经济增长回升并非纯粹是好事。各国央行目前仍在努力抑制通胀。如果中国的需求加大增加了价格压力，政策制定者可能会觉得有必要通过加息或推迟降息来放缓经济增速。美联储副主席莱尔·布雷纳德（Lael Brainard）指出，中国放弃清零政策对全球需求和通胀具有不确定的影响，尤其是在大宗商品方面。欧洲央行行长克里斯蒂娜·拉加德

（Christine Lagarde）此前已经警告称，这种政策逆转将增加“通胀压力”，因为中国将消耗更多能源。高盛称，中国重新开放可能会导致布伦特原油价格在目前每桶约85美元的基础上攀升15至21美元。

1997年亚洲金融危机后，中国经济帮助稳定了该地区。十年后的全球金融危机之后，中国的增长帮助稳定了世界。今年，它为全球增长做出的贡献将再度居首。但是，过去中国的贡献来自投资支出，而如今起主导作用的将是消费。传统上一直有所保留的中国消费者即将大展拳脚。 ■



What pandemic?

China's ultra-fast economic recovery

The country's reopening will boost global growth, perhaps uncomfortably

DURING CHINA'S recent lunar-new-year holiday, tourists flocked to the sprawling Taihao mausoleum in Henan province. Many enjoyed slapping a statue of Qin Hui, a scheming official in the Song dynasty who is notorious for having framed a military hero. One visitor got a little carried away, striking the statue with the lid of an incense burner. Feelings are running high after Qin's villainy featured in a new film, "Full River Red", which topped the box-office charts during the holiday.

This enthusiastic moviegoing, sightseeing and statue-slapping is evidence of a surprisingly rapid consumer revival in the world's second-biggest economy. The mausoleum says it received 300,000 people in the festive period, the most to have visited in three years. Box-office revenues were not only better than last year, they were also higher than in the year before covid-19 struck. China's population, subject until recently to mass screening, is now massing at the screens.

The recovery is arriving earlier than expected because the virus spread faster. Since China hastily abandoned its zero-covid regime, infections appear to have passed remarkably quickly. State epidemiologists estimate that at least 80% of the population has already caught the disease. According to official figures, hospital inpatient numbers peaked on January 5th. A second wave of infections was expected after holiday travel spread the disease from cities to villages. But the virus beat the festive rush. The much-feared second wave appears to have merged with the first, reckons Airfinity, a life-sciences data firm.

Although the death toll from all these infections is unknown, the economic aftermath is becoming clearer. As people have caught and recovered from the virus, China's service economy is returning to life. An index of activity outside the manufacturing sector, based on monthly surveys of purchasing managers, jumped from 41.6 in December to 54.4 in January, the second-biggest leap on record. Xiaoqing Pi and Helen Qiao of Bank of America note that activity in the service sectors "battered by the pandemic", such as retail, accommodation and dining, has risen sharply.

On Meituan, an e-commerce platform, some restaurants have amassed waiting lists 1,000 tables long. People used to queuing for PCR tests now wait to pray at popular temples. In Hangzhou, the capital of Zhejiang province, people gathered outside the Linshun temple at 4am to light incense for the God of Wealth. Others who reached the top of the spectacular Tianmen mountain in Hunan province, famous for its vertiginous glass walkways, were forced to wait until 9pm to catch a cable car back down, according to the National Business Daily, a state newspaper.

Can this frenetic pace be sustained? Optimists point out Chinese households are unusually liquid. Their bank deposits now exceed 120trn yuan (\$18trn), over 100% of last year's GDP, and 13trn yuan more than might have been expected given pre-pandemic trends, according to Citigroup, a bank. These deposits could provide ammunition for a bout of "revenge spending".

Yet the ammunition may be set aside for other purposes. Much is composed of money that nervous households kept in the bank rather than using to buy property or ploughing into a mutual fund. They are unlikely now to lavish it on goods and services. More likely, reckons Citigroup, is a bout of "revenge risk-taking", as households gain confidence to buy assets that are less safe but potentially more rewarding than a bank deposit. This would lift financial markets and give a much-needed boost to property.

Perhaps a more accurate way to assess the forthcoming spending boom is therefore to look at the gap between household income and consumer spending. In the three years before the pandemic, households saved 30% of their disposable income. During the pandemic they saved 33%. The cumulative result of this extra saving is about 4.9trn yuan. If consumers added that to their spending this year it would increase their consumption by 14% (before adjusting for inflation).

The exact size of the spree will ultimately depend on broader economic conditions. Property prices have fallen and the job market is weak. Youth unemployment is still above 16%. But China's labour market has bounced back quickly after previous covid setbacks, and jobless youngsters count for only about 1% of the urban labour force. With luck, a bit of extra spending will result in higher sales and stronger hiring, in turn motivating additional spending. All this means consumption could account for the lion's share of China's growth this year: almost 80%, according to Citigroup, if government spending on services is included. This would be the highest share for more than two decades.

China's splurge will make a welcome contribution to global growth. According to the IMF's forecasts, released on January 30th, the country's economy will grow by 5.2% this year, accounting for two-fifths of the expansion in the world economy. Together, America and the euro area will contribute less than a fifth.

A recent study by economists at America's Federal Reserve makes a basic point with its title: "What Happens in China Does Not Stay in China". Their estimates suggest a policy-induced expansion in China's GDP of 1% adds about 0.25% to the rest of the world's GDP after a year or two. The authors do not examine spillovers from China's reopening. But their results give some indication of the possible consequences. If China's reopening lifts the domestic growth rate from 3% to 5-6% this year, the spillover effects may

be 0.5-0.75% of the rest of the world's GDP, or about \$400bn-600bn at an annualised rate.

An uptick in global growth would not be an unalloyed good, however. Central banks are still attempting to quash inflation. If higher Chinese demand adds to price pressures, policymakers may feel obliged to slow their economies by raising interest rates or delaying cuts. Lael Brainard, vice-chairwoman of the Fed, has noted that China's abandonment of zero-covid has uncertain implications for global demand and inflation, especially in commodities. Christine Lagarde, head of the European Central Bank, has warned the reversal will increase "inflationary pressure", because China will consume more energy. According to Goldman Sachs, another bank, reopening could add \$15-21 to a barrel of Brent crude oil, now trading at around \$85.

After the Asian financial crisis in 1997, the Chinese economy helped to stabilise the region. After the global financial crisis a decade later, China's growth helped to stabilise the world. This year it will once again make the single biggest contribution to global growth. But whereas in the past China's contribution came from investment spending, now consumption will take the lead. Chinese consumers, who traditionally punch below their weight, are about to hit a lot harder. ■



恶劣天气

如何预测破纪录的天气事件

气象学家正试图弄清它们会变得多普遍

二〇二一年，热浪袭击了北美太平洋沿岸的部分地区，加拿大不列颠哥伦比亚省利顿村（Lyttton）的气温达到 49.6°C ，比原来的最高记录高出 4.6°C 。就在人们饱受高温折磨的第四天，突发的大火将利顿村焚毁殆尽（见图）。这些事件如此反常，以至于在几周后的新闻发布会上，主讲的气候建模人员很难解释清楚各种因素如何催生了这一切。

气候学家认为，2021年的北美热浪是任何地方有记录以来最严重偏离气象常态的事件之一。不过其他事件的严重程度也不过一步之遥。随着全球日益变暖，一些曾被认为罕见的现象正变得常见，一些曾被认为不可能发生的现象也开始发生。

这种天气模式的变化促使建模人员更加关注他们的模型所生成的天气现象可能性频率分布曲线的两端（见图表），来寻找这类前所未有的极端天气。瑞士苏黎世联邦理工学院（ETH Zurich）的埃里希·费舍尔（Erich Fischer）近年来领导了一项这方面的研究，并在去年欧洲地球科学联合会（European Geosciences Union）的年会上发表了研究报告。该报告表明，利用当时的可用数据，本可以预测到那次摧毁了利顿村的热浪。

费舍尔采用的增强集成（ensemble-boosting）是近年来开发的几种方法之一。英国气象局（Met Office）采用的是另一种“未见法”（UNSEEN，全称为“用集成方法对极端天气的无先例模拟”）。2014年，英国部分地区被洪水淹没，引发了4.51亿英镑（7.43亿美元）的保险索赔。在对这次洪水的回顾性分析中，英国气象局的维克·汤普森（Vikki Thompson）及其同事首次使用了这种方法。

从英国130多年的记录来看，没有任何迹象表明会发生如此大规模的洪水。但它却真实发生了。正如再保险公司瑞士再保险（Swiss Re）的气候

风险分析师蒂埃里·科尔蒂（Thierry Corti）所说：“风险形势在变化。因此，如果你要模拟罕见事件的概率，就需要把它放在变化的背景下。这就大大增加了模拟的复杂性。”为了弄清楚到底发生了什么，汤普森的团队对英国1981年到2015年间的冬季进行了数千次模拟，并研究了各种可能的结果，包括罕见事件。

在按部就班地重复这些模拟工作时，他们还加入了一些扰乱因素——也就是著名的蝴蝶效应，或者说得更现实点，工厂发动机运转带来的小幅的局部大气升温。通过反复模拟当前的气候，每次再加入一些微小的扰乱因素，英国气象局的建模人员生成了一系列的虚拟冬季，其中包括可能出现但尚未出现的极端天气。

以洪水为例，研究小组发现，每年冬季会有34%的几率在英国四大地区的至少一个地区出现创记录的降水。他们得出结论，决策者最好做好准备，以应对“未来几年”新的破纪录的洪水。他们的警告在2020年头几个月应验了，他们被证明是正确的。

UNSEEN方法正在启发其他人的灵感。例如，各种研究小组正在研究“侥幸”事件，也就是极端干旱或洪涝发生在人口低密度地区，因此受影响的人很少。运用UNSEEN或者类似UNSEEN的方法，就可以评估在附近的人口稠密地区发生类似事件的风险，以及会产生何种后果。

另一些人则关注未来某些特定时刻是否会发生尤其具破坏性的极端天气事件。明年的巴黎奥运会将在巴黎最热的几周里举办。因此，来自法国各个研究机构的一群气象学家想知道那时的热浪可能会有多严重。他们用了另一种方法，发现届时的气温有可能比2003年导致数万人死亡的灾难性热浪期间的气温高4°C以上。

自那以后，法国建立了“防高温计划”，包括启用一个预警系统，以及为必要时开放避暑纳凉场所做好准备。不过，当可能破纪录的高温与成千上万名运动员和数十万名游客一起到来之时，这些措施是否足以减轻这场高温的影响仍需拭目以待。

可能发生的事情并不一定会发生，但在某些情况下，比如巴黎奥运会，这些可能性的风险或影响显然都达到了值得密切关注的程度。另一个例子是汤普森及其同事在2019年发表的一项研究，他们发现，在中国东南部，每年夏天都有10%的几率出现一个破纪录的高温月份。去年的致命热浪创下的记录超出了预警温度。

其他研究提出了这样的问题：某地区是否因为气候变化而“早该”发生极端事件，或者该地区的基础设施或经济状况是否尤其不足以应对可能发生的情况。在美国粮仓堪萨斯州，这两个问题似乎都适用。堪萨斯州的小麦产量占美国的17%，据说该州为小麦种植创造了理想的条件。但是1900年（也就是种植小麦的农民刚移居到这里时）以前的情形可能已经不适用于现在了。根据塔夫茨大学（Tufts University）的艾琳·考夫兰·德佩雷斯（Erin Coughlan de Perez）即将发表的一项研究报告，在如今的气候条件下，曾经百年一遇的热浪很可能十年就会发生一次。

德佩雷斯还发现，在降水量不足的年份，还很可能同时出现高温天气，热到足以抑制小麦中酶的生成，从而损害小麦的生长。但是，气候变化的不规则性可能会让农民产生一种虚幻的安全感，因为她和同事们也发现，最近几年的气温比预计的要低。“就最近经历的一些极端天气事件而言，有几个地区可能只是‘很走运’。”他们写道。同一项研究也预测了中国中部的小麦大省河南出现类似的情况，虽然可能没有那么明显。

保险公司也很关注这些发生几率小但影响很大的事件的相关信息，它们同样也在构建自己的模型。同时，这些信息也可以帮助设计与气候相适应的基础设施。例如，在荷兰，慈善机构“气候适应服务”（Climate Adaptation Services，简称CAS）收集了从现在到2050年气候变化各种可能后果的数据，包括详细的地图，官方可以利用这些地图检验自己的规划。

CAS的UNSEEN建模人员蒂莫·凯尔德（Timo Kelder）表示，他们正在考虑如何增加新的压力测试，以评估当面对这些研究所显示的有可能发生的空前且惨重的事件时，规划能取得多大的成效。与此同时，英国气象局的研究人员正在研究另一种极端事件——“风旱”。这种风险将让英国的大量风

力涡轮机成为摆设。如果英国这项对抗气候变化的巨大努力本身也成为了气候变化的受害者，那确实太讽刺了。 ■



Bad weather

How to predict record-shattering weather events

Meteorologists are trying to work out just how common they will become

THE HEATWAVE that struck parts of North America's Pacific coast in 2021 propelled temperatures in Lytton, a village in British Columbia, to 49.6°C — 4.6° higher than the previous record. On the fourth day of this torment the place erupted in flames and was almost completely destroyed (see picture). These events were so out of the ordinary that, in a press conference held some weeks later by climate modellers, they struggled to explain how circumstances had conjured them.

Climatologists reckon the North American heatwave of 2021 was one of the most extreme deviations from meteorological norms ever recorded, anywhere. But others have come close. As the world gets hotter, phenomena once considered rare are becoming common and others, believed impossible, are happening.

This shift in weather patterns has inspired modellers to pay more attention to the tails of the frequency distributions of meteorological possibility which their models generate (see chart), in search of such unprecedented extremes. One recent exercise, led by Erich Fischer at ETH Zurich, a technology university in Switzerland, and presented at last year's annual jamboree of the European Geosciences Union, shows how the heatwave that destroyed Lytton could have been foreseen with data available at the time.

The approach Dr Fischer used, ensemble-boosting, is one of several developed recently. Another, from Britain's Met Office, is UNSEEN (Unprecedented Simulation of Extremes with Ensembles). This was first put to work by Vikki Thompson and her colleagues at the Met Office in a

retrospective analysis of floods that had drowned parts of the country in 2014, resulting in £451m (\$743m) of insurance claims.

More than 130 years of English records had offered no indication such a biblical deluge was possible. Yet, here it was. As Thierry Corti, a climate-risk analyst at Swiss Re, a reinsurance company, observes, “the risk landscape is evolving. So if you simulate probabilities of a rare event you need to take that against the backdrop of something that’s changing. That makes it much more complex.” To try to understand what had happened, Dr Thompson’s team simulated British winters between 1981 and 2015 many thousands of times, and looked at the spread of possible outcomes, including rare events.

Into this methodical repetition they added a sprinkle of chaos—the famous flap of a butterfly’s wing, or, more realistically, the revving up of a factory’s engines to add a small and local amount of heat to the atmosphere. By repeatedly simulating the present climate, perturbed each time in minute ways, the Met Office modellers generated a range of virtual winters which included extremes that are possible but have not yet manifested themselves.

In the case of floods, the group found a 34% chance each winter that rainfall records would be broken in at least one of four broad regions of Britain. They concluded that decision-makers would do well to prepare for new record-breaking inundations “in the next few years”. They were vindicated when their warnings came to pass in the early months of 2020.

The UNSEEN approach is inspiring others. For example, various groups are now looking at “near-miss” events, in which an extreme drought or flood befalls a region with low population density, thus affecting few people. With UNSEEN and UNSEEN-like methods, it is possible to assess the risk of a similar event striking a neighbouring but more populous area—and with what consequences.

Others have taken an interest in bits of the future when an extreme weather event would be particularly damaging. The Paris Olympics, to be held next year, will take place during that city's hottest weeks. A group of meteorologists from various French research institutes therefore wondered just how bad a heatwave manifesting itself then might be. Using yet another approach, they found a chance of temperatures being more than 4°C higher than they were during a catastrophic heatwave in 2003, in which tens of thousands died.

Since that happened, France has built a "heat plan" which includes an early-warning system and provisions for opening cool spaces if needed. Whether this will be enough to ameliorate the effects of a record-breaker coinciding with the arrival of thousands of athletes and hundreds of thousands of visitors remains to be seen.

That something could happen does not mean it will, but in some cases, such as the Paris Olympics, either the risk or the consequences are clearly high enough to warrant close attention. Another example is a study published in 2019, by Dr Thompson and her colleagues, which found that, in south-east China, each summer holds a 10% chance of there being a record-breaking hot month. The temperatures warned of were within the range of the records set during last year's deadly heatwave.

Other research has asked if a region is "overdue" for an extreme event because of the changing climate, or whether its infrastructure or economy is particularly ill-prepared for what could happen. In the case of Kansas, America's breadbasket, both look true. The state produces 17% of the country's wheat, and is said to foster ideal conditions for growing this crop. But what pertained before 1900, when wheat farmers were moving in, may not hold now. In today's climate, heatwaves that were once once-a-century events are likely to occur once a decade, according to a study to be published soon by Erin Coughlan de Perez of Tufts University.

Dr de Perez also found that hot weather sufficient to damage wheat's growth by inhibiting its enzymes is likely to occur in the same years as periods of low rainfall. But the irregular pace of weather change may lull farmers into a false sense of security, for she and her colleagues discovered, too, that recent years have been cooler than expected. "Several regions might have 'gotten lucky' in terms of their recent experience of extreme events," they write. The same study predicts similar, if less pronounced, patterns in Henan, a wheat-producing province of central China.

Information about low-likelihood but high-impact events is also of interest to insurers (who carry out their own modelling as well) and can help, too, in the design of climate-resilient infrastructure. In the Netherlands, for example, Climate Adaptation Services (CAS), a charity, gathers data on possible consequences of climate change between now and 2050, including detailed maps that the authorities can draw on to test their plans.

Timo Kelder, an UNSEEN modeller at CAS, says they are thinking about how they might add new stress tests which assess how successful plans would be in the face of the brutal and unprecedented events these studies suggest are plausible. Meanwhile, in Britain's Met Office, researchers are now looking at another sort of extreme event—the risk of "wind droughts" which would wipe out a lot of the country's wind-turbine-base electricity supply. It would be ironic indeed if Britain's huge effort to combat climate change in this way were, itself, to fall victim to a changing climate. ■



【首文】搜索引擎

网络搜索之战

AI聊天机器人会吃掉谷歌的午餐吗？

超过25年了，搜索引擎一直是互联网的大门。AltaVista是首个实现网络全文搜索的网站，但谷歌很快就取而代之，此后在全球大部分地区一直称霸搜索领域。现在搜索引擎仍是谷歌的核心业务，其母公司Alphabet借此成为全球市值最高的公司之一，2022年营收2830亿美元，市值达1.3万亿美元。谷歌不仅是一个家喻户晓的名字，还是一个动词。

但没有什么是永恒的，特别是在科技行业。看看一度雄霸商业计算的IBM或是曾经的手机业王者诺基亚就知道了。两者都因为没能把握好重大技术转型关口而被赶下王座。而现在，一项让科技公司垂涎的创新可能也预示着类似的转变和机会。由人工智能（AI）驱动的聊天机器人能让用户通过输入文字对话来收集信息。在这方面领跑的是创业公司OpenAI的ChatGPT。到1月底，也就是推出两个月后，ChatGPT已拥有超过一亿用户，成为“史上增长最快的消费应用”，瑞银表示。

现在许多产品背后都应用了AI，但ChatGPT把AI推向前台，让用户直接与AI机器人聊天。ChatGPT可以撰写不同风格的文章，解释复杂概念，概括文本，做冷知识问答。它甚至可以（勉强）通过法律和医学考试。它还能综合处理网络信息，例如列出符合某些标准的度假地点，或者建议菜单或旅游行程。如果遇到追问，它还能说明理据并提供细节。简言之，人们现在用搜索引擎做的许多事情改用聊天机器人成效可能更好。

于是，随着各家公司都想抢占先机，一连串公告接踵而来。2月7日，对OpenAI投资超过110亿美元的微软宣布其搜索引擎必应推出集成了ChatGPT的新版本。微软老板萨提亚·纳德拉（Satya Nadella）视之为挑战谷歌的机会。而谷歌也宣布将推出自家的聊天机器人Bard，作为其搜索引擎的“伙伴”。它还以三亿美元入股由OpenAI前员工创建、已开发出聊天机

器人Claude的创业公司Anthropic。有中国谷歌之称的百度表示将在3月发布名为文心一言的聊天机器人，股价随即大涨。

但是，可以信任聊天机器人吗？它们对网络搜索及利润丰厚的相关广告业务意味着什么？它们是否会预示又一个熊彼特时刻——AI推翻老牌公司，新兴公司上位？答案取决于三方面：道德选择、盈利模式、垄断经济学。

ChatGPT经常出错。一些人指出它说教式的语气很“爹味”：对自己的答案极度自信，不管准确与否。搜索引擎主要把人们引向其他页面，不担保相关信息的真确性，聊天机器人则不同，它把自己的答案当做金玉良言。聊天机器人在扫描互联网时还必须应对偏误、成见和错误信息的难题。当它们提供不正确或冒犯性的回答时肯定会惹来争议。（据说谷歌之前就是碍于这些顾虑而推迟发布自家的聊天机器人，但现在微软迫使它不得不出手）。ChatGPT的一些回答已经肯定会让佛罗里达州州长罗恩·德桑蒂斯（Ron DeSantis）觉得过度“觉醒主义”、不可接受了。

聊天机器人还必须小心处理一些棘手话题。被问到医疗建议时，ChatGPT作答前会先声明自己“无法诊断具体疾病”；它也拒绝对“如何制造炸弹”这类问题给出建议。但实际上提问者要绕过这些围栏并不难（例如，改问关于炸弹制造者的故事，并要求提供大量技术细节）。科技公司若要决定哪些话题过于敏感，则将不得不选择在何处划出界限。这一切将引发关于审查制度、客观性和真理本质的问题。

科技公司能从中获利吗？OpenAI刚推出ChatGPT的付费高级版，月费为20美元，保证在高峰期也能快速访问。本来已在各自的搜索引擎上销售广告的谷歌和微软将在聊天机器人的回答中显示广告，比如说，有人询问旅游建议，就会弹出相关广告。但这种商业模式可能难以持续。相比提供搜索结果，运行聊天机器人需要更多的处理能力，因此成本较高，令利润下降。

肯定会出现其他商业模式：也许是向广告客户收取更高的费用以影响聊天机器人提供的答案，或是在回复中嵌入客户的网站链接。现在让ChatGPT

推荐一款汽车，它会回答说有很多好品牌，全看你有什么需求。未来的聊天机器人可能更愿意直接推荐品牌。但假如其客观性受广告主的影响而打了折扣，人们还会听取这些机器人的建议吗？人们能加以辨别吗？看，又是一连串难题。

然后是关于竞争的问题。谷歌受到来自OpenAI这样的科技新贵的压力是好消息。但尚不清楚聊天机器人究竟是搜索引擎的竞争对手还是辅助工具。鉴于聊天机器人的回答时不时会出错，先将其部署为搜索引擎的附加组件或作为独立的对话伙伴是明智之举。但随着它们的能力提高，聊天机器人也许能成为各种服务的接口，比如预订酒店或餐厅，特别是以Alexa或Siri这类语音助手的形式提供。但如果聊天机器人的主要价值是建立在其他数字服务之上的一个服务层，这将有利于已在提供此类服务的企业。

然而，Anthropic和OpenAI等当今科技新贵引来谷歌和微软的密切关注（以及大量投资），表明小公司也有机会在这个新领域一争高下。它们将面临巨大的出售压力。但说不准哪天就有哪家聊天机器人新秀公司开发出卓越的技术，开创全新的商业模式，崛起为新的巨头。毕竟谷歌就是这样发展起来的。聊天机器人引发了连串难题，但也提供了机会让网络信息变得更有用、更易获取。就像上世纪90年代搜索引擎刚面世时那样，互联网入口这一连城至宝可能再现江湖，引发争夺。■



Search engines

The battle for internet search

Will the AI chatbots eat Google's lunch?

FOR MORE than 25 years, search engines have been the internet's front door. AltaVista, the first site to allow searches of the full text of the web, was swiftly dethroned by Google, which has dominated the field in most of the world ever since. Google's search engine, still the heart of its business, has made its parent, Alphabet, one of the world's most valuable companies, with revenues of \$283bn in 2022 and a market capitalisation of \$1.3trn. Google is not merely a household name; it is a verb.

But nothing lasts for ever, particularly in technology. Just ask IBM, which once ruled business computing, or Nokia, once the leader in mobile phones. Both were dethroned because they fumbled big technological transitions. Now tech firms are salivating over an innovation that might herald a similar shift—and a similar opportunity. Chatbots powered by artificial intelligence (AI) let users gather information via typed conversations. Leading the field is ChatGPT, made by OpenAI, a startup. By the end of January, two months after its launch, ChatGPT was being used by more than 100m people, making it the “fastest-growing consumer application in history”, according to UBS, a bank.

AI is already used behind the scenes in many products, but ChatGPT has put it centre stage, by letting people chat with an AI directly. ChatGPT can write essays in various styles, explain complex concepts, summarise text and answer trivia questions. It can even (narrowly) pass legal and medical exams. And it can synthesise knowledge from the web: for example, listing holiday spots that match certain criteria, or suggesting menus or itineraries. If asked, it can explain its reasoning and provide detail. Many things that

people use search engines for today, in short, can be done better with chatbots.

Hence the flurry of announcements, as rival firms try to seize the initiative. On February 7th Microsoft, which has invested more than \$11bn in OpenAI, revealed a new version of Bing, its search engine, which incorporates ChatGPT. Satya Nadella, Microsoft's boss, sees this as his chance to challenge Google. For its part, Google has announced Bard, its own chatbot, as a "companion" to its search engine. It has also taken a \$300m stake in Anthropic, a startup founded by ex-OpenAI employees, which has built a chatbot called Claude. The share price of Baidu, known as the Google of China, jumped when it said it would release its chatbot, called Ernie, in March.

But can chatbots be trusted, and what do they mean for search and its lucrative advertising business? Do they herald a Schumpeterian moment in which AI topples incumbent firms and elevates upstarts? The answers depend on three things: moral choices, monetisation and monopoly economics.

ChatGPT often gets things wrong. It has been likened to a mansplainer: supremely confident in its answers, regardless of their accuracy. Unlike search engines, which mostly direct people to other pages and make no claims for their veracity, chatbots present their answers as gospel truth. Chatbots must also grapple with bias, prejudice and misinformation as they scan the internet. There are sure to be controversies as they produce incorrect or offensive replies. (Google is thought to have held back the release of its chatbot over such concerns, but Microsoft has now forced its hand.) ChatGPT already gives answers that Ron DeSantis, Florida's governor, would consider unacceptably woke.

Chatbots must also tread carefully around some tricky topics. Ask ChatGPT

for medical advice, and it prefaces its reply with a disclaimer that it “cannot diagnose specific medical conditions”; it also refuses to give advice on, say, how to build a bomb. But its guardrails have proved easy to circumvent (for example, by asking for a story about a bombmaker, with plenty of technical detail). As tech firms decide which topics are too sensitive, they will have to choose where to draw the line. All this will raise questions about censorship, objectivity and the nature of truth.

Can tech firms make money from this? OpenAI is launching a premium version of ChatGPT, which costs \$20 a month for speedy access even at peak times. Google and Microsoft, which already sell ads on their search engines, will show ads alongside chatbot responses—ask for travel advice, say, and related ads will pop up. But that business model may not be sustainable. Running a chatbot requires more processing power than serving up search results, and therefore costs more, reducing margins.

Other models will surely emerge: charging advertisers more for the ability to influence the answers that chatbots provide, perhaps, or to have links to their websites embedded in responses. Ask ChatGPT to recommend a car, and it will reply that there are lots of good brands, and it depends on your needs. Future chatbots may be more willing to make a recommendation. But will people use them if their objectivity has been compromised by advertisers? Will they be able to tell? Behold, another can of worms.

Then there is a question of competition. It is good news that Google is being kept on its toes by upstarts like OpenAI. But it is unclear whether chatbots are a competitor to search engines, or a complement. Deploying chatbots initially as add-ons to search, or as stand-alone conversation partners, makes sense given their occasional inaccuracies. But as their capabilities improve, chatbots could become an interface to all kinds of services, such as making hotel or restaurant reservations, particularly if offered as voice assistants, like Alexa or Siri. If chatbots’ main value is as a layer on top of

other digital services, though, that will favour incumbents which provide such services already.

Yet the fact that today's upstarts, such as Anthropic and OpenAI, are attracting so much attention (and investment) from Google and Microsoft suggests that smaller firms have a shot at competing in this new field. They will come under great pressure to sell. But what if an upstart chatbot firm develops superior technology and a new business model, and emerges as a new giant? That, after all, is what Google once did. Chatbots raise hard questions, but they also offer an opportunity to make online information more useful and easier to access. As in the 1990s, when search engines first appeared, a hugely valuable prize—to become the front door to the internet—may once again be up for grabs. ■



经济学人视频

商业界如何运用元宇宙？（中）

元宇宙开始为众多行业提供机会，并为解决紧迫甚至致命的挑战带来新方法。



The Economist Film

How will business use the metaverse? Part 2

The Metaverse is starting to offer opportunities to a multitude of industries, and new ways to tackle pressing, even deadly, challenges.



击退疾病

栖息地丧失和气候变化增加了出现新型疾病的风险

在所预测的哺乳动物间的病毒传播中，90%与蝙蝠有关

尽管科学家们还没有确定新冠病毒是如何出现的，但主流理论是人畜共患病溢出（从动物身上传播而来）。新冠造成的死亡人数让积极行动预防未来的大流行病愈加紧迫。最近发表在《自然》杂志上的一项关于蝙蝠（携带着与新冠病毒最接近的一些冠状病毒）的研究发现，这类溢出的风险正在上升——尽管改变人类活动有可能让它重新降至更安全的水平。

如果新冠病毒确实是人畜共患，它可能是先从蝙蝠传播到“桥梁”动物，然后传给人类。作者们着重研究了亨德拉（Hendra）病毒。这种病毒也会被蝙蝠排出体外，然后感染马，再传染给人。在已知感染亨德拉病毒的七人中有四人死亡。这篇论文研究了澳大利亚东部亚热带地区果蝠的亨德拉病毒溢出的情况，自2006年以来那里的溢出一直在增加。研究发现，栖息地丧失加上气候引起食物短缺是溢出增加的原因。

澳大利亚果蝠吃桉树的花蜜。在强烈的厄尔尼诺现象中赤道太平洋地区温度上升，之后开花的树木减少。这造成蝙蝠的栖息地缩小，能吃到的食物变差，体质减弱，可能导致它们排出更多的病原体。

在2003年之前溢出很少见，这些变化持续时间不长，只在短暂的食物短缺期出现。但自1996年以来，人类已经开垦了蝙蝠冬季栖息地的三分之一。蝙蝠不再找寻花蜜为食，而是长时间在靠近人类的地方栖息。马会接触到在农场树上觅食的蝙蝠，造成溢出。

蝙蝠是唯一会飞的哺乳动物，是人畜共患病的强力媒介。2022年的另一篇论文发现，全球变暖迫使动物改变栖息地，预计会让哺乳动物物种之间初次相遇（因此会有潜在的病毒传播）的几率增加一倍。该研究推算出90%的首次接触（集中在亚洲和非洲的热带山区）都与蝙蝠有关，因为蝙蝠能长距离旅行，和许多物种打交道。

现在要减缓动物之间的病毒传播可能为时已晚：该研究显示，这类传播在气候变化温和的情况下甚至会比气候变化严重的情况下更多见。相比之下，栖息地丧失的影响似乎是可逆的。关于澳大利亚的论文发现，当桉树再次开花时，蝙蝠又成群结队地回来了。不管新冠源起何处，恢复蝙蝠的栖息地可能有助于防止下一次大流行病。

图表来源：《蝙蝠生态快速变化驱动的病原体溢出》，佩姬·伊比（Peggy Eby）等著，《自然》，2022年；《气候变化增加了跨物种病毒传播风险》，科林·J·卡尔森（Colin J. Carlson）等著，《自然》，2022年 ■



Batting down disease

Habitat loss and climate change increase the risk of new diseases

Bats account for 90% of predicted viral transmission between mammal species

ALTHOUGH SCIENTISTS have not determined how covid-19 emerged, the leading theory is zoonotic spillover (transmission from animals). The death toll from covid has given efforts to prevent future pandemics new urgency. A recent study in Nature on bats, which carry SARS-CoV-2's closest cousins, finds that the risk of such spillovers is rising—though changes in human activity could return it to safer levels.

If covid is indeed zoonotic, it probably jumped first from bats to a “bridge” animal and then to people. The authors focus on the Hendra virus. This is also excreted by bats and infects horses, which spread it to humans. Of the seven people known to have caught Hendra, four died. The paper studied Hendra spillovers from fruit bats in subtropical eastern Australia, which have risen since 2006. It found that habitat loss combined with climate-induced food shortages explained the increase.

Australian fruit bats eat eucalyptus-tree nectar. Following strong El Niño events, when temperatures in the equatorial Pacific Ocean rise, fewer trees flower. This leads bats to form smaller roosts and eat inferior food, weakening them and probably causing them to excrete more pathogens.

Before 2003, when spillovers were rare, these changes lasted only for brief spells of food scarcity. But since 1996 humans have cleared a third of the bats' winter habitat. Instead of hunting for nectar, bats now spend long periods in roosts near humans. Horses are exposed to those feeding in trees on farms, causing spillovers.

Bats, the only flying mammal, are potent vectors for zoonosis. Another

paper in 2022 found that global warming, by forcing animals to change habitats, is expected to double the rate of first encounters (and thus potential viral spread) between mammal species. The study calculated that 90% of first contacts, concentrated in tropical, mountainous parts of Asia and Africa, involve bats, because they travel long distances and interact with lots of species.

It may be too late to slow viral transmission between animals: the study showed that this will be even more common if climate change is moderate than if it is severe. In contrast, the impact of habitat loss appears reversible. The paper on Australia found that when eucalyptus trees bloomed again, bats flocked back. Regardless of the origins of covid, restoring bats' habitats could help prevent the next pandemic.

Chart sources: "Pathogen spillover driven by rapid changes in bat ecology", by Peggy Eby et al., Nature, 2022; "Climate change increases cross-species viral transmission risk", by Colin J. Carlson et al., Nature, 2022



触觉技术

元宇宙和未来小设备的触感世界

很快，游戏玩家就能拿起物品，并体验被子弹击中的感觉【新知】

奥尔德斯·赫胥黎（Aldous Huxley）笔下的美丽新世界（小说即以此为标题）中的一大创想是“感官电影”（feelies）。1932年，也就是它出版的那一年，电影开始从默片走向有声。尽管让人心里发毛，但有声电影进一步发展为感官电影似乎是顺理成章的。书中提到当地剧院上映的一部电影中，有一场熊皮地毯上的激情戏，其中每一根熊毛的触感都得以再现。

感官电影至今还未问世，但人们正在为之努力。如今电脑游戏和虚拟现实（VR）继承了电影在轻娱乐中的作用，这两个领域中的触觉研究人员正试图在视觉和听觉之外再加上触觉，以增强人们在虚拟世界中的沉浸幻觉。他们希望，今后在这样的虚拟乐园中，如果你伸手去摘树上的苹果，你的手将不再会从中穿过，而是能感觉自己握住了苹果，即便不能真的吃它。反过来说，如果你身处失乐园，躲在苹果树后的坏人向你开枪，你也会感受到子弹的冲击力。

为体验到这一切，用户需要穿上触觉服装。有人雄心勃勃地大谈全身触觉套装，但如果只是苹果、树和枪手这些场景，有触觉手套和触觉背心就足够了。当用户戴着触觉手套的手移动时，虚拟手也会随之做出相应的动作，与“被触碰”物体相对应的触感会通过集成在手套中的触觉致动器反馈回来。触觉背心也以类似的原理触发上半身一些部位的知觉。

致动器本身有很多种。目前使用最广泛的是ERM（偏心旋转质量致动器）和LRA（线性谐振致动器）。ERM是一种微型电机，用来驱动装有偏心块的轴，当轴旋转时，整个致动器都会振动。LRA则是使用电磁线圈来震动表面。如今，这些装置被用于智能手机的新消息提醒，以及对点击触摸屏做出反应等。而要把这些成熟的技术应用于VR和游戏应该是相当容易的事情。

不过，并不是只有ERM和LRA才能实现沉浸式触觉。例如，西班牙公司OWO Game即将发售的一款可以贴身穿着的触觉背心就使用了电刺激，而不是依靠致动器的振动。它向躯干的不同部位发送强度可调节的电流。除了产生刺痛感，这些电流还能导致肌肉收缩。看起来使用这种方法可以再现被枪击、刀刺以及炸飞等效果。

与此同时，华盛顿州雷德蒙德（Redmond）一家名为HaptX的公司已经在研究气动技术——许多人可能认为这项技术已经过时了。公司创始人之一鲍勃·克罗克特（Bob Crockett）解释说，HaptX需要通过压缩空气来让皮肤产生足够大的位移，以实现逼真的触感。他表示，其他触觉设备无法做到这一点。

HaptX的手套G1通过一个管子网络来充气和抽气，让每只手套内的135个微小气囊胀大或收缩。最敏感的气囊位于指尖处，直径不到1毫米。手套的手指部位还包括气动的“外骨骼肌腱”，可以抑制手指的运动，从而模拟触摸固体的感觉。压缩机和为系统供电的电子设备都装在背包里，这样用户就可以自由移动。

这些小玩意都价格不菲。一副G1手套至少要花你4500美元。不过，它最初的销售对象是企业用户，而不是个人。预计其早期客户将包括一些已经在使用VR进行培训并希望改善培训效果的机构，比如向外科医生教授手术技术的医学院，或者喷气式发动机的维修工厂等。另一个用途也许是让在世界不同地方的工程师可以相互合作。比如说，新车型的研制人员可以在虚拟实验室里碰面，对虚拟组件进行修改调整，以及传阅虚拟的设计图稿。

不过，HaptX之所以选择气动技术还有一个更深层次的原因：它不打算仅仅制造手套。它计划开发全身触觉套装，并且认为气动致动比电动致动更容易量产。HaptX对细节讳莫如深，只是说如果用户穿戴上一套外骨骼，全身都能产生知觉——包括将用户双手向下拉的力，这样用户就能感受到虚拟物体的重量。

VR和游戏属于触觉技术的高端市场。但设法改善非虚拟世界中的触觉反馈也很重要。智能手机、电脑和触摸屏如今在汽车、快餐店等场所被大量使用，它们都可以从增加一些触觉中受益。

阿姆斯特丹的Aito公司希望能够提供这样的产品。Aito为笔记本电脑和其他数字设备生产触觉系统。这些系统采用基于压电材料的致动器，这种材料会随着电压的变化而收缩或膨胀，从而产生轻微的运动。这个过程也可以逆转。当受到挤压时，压电晶体会产生电流。也就是说，压电材料既可以用作致动器，也可以用作传感器。

Aito的致动传感器有三层。最外层由塑料、玻璃，甚至木头制成。中间层是电容栅极，它根据栅极电场中产生的变化来确定手指触碰设备的位置。第三层是压电激活器的矩阵。这三层合在一起只有1.8毫米厚，可以集成到触摸屏或触控板上。

当致动传感器检测到手指时，它会根据手指所处的位置和施加的压力做出适当的反应。它可能发出咔哒声，或者咕噜声。或者让屏幕的上层保持稳定，但呈现粗糙的质感，用手指或塑料触控笔时就像钢笔在纸张上书写，或者像画笔在画布上作画。

随着带折叠屏的便携设备的应用，设备的下半部分或许可以被用作触觉键盘。Aito的老板内德科·伊万诺夫（Nedko Ivanov）表示，通过编程，它可以提供类似机械键盘的触觉反应，不过还带有额外功能。比如，加大按压力度就能让字母变成大写，而不用按shift键。

这也会让设备变得更薄更轻。而且同样的机器不用修改硬件就能在不同的地方销售，这是因为基于屏幕的触觉键盘通过编程可以使用任何适合当地语言的字符集。

其中一些新功能也将被用到汽车上——尤其是当传统的仪表盘开关越来越多地被屏幕上的图标取代。没有了机械开关那种令人心安的咔哒声，驾驶员在视线不离开路面的情况下很难判断这些图标有没有被开启或关闭。

触觉技术可能还有另一大用途。色情内容制作者曾经是互联网的早期先行者（事实上，在互联网问世之前，他们也是电影和摄影的先行者）。因此，也就不奇怪他们中的一些人正在研究虚拟的性接触（业内称之为“远程性爱”）。例如，一些情趣用品公司已经开始在它们的产品线中添加有蓝牙功能的产品，让情侣们可以远程互动。或许赫胥黎的想象终究不是太离谱。 ■



Haptic technologies

The touchy-feely world of the metaverse and future gadgets

Soon, game players will be able to pick things up—and feel the bullets, when they are hit

THE BRAVE NEW WORLD Aldous Huxley describes in his novel of that title features the “feelies”. In 1932, its year of publication, movies were turning into talkies. Feelies must have seemed a logical, if creepy, extension of that. The book alludes to a film at a local theatre with a love scene on a bearskin rug, in which the sensation of every hair of the bear is reproduced.

The feelies have still not arrived. But people are working on them. In computer games and virtual reality (VR), two heirs to cinema’s role in light entertainment, practitioners of the discipline of haptics are attempting to add a sense of touch to those of vision and hearing, to increase the illusion of immersion in a virtual world. In future, they hope, if you reach out to pluck an apple from a tree in such a paradise, your hand will no longer go through it. You will, rather, be able to feel and grasp the fruit, if not actually eat it. Conversely, if it is a paradise lost you are in, and a baddy hiding behind the apple tree shoots you, you will feel the bullet’s impact.

To experience all this a user will wear haptic clothing. The ambitious talk of whole-body haptic suits, but in the case of the apple, the tree and the gunman haptic gloves and a haptic vest would suffice. Moving a gloved hand creates corresponding movement of a user’s virtual hand, with sensations appropriate to objects “touched” being fed back via devices called haptic actuators, incorporated into the glove. Haptic vests similarly stimulate parts of the upper body.

Actuators themselves come in a variety of forms. Those most widely used at the moment are ERMs (eccentric rotating masses) and LRAs (linear resonant

actuators). An ERM is a tiny motor that drives a shaft fitted with an off-centre weight which causes the whole thing to vibrate when the shaft spins. An LRA uses an electromagnetic coil to shake a surface. Nowadays, these devices are employed for jobs like alerting smartphone users to incoming messages and reacting when a touchscreen is tapped. But adapting such well-understood technologies for use in VR and gaming should be fairly easy.

ERMs and LRAs are not, however, the only possible approaches to immersive haptics. For instance, OWO Game, a Spanish firm, is about to put on sale a haptic vest, worn next to the skin, that relies on electrical stimulation rather than vibrating actuators. It delivers tuneable levels of current to different parts of the torso. Besides creating tingling sensations, these can also cause muscles to contract. Effects replicable using this approach apparently include being shot, stabbed and blown up.

In Redmond, Washington, meanwhile, a firm called HaptX has reached for pneumatics, a technology many might think had seen its heyday. Bob Crockett, one of the company's founders, explains that the firm needs compressed air to produce a big enough displacement of the skin to effect a realistic sensation of touch. Other haptic devices, he says, cannot do that.

HaptX's gloves, branded G1, have their air pumped in and out through a network of tubes which inflate or deflate 135 tiny balloons incorporated into each glove. The most sensitive of these balloons—those in the finger tips—are less than 1mm in diameter. The gloves' fingers also include pneumatic "exotendons", which brake the fingers' movement, thereby simulating the feeling of touching a solid object. The compressor and electronics powering the system are held in a backpack, so a user can move around freely.

None of this will be cheap. A pair of G1 gloves will set you back at least

\$4,500. The initial market, though, is corporate, rather than retail. Early customers are expected to include organisations that already use VR for training and want to improve the experience: medical schools teaching operating techniques to surgeons, for example, or workshops that repair jet engines. Another use might be to permit collaboration between engineers living in different parts of the world. People working on a new car, say, could meet in a virtual laboratory, tinker with virtual components, and pass around virtual copies of their designs.

There is, though, a further reason why HaptX has chosen pneumatics: it does not intend to stop at making gloves. It has plans for a whole-body haptic suit and thinks pneumatic actuation will be easier to scale up than something based on electric motors. It is cagey about details, but users would don an exoskeleton that could create sensations all over the body—including forces that pull a user's hands downward, so he or she would feel the weight of virtual objects.

VR and gaming are the high end of haptics. But ways of improving haptic feedback in the non-virtual world are important, too. Smartphones, computers and the touchscreens now proliferating in vehicles, fast-food venues and so on could all benefit from a bit of haptic feedback.

Aito, a firm based in Amsterdam, hopes to provide just that. It produces haptic systems for laptops and other digital devices. These employ actuators based on piezoelectric materials, which shrink or expand in response to a voltage, producing a slight movement. And the process works in reverse, as well. When squeezed, a piezoelectric crystal generates a current. This means piezo materials can be employed both as actuators and as sensors.

Aito's actu-sensors have three layers. Their covers are plastic, glass or even wood. Below lies a capacitance grid, which determines, from the change created in the grid's electric field, the position of a finger touching the

device. The third layer is a matrix of piezo activators. All three combine into something barely 1.8mm thick that can be incorporated into touchscreens and touch pads.

When an actu-sensor detects a finger it responds appropriately, according to the position and pressure of the digit in question. It might create clicks. Or rumbles. Or form the screen's upper layer into a stable but scratchy surface that would cause a finger or a plastic stylus to feel like a fountain pen gliding over paper, or like a brush painting on canvas.

With the introduction of portable devices that have foldable screens, the lower half might thereby be used as a haptic keyboard. It could be programmed to provide a tactile response like that of a mechanical keyboard, but with additional features, says Nedko Ivanov, Aito's boss. For instance, pressing down harder would capitalise a letter, doing away with the need for a shift key.

This would also allow devices to be slimmer and lighter. And the same machine could be sold in different places without having to modify its hardware, for a screen-based haptic keyboard could be programmed to use whatever character set was appropriate to the local language.

Some of these new features will work their way into cars, too—especially as conventional dashboard switches are replaced more and more by icons on a screen. Without a satisfying mechanical click, it can be hard to tell, without taking your eyes off the road, whether such icons have been activated or deactivated.

And there is also one other potentially big use for haptics. Pornographers were early pioneers of the internet (and, indeed, of film and photography before that). So it is hardly surprising a number of them are now working on virtual-sex encounters—known in the trade as “teledildonics”. Some

companies producing sex toys, for example, have already begun adding Bluetooth-enabled items to their range, allowing couples to link up remotely, as it were. Perhaps Huxley wasn't so far off the money after all. ■



自由交流

AI热潮：以史为鉴

强大的新技术如何改变经济

有一些创新，需要一点想象力才能看出它们可能会如何改变经济。但最新的AI工具则不然。智能聊天机器人ChatGPT自去年11月发布以来迅速风靡全网，人们很容易就会想到（容易得令一名作家有些不适）在一些场景中这样的技术会如何大大提高人类的工作效率，甚或完全取而代之。GPT是“generative pre-trained transformer”（生成式预训练转换器）的缩写，是一种特定的语言模型。其实GPT也完全可以是“general-purpose technology”（通用技术）的缩写：一种翻天覆地的创新，可以像蒸汽机、电力和计算机那样提升各行各业的生产率。通过观察这些早期GPT所推动的经济革命，可以帮助我们了解强大的AI在未来一些年里将如何改变经济。

在1995年发表的一篇论文中，斯坦福大学的蒂莫西·布雷斯纳汉（Timothy Bresnahan）和特拉维夫大学的曼努埃尔·特拉坦伯格（Manuel Trajtenberg）阐述了他们认为通用技术应当具备的特征。这样的技术必须为众多行业所用，本身具有持续改进的潜力，并且催生出“互补性创新”——即在使用该技术的行业中诱发连锁创新。AI正被广泛采用，似乎每天都变得更强，并越来越多地融入到研发过程之中。那么，经济革命将何时开启？

历史给人们的第一条经验是，即使是最强大的新技术也需要时间来改变经济。詹姆斯·瓦特（James Watt）于1769年申请了蒸汽机的专利，但直到1830年代的英国和1860年代的美国，蒸汽动力才取代水力成为工业动力的来源。萨塞克斯大学（University of Sussex）的尼古拉斯·克拉夫茨（Nicholas Crafts）指出，在英国，蒸汽对生产率增长的贡献到1850年后才达到顶峰，此时距瓦特获得专利已近一个世纪。还有电气化，关键的技术进步在1880年之前就已经完成，但美国的生产率增速在1888至1907年间

实际上还放缓了。首个硅集成电路问世近三十年后，诺贝尔经济学奖得主罗伯特·索洛（Robert Solow）还在评论说，计算机时代似乎无处不在，唯独在生产率数据上没有体现。直到1990年代中期，计算机驱动的生产率爆发才最终在美国出现。

创新与其经济影响存在时间差，一定程度上是因为创新需要改进。早期的蒸汽机效率极低，还要消耗大量煤炭，成本高昂。同样，与大约10年前曾引发一次AI小高潮的AI工具相比（例如苹果于2011年发布的虚拟助手Siri），最近AI的惊人表现是很大的进步。资本约束也可能减缓技术部署。纽约大学阿布扎比分校的罗伯特·艾伦（Robert Allen）认为，英国工业化过程中生产率增长缓慢，反映出建设工厂和制造机器的资本不足，而随着资本家将丰厚的利润再投资，才逐步解决这一问题。

最近的研究则强调了需要一定时间才能积累起所谓的无形资本，也就是有效利用新技术所需的基本专门知识和技能。斯坦福大学的埃里克·布林约尔弗森（Erik Brynjolfsson）、麻省理工学院的丹尼尔·洛克（Daniel Rock）和芝加哥大学的查德·赛弗森（Chad Syverson）提出，颠覆性的新技术可能与“生产率J曲线”现象相关联。在新技术出现后的几年或几十年里，随着公司和工人花费时间和资源去研究技术并围绕它设计业务流程，测得的生产率增速实际上可能会降低。只有当后来这些投入结出成果后，J曲线才会向上飙升。几位作者认为，与AI相关的无形资本投资可能已经在抑制生产率增长，尽管还不明显。

当然，对许多人来说，AI对经济增长的影响是个次要问题，他们更关注它对工人有什么影响。在这个问题上，历史给出的信息有好有坏。好消息是，尽管出现了划时代的技术和经济变革，但对大规模技术性失业的担忧从未成真。然而，技术还是可能会对个别职业造成冲击，并可能因此导致社会混乱，事实上也确实造成了一些冲击。在工业革命早期，机械化急剧增加了对相对缺乏手艺的工人的需求，而大大挤压了以前承担大部分工作的手艺人的收入，因此一些人选择参加捣毁机器的卢德运动。在1980和1990年代，工厂车间和办公室里常规工作的自动化让许多中等收入工人失业，但同时促进了高技能和低技能工人就业。

AI很可能会提高所有不同技能水平的工人的生产率，甚至是作家。然而这对某种职业整体而言意味着什么，取决于生产率提高和成本降低是导致需求大幅增长，还是只有小幅增长。当亨利·福特通过生产流水线——一种具有GPT特征的流程创新——降低了汽车制造成本后，需求激增，工人受益。比如在医学领域，如果AI能够提高生产率并降低成本，可能就会大大提升对医疗服务和专业人员的需求。

强大的AI有可能打破以往的模式。一项几乎可以处理普通人所能完成的任何任务的技术将把人类带入未知的经济领域。然而即使在这种情况下，依然可以从历史中获得一些经验。蒸汽革命带来的持续经济增长，还有电气化和之后其他创新带来的进一步加速增长本身就是前所未有的。它们促使人类紧急行动起来，创造出新的思想和制度，以确保彻底的经济变革能够转化为广泛的繁荣而非混乱。或许人们很快又该奋力动起来了。 ■



Free exchange

The AI boom: lessons from history

How powerful new technologies transform economies

IT CAN TAKE a little imagination to see how some innovations might change an economy. Not so with the latest AI tools. It is easy—from a writer's perspective, uncomfortably so—to think of contexts in which something like ChatGPT, a clever chatbot which has taken the web by storm since its release in November, could either dramatically boost a human worker's productivity or replace them outright. The GPT in its name stands for “generative pre-trained transformer”, which is a particular kind of language model. It might well stand for general-purpose technology: an earth-shaking sort of innovation which stands to boost productivity across a wide-range of industries and occupations, in the manner of steam engines, electricity and computing. The economic revolutions powered by those earlier GPTs can give us some idea how powerful AI might transform economies in the years ahead.

In a paper published in 1995, Timothy Bresnahan of Stanford University and Manuel Trajtenberg of Tel Aviv University set out what they saw as the characteristics of a general-purpose technology. It must be used in many industries, have an inherent potential for continued improvement and give rise to “innovational complementarities”—that is, induce knock-on innovation in the industries which use it. AI is being adopted widely, seems to get better by the day and is being deployed in ever more R&D contexts. So when does the economic revolution begin?

The first lesson from history is that even the most powerful new tech takes time to change an economy. James Watt patented his steam engine in 1769, but steam power did not overtake water as a source of industrial horsepower

until the 1830s in Britain and 1860s in America. In Britain the contribution of steam to productivity growth peaked post-1850, nearly a century after Watt's patent, according to Nicholas Crafts of the University of Sussex. In the case of electrification, the key technical advances had all been accomplished before 1880, but American productivity growth actually slowed from 1888 to 1907. Nearly three decades after the first silicon integrated circuits Robert Solow, a Nobel-prizewinning economist, was still observing that the computer age could be seen everywhere but in the productivity statistics. It was not until the mid-1990s that a computer-powered productivity boom eventually emerged in America.

The gap between innovation and economic impact is in part because of fine-tuning. Early steam engines were wildly inefficient and consumed prohibitively expensive piles of coal. Similarly, the stunning performance of recent AI tools represents a big improvement over those which sparked a boomerang of AI enthusiasm roughly a decade ago. (Siri, Apple's virtual assistant, was released in 2011, for example.) Capital constraints can also slow deployment. Robert Allen of New York University Abu Dhabi argues that the languid rise in productivity growth in industrialising Britain reflected a lack of capital to build plants and machines, which was gradually overcome as capitalists reinvested their fat profits.

More recent work emphasises the time required to accumulate what is known as intangible capital, or the basic know-how needed to make effective use of new tech. Indeed, Erik Brynjolfsson of Stanford University, Daniel Rock of the Massachusetts Institute of Technology and Chad Syverson of the University of Chicago suggest a disruptive new technology may be associated with a "productivity J-curve". Measured productivity growth may actually decline in the years or decades after a new technology appears, as firms and workers divert time and resources to studying the tech and designing business processes around it. Only later as these investments bear fruit does the J surge upward. The authors reckon that AI-related

investments in intangible capital may already be depressing productivity growth, albeit not yet by very much.

Of course for many people, questions about the effects of AI on growth take a back seat to concerns about consequences for workers. Here, history's messages are mixed. There is good news: despite epochal technological and economic change, fears of mass technological unemployment have never before been realised. Tech can and does take a toll on individual occupations, however, in ways that can prove socially disruptive. Early in the Industrial Revolution, mechanisation dramatically increased demand for relatively unskilled workers, but crushed the earnings of craftsmen who had done much of the work before, which is why some chose to join machine-smashing Luddite movements. And in the 1980s and 1990s, automation of routine work on factory floors and in offices displaced many workers of modest means, while boosting employment for both high- and low-skilled workers.

AI might well augment the productivity of workers of all different skill levels, even writers. Yet what that means for an occupation as a whole depends on whether improved productivity and lower costs lead to a big jump in demand or only a minor one. When the assembly line—a process innovation with GPT-like characteristics—allowed Henry Ford to cut the cost of making cars, demand surged and workers benefited. If AI boosts productivity and lowers costs in medicine, for example, that might lead to much higher demand for medical services and professionals.

There is a chance that powerful AI will break the historic mould. A technology capable of handling almost any task the typical person can do would bring humanity into uncharted economic territory. Yet even in such a scenario, the past holds some lessons. The sustained economic growth which accompanied the steam revolution, and the further acceleration which came along with electrification and other later innovations, were

themselves unprecedented. They prompted a tremendous scramble to invent new ideas and institutions, to make sure that radical economic change translated into broad-based prosperity rather than chaos. It may soon be time to scramble once again. ■



夹在中间

土耳其不止是东西文明的交汇处，还是构造板块的交界处

目前的地震是进入现代以来东安纳托利亚断层上的首次七级地震

二月六日凌晨席卷土耳其南部和叙利亚北部的地震是本世纪最具破坏性的地震之一。灾难发生后不过三天，据报死亡人数已超过一万人。这恐怖后果主要是因为当地建筑质量低劣，而且地震发生在人们熟睡之时。但任何如此威力的地震（最高的两次分别是7.8级和7.5级）都会造成严重破坏。全球每年大概只会发生15次七级或以上的地震。

虽然远离太平洋“火环”这个全球强震最高发地带，但土耳其所在地区的地震却异常活跃。构造板块是随着地幔中的热对流而移动的地壳分块，地震往往就发生在这些板块的交界带。地壳岩层会沿着分隔板块的断层线缓慢相互滑动，常有卡在一起的情况。这导致应力积聚，直到断层滑动释放应力，造成地震。

地中海东部有一个特别复杂的板块结构，涉及多个“微板块”，其中就有土耳其大部分地区所处的安纳托利亚板块。仅一亿年前，该板块还包含分隔非洲和欧亚大陆的特提斯海（Tethys）的南岸部分地区。随着该水体消失，只剩下咸海、黑海、里海和地中海，安纳托利亚板块向北漂移。之后被挤压在其他四个板块之间，包括东南方的阿拉伯板块（正在向北移动）和北方的欧亚板块（向南移动）。这两个板块如今仍在一起推挤安纳托利亚板块这个“小邻居”。

1999年伊斯坦布尔附近发生灾难性地震，之后土耳其领导人誓言要提高防震减灾能力。那次地震起源于北安纳托利亚断层，这个断层是安纳托利亚板块与欧亚板块的交界处，一直是土耳其大多数强震的发源地。相比之下，位于安纳托利亚板块与阿拉伯板块交界处的东安纳托利亚断层自19世纪末现代监测系统建立以来就没发生过七级或以上的地震。

美国西北部和加拿大西南部的卡斯卡迪亚俯冲带等许多其他活跃的断层系

统已有几个世纪没有发生过地震了。这种相对平静不一定表示地震风险低。东安纳托利亚断层年复一年地积聚应力，让它酝酿出了一场灾难性的大地震。

图表来源：美国地质勘探局；克里斯多福·史考提斯，Paleomap项目，2016年；《板块边界最新数字模型》，彼得·伯德，2003年；《经济学人》 ■



Stuck in the middle

Turkey sits at the crossroads of tectonic plates as well as civilisations

The recent quake was the first magnitude-seven event on the East Anatolian fault in modern times

THE EARTHQUAKES that ripped across southern Turkey and northern Syria in the small hours of February 6th were among the most devastating of this century. Within three days of the disaster, the reported death toll surpassed 10,000. This horrifying impact stems largely from shoddy construction practices and from the timing of the quake, which occurred while people were sleeping. But any seismic event this powerful—the biggest quakes were of magnitude 7.8 and 7.5—would inflict grave damage. Worldwide, only around 15 earthquakes of magnitude seven or greater happen each year.

Although Turkey is far from the Pacific “ring of fire” that generates most of the world’s strongest earthquakes, its neighbourhood is unusually seismically active. Quakes tend to occur along the boundaries between tectonic plates, the segments of Earth’s crust that get moved around by convection currents in the hot mantle below. Along the fault lines that separate plates, crustal rocks move slowly past each other, often sticking and jamming. This causes strain to accumulate until the fault slips, causing an earthquake.

The eastern Mediterranean has a particularly complex tectonic structure involving several “microplates”, including the Anatolian plate, on which most of Turkey sits. A mere 100m years ago, this plate comprised part of the southern shore of a sea called Tethys, which separated Africa from Eurasia. As this body of water closed up, leaving the Aral, Black, Caspian and Mediterranean seas as its only remnants, the Anatolian plate drifted north. It then got squeezed between four others, including the Arabian plate to the

south-east (which is migrating north) and the Eurasian plate to the north (which is moving south). Both of these plates are still pushing into their small Anatolian neighbour today.

In the wake of a catastrophic earthquake near Istanbul in 1999, Turkish leaders vowed to improve seismic preparedness. That tremor originated in the North Anatolian fault, the Anatolian plate's boundary with the Eurasian plate, which has been the source of most of Turkey's large quakes. In contrast, the East Anatolian fault, where it rubs up against the Arabian plate, had not seen a quake of at least magnitude seven since modern monitoring systems began in the late 19th century.

Many other active fault systems, such as the Cascadia subduction zone in the north-western United States and south-western Canada, have gone centuries without an earthquake. Such relative quiet does not necessarily indicate low seismic risk. Strain along the East Anatolian fault had been building up year after year, making the fault ripe for a cataclysm.

Chart sources: USGS; Christopher Scotese, Paleomap Project, 2016; "An updated digital model of plate boundaries", Peter Bird, 2003; The Economist ■



科研战役

AI实验室竞赛升温

ChatGPT并非独一家

时不时就会有一项新技术让全球为之着迷。从硅谷、华尔街、全球各地的高管办公室、新闻编辑室和教室里的讨论来看，最新的例子是ChatGPT。2022年11月，创业公司OpenAI发布了其创造的AI聊天机器人ChatGPT，短短五天就吸引了100万注册用户，成为史上用户扩张最快的消费产品之一。微软刚刚向OpenAI 投资了100亿美元，想要把ChatGPT这类能力（包括生成看起来可能是由人类创建的文本、图像和视频）融入到其销售的大部分软件中去。1月26日，谷歌发布了一篇论文，描述了一种类似的模型，可以根据对歌曲的文本描述来生成音乐。其母公司Alphabet的投资者正在聆听谷歌对ChatGPT的回应。据报道，中国搜索巨头百度计划在3月将一个聊天机器人整合到其搜索引擎中。

ChatGPT才刚刚问世，现在要说这种追捧是否实至名归还为时过早。然而，不管ChatGPT及其竞争对手背后的“生成式”AI模型正在多大程度上改变商业、文化和社会，它们已经在改变科技行业对创新及创新引擎的看法。这些创新引擎就是像OpenAI和Google Research那样的企业研究实验室，它们正在将科技巨头的数据处理能力和计算机科学一些焦点领域里的聪明头脑结合起来。这些相互竞争的实验室无论是大型科技公司内部的一个部门、下属机构、还是由独立的创业公司运营，都在参与一场史诗级的AI霸权竞赛（见图表1）。这场竞赛的结果将决定AI时代将多快来到世界各地的计算机用户眼前——以及谁将主宰这个时代。

长期以来，企业研发机构一直是科学进步的源泉，在美国尤其如此。一个半世纪前，托马斯·爱迪生用他通过留声机和灯泡等发明获得的收入为他在新泽西州门洛帕克（Menlo Park）设立的实验室提供资金。第二次世界大战后，美国企业界大举投资基础科学，希望能由此产生实用的产品。杜邦（化学品制造商）、IBM和施乐（两者都是硬件制造商）都设有大型研

究实验室。AT&T的贝尔实验室产生了晶体管、激光器和光伏电池等众多发明，其研究人员因此共获得九项诺贝尔奖。

但到了20世纪后期，企业研发越来越重“发”而轻“研”。2017年，经济学家阿希什·阿罗拉（Ashish Arora）及其同事研究了1980年至2006年这一时期，发现企业已经从关注基础科学转向开发既有想法。阿罗拉和他的合著者认为，这种转变背后的原因是研究的成本不断上升，要获得成果越来越难。施乐开发了现在为计算机用户所熟悉的图标和窗口，从中获利最多的却是苹果和微软。科学研究对创新仍然重要，但主导机构成了非盈利性的大学。

AI的兴起正再次颠覆一切。从事AI研究的不仅是大公司。Anthropic和Character AI等创业公司都已有了类似ChatGPT的项目。另一家创业公司Stability AI组建了一个由小公司、大学和非营利组织组成的联盟来汇集计算资源，创建了一个备受欢迎的开源模型，可将文本转换为图像。在中国，北京智源人工智能研究院等政府支持的机构也表现出色。

但近年来几乎全球所有超级AI的突破都来自超大公司，因为它们拥有计算能力（见图表2），还因为这是一个少有的基础研究成果可以快速融入产品的领域。亚马逊的AI驱动着它的Alexa语音助手，Meta最近因其一个模型在战略棋盘游戏《强权外交》（Diplomacy）中击败人类玩家而引起轰动，这两家公司开展的AI研究数量分别相当于计算机科学牛校斯坦福大学的三分之二和五分之四。Alphabet和微软的研究还要多得多，这还不包括Google Research的姊妹实验室、Alphabet于2014年收购的DeepMind，以及微软投资的OpenAI（见图表3）。

至于哪家公司在技术成果上真正领先，专家的看法各不相同。例如，中国的实验室似乎在计算机视觉这个涉及图像分析的子学科中领跑，它们在该领域被引用次数最多的论文中所占份额最大。根据微软打造的一项排名，全球排名前五的计算机视觉团队都是中国的。北京智源还构建了自称全球最大的自然语言模型悟道2.0。Meta的AI西塞罗（Cicero）在玩《强权外交》时通过战略推理和欺骗来对抗人类对手，战绩突出。DeepMind的AI

在出了名难懂的棋盘游戏围棋中击败了人类冠军，而且还能预测蛋白质的形状，这一直是生命科学的一项挑战。

所有这些成就都令人惊叹。不过，说到因ChatGPT而大火的那种AI，真正的对决是在微软和Alphabet之间展开的。为了看看谁的技术更胜一筹，本刊测试了这两家公司的AI。在一位谷歌工程师的帮助下，我们分别向ChatGPT和谷歌尚未推出的聊天机器人提出了一些问题，前者基于OpenAI名为GPT-3.5的模型，后者基于LaMDA模型。这些问题包括选自一项美国数学竞赛的十道题（比如“求和为60的有序质数对的个数”）和美国高中毕业生参加的SAT测验的十道阅读题（“阅读以下段落，判断哪个选项最符合文中所述情况”）。为了让测试更有趣，我们还向二者征求约会建议（“根据以下来自一款约会应用的对话，说出初次邀请对方跟自己约会的最佳方式是什么？”）

这两个AI没有哪个明显更胜一筹。谷歌的AI数学稍好，答对了五题，ChatGPT答对了三题。它们的约会建议都有好有坏，我们给两者都输入了约会应用中的一些真实对话，它们都根据一段对话给出了具体建议，而针对另一段对话则给出了诸如“开放豁达”和“有效沟通”之类的陈词滥调。另外ChatGPT答对了九道SAT阅读题，而谷歌机器人答对了七道。ChatGPT对我们的反馈似乎也更敏感，在第二次试着回答一些问题时给出了正确答案。1月30日，OpenAI官宣ChatGPT经过更新，提高了数学能力。当我们给这两个AI又出了十道数学题时，谷歌机器人再次领先两分。但给了第二次机会后，ChatGPT就追平了。

至少到目前为止，没有哪个AI模型具有绝对优势，原因是AI知识传播得很快。Stability AI的夏睿文说，这些彼此竞争的实验室的研究人员“都相互往来”。就像曾在谷歌工作的夏睿文一样，许多人会带着他们的专业知识和经验在不同公司之间跳槽。此外，由于最优秀的AI人才骨子里都是科学家，因此他们在转投私营部门时，往往以能继续发表研究成果并在会议上演讲展示为条件。这就是谷歌会公开AI模型关键组成部分“Transformer”等重大进展的部分原因，这为其竞争对手助了一臂之力。（ChatGPT中的“T”就代表Transformer。）Meta的顶尖AI专家杨立昆（Yann LeCun）认为，

这一切的结果就是“任何一家公司的领先优势都不会超过两到六个月”。

不过，现在说什么都还言之过早。各家实验室可能不会永远都难分高下。据报道，谷歌担心ChatGPT会增强微软的搜索引擎必应，已经发布了“红色警戒”。DeepMind历来专注于游戏和科学，其研究人员表示公司现在正在向语言建模投入更多资源，它的聊天机器人Sparrow可能将于今年亮相。

可能有助于决定这场竞赛最终结果的一个变量是实验室的组织方式。

OpenAI是一家小公司，没什么收入流要保护，可能会比竞争对手享有更多自由来向公众发布产品。这反之又会产生大量的用户数据，可以让它的模型变得更好（也就是所谓的“基于人类反馈的强化学习”），这又可以吸引 more 用户。

这种先发优势也可能通过另一种方式实现自我强化。业内人士指出，OpenAI近年来发展迅速，让它能够从包括DeepMind在内的竞争对手那里挖走专家。为了跟上步伐，Alphabet、亚马逊和Meta可能需要重新找到自己快速行动和打破常规的能力。鉴于它们正在接受来自世界各国政府的各种监管审查，这是一项需要小心处理的任务。

另一个决定因素可能是技术发展路径。到目前为止，生成式AI模型是越大越好。这为资金雄厚的科技巨头带来了巨大优势。但在未来，大小可能无法决定一切。一方面，可以想见模型大小是有限度的。非营利性研究机构Epoch估计，按照目前的发展速度，到2026年，大型语言模型将用尽互联网上的高质量文本（尽管视频等未被充分利用的其他形式的信息在一段时间内仍旧储备丰富）。更重要的是，正如Stability AI的夏睿文所指出的，有一些方法可以针对特定任务微调模型，从而“显著减少扩大规模的需要”。而且人们一直都在开发少花钱多办事的新方法。

生成式AI创业公司去年总共通过110笔交易融资27亿美元。这些资金流入表明，风险投资人正在押注并非所有价值都将被大型科技公司捕获。Alphabet、微软及其科技巨头同行和中国共产党都将试图证明这些投资人想错了。AI竞赛才刚刚开始。 ■



Battle of the boffins

The race of the AI labs heats up

ChatGPT is not the only game in town

EVERY SO OFTEN a technology captures the world's imagination. The latest example, judging by the chatter in Silicon Valley, on Wall Street, in corner offices, newsrooms and classrooms around the world, is ChatGPT. In five days after its unveiling in November the artificially intelligent chatbot, created by a startup called OpenAI, drew 1m users, making it one of the fastest consumer-product launches in history. Microsoft, which has just invested \$10bn in OpenAI, wants ChatGPT-like powers, which include generating text, images and video that seem like they could have been created by humans, to infuse much of the software it sells. On January 26th Google published a paper describing a similar model that can create music from a text description of a song. Investors in Alphabet, its parent company, are listening out for its answer to ChatGPT. Baidu, a Chinese search giant, reportedly plans to add a chatbot to its search engine in March.

It is too early to say how much of the early hype is justified. Regardless of the extent to which the “generative” AI models behind ChatGPT and its rivals transform business, culture and society, however, they are already transforming how the tech industry thinks about innovation and its engines—the corporate research labs that, like OpenAI and Google Research, are combining big tech’s processing power with the brain power of some of computer science’s brightest sparks. These rival labs—be they part of big tech firms, affiliated with them or run by independent startups—are engaged in an epic race for AI supremacy (see chart 1). The result of that race will determine how quickly the age of AI will dawn for computer users everywhere—and who will dominate it.

Corporate research-and-development (R&D) organisations have long been a source of scientific advances, especially in America. A century and a half ago Thomas Edison used the proceeds from his inventions, including the phonograph and the lightbulb, to bankroll his workshop in Menlo Park, New Jersey. After the second world war, America Inc invested heavily in basic science in the hope that this would yield practical products. DuPont (a maker of chemicals), IBM and Xerox (which both manufactured hardware) all housed big research laboratories. AT&T's Bell Labs produced, among other inventions, the transistor, laser and the photovoltaic cell, earning its researchers nine Nobel prizes.

In the late 20th century, though, corporate R&D became steadily less about the R than the D. In 2017 Ashish Arora, an economist, and colleagues examined the period from 1980 to 2006 and found that firms had moved away from basic science towards developing existing ideas. The reason, Mr Arora and his co-authors argued, was the rising cost of research and the increasing difficulty of capturing its fruits. Xerox developed the icons and windows now familiar to computer-users but it was Apple and Microsoft that made most of the money from it. Science remained important to innovation, but it became the dominion of not-for-profit universities.

The rise of AI is shaking things up once again. Big corporations are not the only game in town. Startups such as Anthropic and Character AI have built their own ChatGPT challengers. Stability AI, a startup that has assembled a consortium of small firms, universities and non-profits to pool computing resources, has created a popular open-source model that converts text to images. In China, government-backed outfits such as the Beijing Academy of Artificial Intelligence (BAAI) are pre-eminent.

But almost all recent breakthroughs in big AI globally have come from giant companies, because they have the computing power (see chart 2), and because this is a rare area where results of basic research can be rapidly

incorporated into products. Amazon, whose AI powers its Alexa voice assistant, and Meta, which made waves recently when one of its models beat human players at “Diplomacy”, a strategy board game, respectively produce two-thirds and four-fifths as much AI research as Stanford University, a bastion of computer-science eggheads. Alphabet and Microsoft churn out considerably more, and that is not including DeepMind, Google Research’s sister lab which the parent company acquired in 2014, and the Microsoft-affiliated OpenAI (see chart 3).

Expert opinion varies on who is actually ahead on the merits. The Chinese labs, for example, appear to have a big lead in the subdiscipline of computer vision, which involves analysing images, where they are responsible for the largest share of the most highly cited papers. According to a ranking devised by Microsoft, the top five computer-vision teams in the world are all Chinese. The BAAI has also built what it says is the world’s biggest natural-language model, Wu Dao 2.0. Meta’s “Diplomacy” player, Cicero, gets kudos for its use of strategic reasoning and deception against human opponents. DeepMind’s models have beat human champions at Go, a notoriously difficult board game, and can predict the shape of proteins, a long-standing challenge in the life sciences.

Jaw-dropping feats, all. When it comes to the sort of AI that is all the rage thanks to ChatGPT, though, the big battle is between Microsoft and Alphabet. To see whose tech is superior, The Economist has put both firms’ AIs through their paces. With the help of an engineer at Google, we asked ChatGPT, based on an OpenAI model called GPT-3.5, and Google’s yet-to-be-launched chatbot, built upon one called LaMDA, a set of questions. These included ten problems from an American maths competition (“Find the number of ordered pairs of prime numbers that sum to 60”) and ten reading questions from America’s SAT school-leavers’ exam (“Read the passage and determine which choice best describes what happens in it”). To spice things up, we also asked each model for dating advice (“Given the following

conversation from a dating app, what is the best way to ask someone out on a first date?”).

Neither AI emerged as clearly superior. Google’s was slightly better at maths, answering five questions correctly, compared with three for ChatGPT. Their dating advice was uneven: fed some real exchanges in a dating app, each gave specific suggestions on one occasion, and platitudes such as “be open minded” and “communicate effectively” on another. ChatGPT, meanwhile, answered nine SAT questions correctly compared with seven for its Google rival. It also appeared more responsive to our feedback and got a few questions right on a second try. On January 30th OpenAI announced an update to ChatGPT improving its maths abilities. When we fed the two AIs another ten questions, LaMDA again outperformed by two points. But when given a second chance ChatGPT tied.

The reason that, at least so far, no model enjoys an unassailable advantage is that AI knowledge diffuses quickly. Researchers from competing labs “all hang out with each other”, says David Ha of Stability AI. Many, like Mr Ha, who used to work at Google, move between organisations, bringing expertise and experience with them. Moreover, since the best AI brains are scientists at heart, they often made their defection to the private sector conditional on a continued ability to publish their research and present results at conferences. That is partly why Google made public big advances including the “transformer”, a key building block in AI models, giving its rivals a leg-up. (The “T” in ChatGPT stands for transformer.) As a result of all this, reckons Yann LeCun, Meta’s top AI boffin, “Nobody is ahead of anybody else by more than two to six months.”

These are, though, early days. The labs may not remain neck-and-neck for ever. Google has reportedly issued a “code red”, fearing that ChatGPT could boost Microsoft’s rival Bing search engine. Researchers at DeepMind say their firm, which has historically focused on game-playing and science,

is putting more resources into language modelling; its chatbot, called Sparrow, may be unveiled this year.

One variable that may help determine the ultimate outcome of the contest is how labs are organised. OpenAI, a small firm with few revenue streams to protect, may find itself with more latitude than rivals to release products to the public. That in turn is generating tonnes of user data that could make its models better (“reinforcement learning from human feedback”, if you must know)—and thus attract more users.

This early-mover advantage could be self-reinforcing in another way, too. Insiders note that OpenAI’s rapid progress in recent years has allowed it to poach experts from rivals including DeepMind. To keep up, Alphabet, Amazon and Meta may need to rediscover their ability to move fast and break things—a delicate task given all the regulatory scrutiny they are receiving from governments around the world.

Another deciding factor may be the path of technological development. So far in generative AI, bigger has been better. That has given rich tech giants a huge advantage. But size may not be everything in future. For one thing, there are limits to how big the models can conceivably get. Epoch, a non-profit research institute, estimates that at current rates, big language models will run out of high-quality text on the internet by 2026 (though other less-tapped formats, like video, will remain abundant for a while). More important, as Mr Ha of Stability AI points out, there are ways to fine-tune a model to a specific task that “dramatically reduce the need to scale up”. And novel methods to do more with less are being developed all the time.

The capital flowing into generative-AI startups, which last year collectively raised \$2.7bn in 110 deals, suggests that venture capitalists are betting that not all the value will be captured by big tech. Alphabet, Microsoft, their

fellow technology titans and the Chinese Communist Party will all try to prove these investors wrong. The AI race is only just getting started. ■



代际接力

祖父母时代已经到来

祖父母与孙辈之比高于以往任何时候。这影响重大。【深度】

一九八〇年最煽情的歌曲是英国斯托克波特（Stockport）圣威尼弗雷德学校（St Winifred's School）合唱团演唱的《没人能像奶奶一样》（There's No One Quite Like Grandma）。各地的孩子都把它当作圣诞礼物送给祖母，这首歌因此冲上了英国排行榜榜首。“奶奶，我们爱您，”他们唱道，“奶奶，我们真的爱您。虽然您可能离我们很远，但我们思念着您。”

如今，曾经天真无邪的合唱团成员自己也开始为人祖父母，而现在当祖父母可与以前大不同了。两大人口趋势让祖父母们变得更加重要。首先，人们的寿命更长了。自1960年以来，全球预期寿命已从51岁上升到72岁。其次，家庭正在缩小。同样在这一时期内，女性一生中预期生育的婴儿数量减少了一半，从5个降到2.4个。这意味着在世的祖父母与孙辈数量之比正在稳步上升。

这方面研究少得出奇。本刊无法找到全球到底有多少在世祖父母的可靠数据，因此我们请来德国马克斯普朗克人口研究所（Max Planck Institute for Demographic Research）的迪亚哥·阿尔布雷斯·古铁雷斯（Diego Alburez-Gutiérrez），用每个国家的亲属结构模型分析联合国年龄和人口数据，来做一些估算。

结果发现，世界上有15亿位祖父母，多于1960年的5亿（尽管越往前追溯，估算越不准确）。他们占总人口的比例从17%上升到20%。祖父母与15岁以下儿童之比从1960年的0.46跃升至今天的0.8。

我们预计到2050年将有21亿位祖父母（占总人口的22%），人数略多于15岁以下儿童。这将产生深远影响。证据表明有祖父母帮忙照顾（实际生活中通常是祖母帮忙照顾）的孩子成长得更好。这将有助于推动另一场未完成的社会革命——女性进入职场。

由于各个国家的生育率和预期寿命差异很大，“祖父母时代”尚未在所有国家到来（见图表1）。祖父母在保加利亚占总人口的29%，但在布隆迪只占10%。他们的平均年龄也相差很大，在乌干达是53岁，在日本是72岁（见图表2）。要了解祖父母人数众多有何影响，从一个祖父母人数仍然不多的国家说起是个不错的办法。

来看看塞内加尔。大多数塞内加尔农村人口都是自给自足的农民。尽管生育率从1980年的每名妇女生育7.3个婴儿下降到了今天的4.5个，但大家庭仍然是常态。 15 岁以下儿童与在世祖父母之比为3.5比1。

裹着蓝白相间头巾的84岁老祖母艾米·迪亚洛（Amy Diallo）在被问到自己有多少个孙辈儿女时得先好好想想。“三十个。”盘腿坐在家中地板上的她最后抬起头说。她们一家人住在塞内加尔首都达喀尔（Dakar）郊外的塔利布贝斯（Tally Boubess），门外的路上，马匹、马车、绵羊和汽车挤在一起通行。

身为最年长的家庭成员，她备受尊重。她教导孩子们：要诚实、虔诚，秉持传统，还有别再打弟弟啦。每年，她都会带着子女、孙子女、曾孙和姻亲前往穆斯林圣城蒂瓦万（Tivaouane）朝圣，一大家子可能有一百来号人。

祖父母会将传统信仰、故事、歌曲和历史感传递给后代。往通俗了说，多一个人多一双手。这对父母和孩子都有帮助。例如，在冈比亚（Gambia）农村进行的一项研究发现，有外婆（姥姥）帮忙的家庭里，孩子能活到两岁的机会显著增加。在撒哈拉以南非洲，有祖父同住的孩子上学的几率高出约15%，有祖母同住的孩子高出38%。

至于迪亚洛，她从未外出工作过。但她已经帮助她的一些后代走出了家门。她的一个女儿恩迪耶（Ndeye）虽然有八个孩子，还是找到了一份办公室工作，因为迪亚洛会帮她带孩子。

然而，尽管迪亚洛对子孙满怀关爱和责任感，她也没法照看全部30个孙子女。政府也没什么援助。迪亚洛的好多个女儿和孙女从未像恩迪耶那样离

家工作过。这种情况很普遍。在塞内加尔，只有不到三分之一的工作年龄妇女有工作或正在找工作。在最贫穷的那些国家，祖父母尽他们最大的努力帮助子女，但毕竟人数不足。

在较富裕的地方，生育率的下降比非洲快得多。例如，通常一名墨西哥妇女预计只会生两个孩子，而在1960年时会生将近七个。墨西哥的在世祖父母与孙辈之比是塞内加尔的三倍。墨西哥的祖母因此有更多时间花在每个孙辈身上。

厄玛·阿吉拉尔·沃杜佐克（Irma Aguilar Verduzco）和她的女儿（小厄玛）及两个外孙罗德里戈（Rodrigo）和费尔南达（Fernanda）住在一起。她负责做饭，送孩子上下学，和他们一起读书。现年16岁的罗德里戈从三岁起就喜欢坐下来喝着咖啡和外婆聊天。现年12岁的费尔南达仍然喜欢和外婆睡。与此同时，小厄玛一直以来每天工作12小时，目前担任大型铁路项目玛雅铁路（Maya Train）的经理。她离了婚，说前夫“一点也帮不上家里”。没有厄玛的帮助，她“啥也不可能办到”。

在墨西哥，祖母是父母之外幼儿的主要照护人，尤其是在疫情迫使许多托儿所关闭之后。祖父母照看着近40%的6岁以下儿童。在孩子们的外婆搬来一起住之前，小厄玛一直左支右绌。“在墨西哥，没人会特别体谅或照顾在职妈妈。”她抱怨道。她的孩子经常独自在家。“有时我也会付钱请人照顾他们，但没那么多钱，也很难信任别人。”多年前的一天，从托儿所回来的罗德里戈骨头折了。小厄玛怀疑他受了虐待。有妈妈来帮忙，她松了一口气。

美洲开发银行（Inter-American Development Bank）的米格尔·塔拉马斯（Miguel Talamas）和他的同事试图估计墨西哥的祖母在帮助女儿获得有偿工作方面起到了多大作用。他们研究了祖母去世后家庭发生的变化。祖母去世会让女儿留在劳动力市场的机会减少27%，即下降了12个百分点，收入降低了53%。（同一项研究发现对父亲的就业率没有影响。）

与祖父母一起生活并不总是那么容易。他们可能有过时的想法或要求晚辈

言听计从。在印度，夫妻按传统习俗与丈夫的父母住在一起，有一类电视剧专门展现婆媳之间的紧张关系。2018年对印度农村妇女的一项研究发现，那些与婆婆一起生活的儿媳几乎没有自由可言。其中只有12%被允许单独拜访亲戚朋友。

如果祖母坚持男尊女卑的习俗，儿媳就更难外出工作。但一项有趣的研究发现，平均而言，这种影响又因为有婆婆帮忙做家务而被抵消。随着印度的生育率从1960年的6.0下降到今天的略高于2.0，这种帮助也集中到了更少的孩子身上。亚马逊的玛德胡丽卡·康纳（Madhulika Khanna）和智库3ie的迪维娅·潘迪（Divya Pandey）研究了婆婆死后印度妇女的情况。她们发现，儿媳从事或寻求有偿工作的可能性会降低10%，这可能是因为她们不得不花更多时间捡柴火和照顾孩子。即使是霸道的祖母也可能无意中为女性解放出一份力。

富裕国家通常会提供服务，帮助女性兼顾育儿和工作。但是，许多父母仍会另外寻求祖父母的帮助。养老金让祖父母不再需要工作，这也有帮助。一项调查显示，在美国，50%的幼儿、35%的学龄儿童和20%的青少年通常每周都会与祖父母生活一段时间。

这会带来很大的不同。马尼托巴大学（University of Manitoba）的珍妮丝·康普顿（Janice Compton）和华盛顿大学的罗伯特·波拉克（Robert Pollak）分析了美国人口普查数据，发现子女年幼的已婚女性如果居住地距离祖母25英里以内，她们的劳动参与率就会提升4至10个百分点。

所谓的“祖母带娃”也可能有缺点。英国的一项研究发现，与托儿所或保姆相比，祖父母更有可能把他们照顾的幼儿留在有火灾隐患的地方。来自美国、英国、中国和日本的研究表明，祖父母照看的孩子更容易肥胖，但尚不清楚这是由于溺爱还是其他因素造成的。

尽管祖母能帮助母亲重返职场，但这通常意味着她们自己要退出劳动力大军。“所以必须做出抉择。”塔拉马斯说。还是在墨西哥，赫梅琳达·科潘戈·巴斯克斯（Hermelinda Coapango Vázquez）是一名美甲师，但她只在

不需要照顾孙子的时间接受预约。“我的孙子就是我的命，”她说，“我没有伴侣，也不喜欢有很多朋友。”巴西的一项研究发现，当0至3岁的孩子被随机分配到正规的托儿所时，家庭的整体收入会更高，这主要是因为祖父母和年长的兄姐可以腾出时间去工作。

另一个缺点是严重依赖祖母照顾孩子的家庭不太容易搬家和找到更好的工作。维尔茨堡大学（University of Wurzburg）的伊娃·加西亚-莫兰（Eva Garcia-Moran）和马德里自治大学（Autonomous University of Madrid）的佐伊·库恩（Zoe Kuehn）所做的一项研究发现，住所离公婆不远的西德女性的收入要比同龄人低约5%，通勤时间也更长。

完全或主要由祖父母抚养的孩子往往比同龄人有更多问题。在美国，大约2%的儿童主要由祖父母抚养长大，北伊利诺伊大学（Northern Illinois University）的劳拉·皮特曼（Laura Pittman）发现，与同龄人相比，这些青少年的情绪和行为问题更多。这也许并不奇怪。如果孩子不和父母住在一起，经常是因为出了什么大事——例如父亲入狱，母亲去世或无力抚养。在这种情况下，与祖父母生活通常比其他选择要好得多。

来自路易斯安那州巴吞鲁日（Baton Rouge）的凯蒂·克拉克（Katie Clark）今年68岁，由于女儿使用鸦片制剂成瘾，她有女儿的一个孩子的单独监护权，也曾照顾她的另外五个孩子。女儿生下第一个孩子后不久，克拉克就承担起了照顾这个孩子的责任。大约12年后，无家可归的女儿带着另外五个孩子找上门来。她把孩子都扔在了凯蒂家，后来又带着警察回来要求凯蒂把孩子还给她。女儿目前拥有后来的五个孩子的监护权，凯蒂担心她会再次对他们疏于照顾。完全由凯蒂抚养长大的那个孩子现在已经上了大学。

在中国农村，祖父母帮助减轻了政府造成的伤害。在类似种族隔离政策的户籍制度下，移居城市的农民被视为二等公民。他们的孩子被当地的公立学校拒之门外，因此经常被留在老家的祖父母身边。但农村的学校往往非常糟糕。祖父母虽然很尽心，但往往是文盲。斯坦福大学的斯科特·罗泽尔（Scott Rozelle）发现，中国农村半数以上的幼儿存在认知迟缓，部分

原因是他们的祖父母没有意识到和他们说话很重要。

中国城市又是另一种情况。独生子女政策（2021年变成了三孩政策）在城市一直比农村执行得更加严格。许多城市家庭由四个祖父母、两个父母和一个孩子组成。因此不缺少照顾孩子的人。城市里的孩子通常在工作日与祖父母同住，周末才能见到努力打拼的父母。

在中国，托儿所价格高而且不受信任。祖母通常在50多岁时退休来照顾宝贝独苗。这种做法效果还不错。中国女性的劳动参与率为62%，略高于美国。“要想孩子接受好的教育，就得努力挣很多钱。”建筑师妈妈鲍舟（音译）说。她家也是个“421”家庭，两边的祖父母都有帮忙照顾孩子。但“在赚钱的过程中，你可能会失去陪伴孩子的时间”。她还表达了一种普遍的担忧，即祖父母往往会宠坏他们唯一的孙子女。“他们会照顾得太过周到，”她说，“孩子的独立性就差了。”

共产党提倡传统价值观，例如家人彼此照顾，这样就无须国家承担了。在北京，政府甚至在2005年成立了一所学校，教授祖父母如何更好地带孩子。但下一代人可能不愿承担同样的责任。恒生银行的王丹认为，现在的中产阶级父母很少想着要在几十年后照看他们孩子的孩子。王丹担心，如果他们选择不帮子女带孩子，那可能会让他们的女儿更难兼顾育儿和工作。

总的来说，照顾孩子似乎对祖父母有益。那些花时间和孙子孙女在一起的人自述的抑郁和孤独的程度较低。但再好的东西也是过犹不及。小孩子可能会很累人、气人、烦人。根据新加坡一项主要针对华裔家庭的研究，许多人照顾孙辈更多是出于责任而不是喜欢干这事。随着年事渐高，许多人愈发感到力不从心。有些人被逼成了“三明治一代”，既要帮忙照顾孙辈，又要照顾自己生病的父母。一些人渴望更轻松的退休生活。墨西哥的祖母厄玛承认，等孙辈更独立一些，她想多出去旅行。

有一个地方的祖父母有充足的时间放松，那就是瑞典，那里强大的社会福利制度意味着父母很少依赖祖父母的帮助。瑞典夫妇每生一个孩子总共可

以休16个月的育儿假，其中大部分时间里政府会按他们原本的工资支付大部分薪水。（其中三个月必须是男人休假，不休就浪费掉。许多夫妇会平分这16个月。）假期休完之后，可以把孩子送去有政府补贴的托儿所，夫妻双方都重回职场是常态。由于托儿所哪里都有，瑞典人迁居其他城市寻找更好的工作相对容易。

“祖父母偶尔可能会去幼儿园接接孩子，或临时帮忙照看，但这不是常态。”隆德大学（Lund University）的安德烈亚斯·伯格（Andreas Bergh）说。祖父母帮忙不是为了让妈妈能重回职场，而可能是让她能和丈夫单独出去吃顿饭。祖父母的帮助是“额外福利”，斯德哥尔摩智库Timbro的安德烈亚斯·海诺（Andreas Heino）说。

育儿假补贴这么慷慨，就连企业家也该休就休。桑德拉·卡斯塔斯（Sandra Kastås）在斯德哥尔摩经营着两家公司。2021年儿子出生后，她休了两个月的假，接下来的一年里只在部分时间工作，她的IT专家丈夫也一样。尽管她的日程排得很满，但并不指望父母经常来帮忙。他们住在偏远的哥特兰岛（Gotland），不常来看望。她的母亲“用送礼物来表达她的爱”，比如书籍和她亲手织的毛衣。她通过FaceTime和外孙聊天。“她打电话来时，孩子会拥抱电话。很有趣。”卡斯塔斯说。

大多数瑞典人对他们的制度感到满意。但一些老年人抱怨感到孤独。近一半瑞典家庭是单人家庭，这个水平在欧洲仅次于芬兰。在1040万瑞典人中，约有90万人超过60岁并且独居。其中有五分之一被认为处于社交孤立状态，也就是说他们一个月见朋友或家人的次数不超过两次。在疫情期间，瑞典人有个暗黑笑话，说要隔离老人很容易，“反正我们也不常去看孩子的祖父母”。来自非洲或中东等地的移民常常对瑞典家庭的原子化程度感到震惊。

历史学家拉尔斯·特拉加德（Lars Tragardh）对瑞典的“国家个人主义”非常赞许。他说，国家把国民视为个体来照顾，让他们能自己做选择，而不必依赖他人。其他地方的父母羡慕北欧的父母能得到这样的帮助，尽管为此他们需要缴纳更多税。不过，即使是最慷慨的福利国家也无法给予爱。

在瑞典地方政府的一个协会工作的海伦娜·鲍斯（Helena Paues）说她的父亲非常喜欢带她有阅读障碍的儿子威勒（Wille）参观博物馆。“孩子热爱事实和科学。我想他的外公带他把斯德哥尔摩的博物馆都逛遍了，科学博物馆、维京博物馆，等等。他们俩非常亲。我父亲年轻时也有读写困难。”

夏天，孩子们会去外祖父母的度假屋住，去湖里游泳，在树屋里喝柠檬水。他们每年都吵着要去。鲍斯说她的父亲潜移默化地把尊重他人等价值观教给了孩子。“他不需要把道理挂在嘴上，而是以身作则。他让孩子们懂得他们的意见很重要，因为他会仔细倾听他们说什么。”她最后说：“作为一个孩子，你需要接触更多成年人，而不仅仅是父母。”■



The generation game

The age of the grandparent has arrived

The ratio of grandparents to children is higher than ever before. That has big consequences

THE MOST saccharine song of 1980 was “There’s No One Quite Like Grandma”, performed by the St Winifred’s School choir from Stockport, England. It shot to the top of the British charts as kids everywhere gave it to granny for Christmas. “Grandma, we love you,” they sang. “Grandma, we do. Though you may be far away, we think of you.”

Today, as the once-cherubic choristers start to become grandmas and grandpas themselves, grandparenting has changed dramatically. Two big demographic trends are making nana and gramps more important. First, people are living longer. Global life expectancy has risen from 51 to 72 since 1960. Second, families are shrinking. Over the same period, the number of babies a woman can expect to have in her lifetime has fallen by half, from 5 to 2.4. That means the ratio of living grandparents to children is steadily rising.

Surprisingly little research has been done into this. The Economist could not find reliable figures for how many living grandparents there are, so we asked Diego Alburez-Gutiérrez of the Max Planck Institute for Demographic Research in Germany to produce some estimates by crunching UN age and population data with models of kinship structures in each country.

We found that there are 1.5bn grandparents in the world, up from 0.5bn in 1960 (though the further back one goes, the fuzzier the estimates become). As a share of the population they have risen from 17% to 20%. And the ratio of grandparents to children under 15 has vaulted from 0.46 in 1960 to 0.8 today.

By 2050 we project that there will be 2.1bn grandparents (making up 22% of humanity), and slightly more grandparents than under-15s. That will have profound consequences. The evidence suggests children do better with grandparental help—which usually, in practice, means from grandmothers. And it will help drive another unfinished social revolution—the movement of women into paid work.

Since fertility rates and life expectancy vary enormously from country to country, the age of the grandparent has not yet dawned everywhere (see chart 1). They are 29% of Bulgarians but only 10% of Burundians. Their average age varies widely, too, from 53 in Uganda to 72 in Japan (see chart 2). To understand what a difference plentiful grandparents make, a good place to start is in a country where they are still scarce.

Consider Senegal. Most rural Senegalese are subsistence farmers. Although fertility has dropped from 7.3 babies per woman in 1980 to 4.5 today, large families remain the norm. Children under 15 outnumber living grandparents by 3.5 to 1.

Amy Diallo, an 84-year-old matriarch wrapped in a blue and white hijab, has to think carefully when asked how many she has. “Thirty,” she concludes, looking up from her cross-legged position on the floor of her home in Tally Boubess, outside Dakar, the capital, on a street where horses and carts jostle with sheep and cars.

As the oldest member of her family, she commands respect. She offers moral guidance to the young: be honest and pious, uphold tradition and stop hitting your younger brother. Every year she leads a family pilgrimage to Tivaouane, a Muslim holy city, with children, grandchildren, great-grandchildren and various in-laws, perhaps a hundred in all.

Grandparents pass on traditional beliefs, stories, songs and a sense of

history. More prosaically, they bring an extra pair of hands. That helps both parents and children. A study in rural Gambia, for example, found that the presence of a maternal grandmother significantly increased a child's chance of living to the age of two. In sub-Saharan Africa the odds of being in school are about 15% higher for children living with a grandfather and 38% higher for children who live with a grandmother.

As for Mrs Diallo, she has never worked outside the home. But she has helped some of her offspring to do so. Ndeye, one of her daughters, got a job in an office despite having eight kids herself, because Mrs Diallo helped out with the children.

Yet for all her sense of love and duty, Mrs Diallo cannot babysit all 30 grandkids. The state offers little help. Unlike Ndeye, many of Mrs Diallo's daughters and granddaughters have never worked outside the home. This is common: barely a third of working-age women in Senegal are either in work or seeking it. Grandparents in the poorest countries do their best, but there are not enough of them.

In richer places, fertility has fallen much further than in Africa. A typical Mexican woman, for example, can expect to have only two children, down from nearly seven in 1960. Mexico's ratio of living grandparents to children is three times higher than Senegal's. Mexican abuelas thus have more time to lavish on each grandchild.

Irma Aguilar Verduzco lives with her daughter, also called Irma, and two grandchildren, Rodrigo and Fernanda. She cooks, does school runs and reads with her grandchildren. Ever since he was three, Rodrigo, now 16, has liked to take a cup of coffee and sit down for a chat with his grandmother. Fernanda, now 12, still likes to get into bed with her. Irma junior, meanwhile, has long worked 12-hour days, currently as a manager at the Maya Train, a big rail project. She is divorced, and says her ex-husband "does

not help". She "could not have done anything" without Irma senior's help.

Grandmothers are the main source of non-parental child care for young children in Mexico, especially since covid-19 forced many nurseries to close. They watch over nearly 40% of sprogs under six. Before grandma moved in, Irma was struggling. "There is no understanding or flexibility for working mothers in Mexico," she complains. Her kids were often home alone. "Sometimes I paid people to look after them but it was hard to afford and hard to trust people." One day, years ago, Rodrigo came home from nursery with a broken bone; Irma suspects mistreatment. With her mother around, she feels relaxed.

Miguel Talamas of the Inter-American Development Bank and his colleagues have tried to estimate how much Mexican grandmothers help their daughters get paid work. They looked at what happened to families after grandmothers die. An abuela's death reduced by 27%, or 12 percentage points, the chance that her daughter was in the labour force, and reduced her earnings by 53%. (The same study found no effect on the employment rate of fathers.)

Living with grandparents is not always easy. They may have outdated ideas or demand too much deference. In India, where couples traditionally live with the husband's parents, a genre of television drama turns on the fraught relations between wives and mothers-in-law. A study of rural Indian women in 2018 found that those who lived with their mummyji (mother-in-law) had little freedom. Only 12% were allowed to visit friends or relatives alone.

A grandma who enforces old-fashioned norms of wifely subjugation can make it harder for her daughter-in-law to work outside the home. But an intriguing study finds that on average, this effect is outweighed by the help the mother-in-law gives with domestic chores. Such help has become more concentrated as India's fertility rate has fallen, from six in 1960 to just over

two today. Madhulika Khanna of Amazon and Divya Pandey of 3ie, a think-tank, looked at what happened to Indian women if mummyji died. They found the daughters-in-law were 10% less likely to do or seek paid work, probably because they had to spend more time collecting firewood and minding their children. Even overbearing grandmothers can inadvertently do their bit for female emancipation.

Rich countries generally provide services that help women juggle child-care and work. But many parents seek extra help from grandparents nonetheless. Old-age pensions help, by allowing grandparents to give up work. According to one survey, 50% of very young children, 35% of primary-school-aged children and 20% of teens in America spend time with their grandparent in a typical week.

This can make a big difference. Janice Compton of the University of Manitoba and Robert Pollak of Washington University crunched American census data and found that living within 25 miles of a grandmother raised the labour-force participation rate for married women with small children by 4-10 percentage points.

“Granny nannying”, as some call it, can have downsides, too. A British study found grandparents are more likely to leave their wards near fire hazards than nurseries or nannies. Studies from America, Britain, China and Japan suggest that a child around grandparents is more likely to be obese, though whether this is due to spoiling or other factors is unclear.

And although grandmas help daughters return to the workforce, that often means withdrawing from it themselves. “There is a clear trade-off,” says Mr Talamas. Back in Mexico, Hermelinda Coapango Vázquez works as a manicurist but takes appointments only at times that fit around caring for her grandson. “My grandson is my life,” she says. “I don’t have a partner and I am not one for having lots of friends.” A study from Brazil found

that when children aged 0-3 were randomly assigned formal childcare, the family collectively earned more, mainly because grandparents and older siblings were freed up to work.

Another pitfall is that families that rely heavily on grandma for child-care are less likely to move and find a better job. A study by Eva Garcia-Moran of the University of Wurzburg and Zoe Kuehn of the Autonomous University of Madrid found that west German women who lived near their parents in-laws earn about 5% less and commute for longer than their peers.

Children parented solely or mostly by grandparents tend to be worse off than their peers. In America, where roughly 2% of children are raised primarily by a grandparent, Laura Pittman of Northern Illinois University found more emotional and behavioural problems among such adolescents than their peers. That is perhaps not surprising. If children are not living with their parents, it is often because something has gone badly wrong: a father in jail; a mother dead or incapable. In these circumstances, living with a grandparent is usually far better than the alternatives.

Katie Clark, a 68-year-old from Baton Rouge, Louisiana, has had sole custody of one grandchild and has temporarily cared for five others because of her daughter's addiction to opiates. She took charge of her daughter's first baby soon after she was born. About 12 years later, the daughter arrived, homeless, with five more. She abandoned her children in Katie's home, before returning with police to demand them back. The daughter currently has custody of the five children, and Katie fears she is neglecting them again. The child raised entirely by Katie is now at university.

In rural China, grandparents help reduce the harm caused by the government. Under the apartheid-like hukou (household registration) system, rural Chinese who move to cities are treated as second-class citizens. Their children are barred from local public schools, so they are

often left behind with their grandparents in their parents' home village. But rural schools are often dire. Grandparents, though well-meaning, are often barely literate. Scott Rozelle of Stanford University finds that more than half of toddlers in rural China are cognitively delayed, partly because their grandparents do not realise that it is important to talk to them.

In Chinese cities the story is different. The one-child policy (which became a three-child policy in 2021) was always enforced more strictly in cities than the countryside. So many urban families consist of four grandparents, two parents and just one child. Thus, there is no shortage of caring hands. Urban children often live with grandparents during the week and see their hard-working parents on weekends.

Nurseries are pricey and distrusted in China. Grandmothers often retire in their 50s to watch over the precious only grandchild. This works well enough. The labour-force participation rate for Chinese women is, at 62%, slightly higher than America's. "If you want to give your child a good education, you have to work hard to earn a lot of money," says Zhou Bao, an architect and mother in a "4-2-1" family who has used both sets of grandparents for child-care. But "in the process of making money, you can lose the time spent with your child." And she expresses a common fear that grandparents tend to spoil their only grandchildren. "They can be too attentive," she says, "making them less independent."

The Communist Party promotes traditional values, such as family members caring for each other so the state does not have to. In Beijing the government even set up a school in 2005 to teach grandparents how to look after children better. But the next generation may not wish to shoulder the same responsibilities. Few middle-class parents today expect to be bringing up their children's children in a few decades, reckons Dan Wang of Hang Seng Bank. If they opt out of grandparenting, that could make it harder for their daughters to combine motherhood and work, fears Ms Dan.

Overall, looking after kids appears to be good for grandparents. Those who spend time with their grandchildren report lower levels of depression and loneliness. But one can have too much of a good thing. Youngsters can be exhausting, frustrating and objectionable. A study in Singapore, with mainly ethnically Chinese families, found that many looked after their grandchildren more out of duty than because they relished it. Many find it harder as they age. Some are squeezed in the “grandsandwich generation”—relied upon to help both their grandchildren and their own ailing parents. Some hanker for a more relaxing retirement. Grandma Irma in Mexico admits she would like to travel more as her grandchildren grow more independent.

One place where grandparents have plenty of time to relax is Sweden, where a strong welfare state means parents seldom rely on them. For each child, a Swedish couple can take 16 months of parental leave, for most of which the state pays them most of their previous wages. (The man must take three months, or they are lost; many split the time off equally.) Afterwards, there are subsidised nurseries, and the norm is for both parents to go back to work. Since child-care is everywhere, Swedes find it relatively easy to move cities to find a better job.

“Once in a while a grandparent might pick up a kid from pre-school or babysit, but not always,” says Andreas Bergh of Lund university. Rather than allow a daughter to go back to work, grandparents might enable her to go out to dinner with her husband. Grandparental help is “a bonus”, says Andreas Heino of Timbro, a think-tank in Stockholm.

Subsidies for parental leave are so generous that even entrepreneurs take a fair chunk of it. Sandra Kastås runs two companies in Stockholm. When her son was born in 2021 she took two months off, then spent a year working half-time, as did her husband, an IT specialist. Despite her hectic schedule, Mrs Kastås expects no regular help from her parents. They live on Gotland,

a remote island, and do not visit often. Her mother “shows her love by sending gifts”, such as books and jumpers she has knitted. She talks to her grandson, on FaceTime. “He hugs the phone when she calls. It’s cute,” says Mrs Kastås.

Most Swedes are happy with their system. But some of the elderly complain of loneliness. Nearly half of Swedish households consist of one person, the highest level in Europe after Finland. In a population of 10.4m, some 900,000 people are over 60 and living alone. Of these, a fifth are considered socially isolated, meaning they do not meet friends or family more than twice a month. During the pandemic, Swedes joked darkly that it would be easy to isolate the elderly because “We don’t visit our grandparents much anyway.” Immigrants from places such as Africa or the Middle East are often shocked at how atomised Swedish families are.

Lars Tragardh, a historian, praises Sweden’s “statist individualism”. The state looks after people as individuals, so they can make their own choices and not have to rely on others, he says. Parents elsewhere envy the help that their Nordic peers receive, despite the higher taxes needed to pay for it. Still, even the most generous welfare state cannot offer love.

Helena Paues, who works for an association of local authorities in Sweden, describes how her father enjoys taking her dyslexic son, Wille, to museums. “He loves facts and science. I think his grandfather has taken him to all the museums in Stockholm: the science museum, the Viking museum, and so on. They have a very close bond. My father also struggled with learning to read and write when he was young.”

In the summer, the grandkids stay at their grandparents’ summer house, swim in the lake, and drink lemonade in a tree house. They clamour to do the same thing every year. Ms Paues says her father instils values such as respect for others. “He doesn’t need to talk about it, he does it by being

himself. He teaches them that their opinions matter, because he listens to them." She concludes: "As a child, you need more grown-ups than just your parents." ■



熊彼特

中国比亚迪正赶超特斯拉成为超凡车厂

它是电动汽车界的丰田

要了解丰田章男为什么会在1月26日宣布将把全球最大的车厂交给二把手佐藤恒治，可以看一下2021年他俩驾驶丰田首款雷克萨斯电动车的那段怪诞视频：丰田章男握着方向盘，一开始他显然对电动车有所保留，说车子开起来有点重。然后，他把加速踏板踩到底，随着车速加快，他高兴地欢呼起来，就像《壮志凌云》里面兴奋不已的飞行员。这看着有点做作尴尬，但也很反映现实。许多人视丰田为电动车队里的落后者。在宣布让位给比自己年轻13岁的佐藤时，丰田的这位候任会长明言，是时候让新一代管理者加速带领公司迈向电动时代了。

媒体评论大多把丰田章男的此次让贤描述为针对特斯拉的应对之策。这么看就过于以西方为中心了。特斯拉也许是世界最大的电动车生产商，而且按其老板马斯克的说法已经远远甩开了对手，拿望远镜都看不见第二名。但这忽略了一家新晋中国车厂。尽管马斯克夸夸其谈，丰田对这家厂商的重视显然不亚于对特斯拉的看重。它就是比亚迪，今年可能超越特斯拉成为全球最大的纯电动汽车厂商（不包括其同样也在生产的混合动力汽车）。比亚迪是丰田在中国的电动车合作伙伴，也是丰田在全球市场上日渐崛起的竞争对手。更重要的是，它还复刻了在过去几十年里让丰田发展为全球最成功车厂的许多特质。

这两家东亚公司的发展史相似。它们都不是造车起家的。丰田的前身生产自动织机，而比亚迪最初是生产手机电池的。从一开始，它们就远远落后于其他全球车厂，所以干脆另辟蹊径。在战前的日本，丰田曾尝试使用木炭替代汽油作燃料。比亚迪则利用在电池方面的专长，专注开发电动车和插电混动车（在中国被称为新能源汽车）。两家公司都先在本国练就本领，也都从相对不发达的汽车市场入手进军海外。

但这些试探性的造车业务很快就成气候了。从1955年到1961年的六年时间里，丰田的出口量增至原来的40多倍，之后也一路高歌猛进。比亚迪表示，其新能源车产量达到一百万辆用时13年，之后达到两百万辆仅用时一年，再六个月后，累计产量已达三百万辆。其业务遍及数十个国家，在中国、巴西、匈牙利、印度等地都有生产基地。它还在美国加州的莫哈韦（Mojave）沙漠设厂制造电动大巴。比亚迪现在是全球第二大锂离子电池生产商（仅次于中国的宁德时代），同时也生产货车、出租车等商用车辆和小电子设备。这些为它的全球扩张搭建了一座桥头堡。

不过，真正重要的是生产和利润。在这方面，按咨询公司Sino Auto Insights的涂乐所说，比亚迪也像是“新丰田”。几十年来，丰田这家日本公司一直是汽车业的制造天才；所谓“丰田之道”（The Toyota Way）就是持续改善、精益制造和无与伦比的供应链管理的结合。比亚迪走了另一条路。它自己生产汽车座椅、电池及半导体等各种部件，是世界上垂直整合程度最高的公司之一。但和丰田一样，它也是效率的典范。涂乐用硅谷流行的GSD（“Get shit done”，即能把难事搞定）一词描述其制造实力。持有比亚迪股份的投资公司雪牛资本（Snow Bull Capital）的泰勒·奥根（Taylor Ogan）对比亚迪的自动化水平赞叹不已：“你在这些工厂里看到的仅有的人类就是在生产线末端做检查或在修理机器人的员工。就像丰田过去那样，比亚迪也重新定义了汽车制造业。”美国投资界传奇巴菲特也是比亚迪的粉丝，同时也是大股东。

效率是盈利的机油。比亚迪提供的最新运营信息少得令人抓狂。但在1月30日，该公司发布了2022年净利润初步估计，大概是24亿至25亿美元，是2021年的五倍多。基于这个数字，奥根表示其公司的计算显示，在上一季度，比亚迪汽车业务的毛利率超过了迄今为止最赚钱的大车厂特斯拉。他认为这反映出在比亚迪（其收入主要来自针对大众市场的插电混动车），利润率更高的高端电动车的销量正在逐步提升。有别于特斯拉，比亚迪的车型众多、风格各异，而且定期推出新型号。

一个很大的未知数是美国，目前比亚迪没有在美销售汽车。它并不是第一个担心受到汽车之城底特律的母国排挤的外国汽车制造商。上世纪80年

代，丰田和其他日本汽车制造商一样，成了美日贸易战的受害者。随着中美竞争白热化，比亚迪面对着巨大的地缘政治压力。它原本预计会在1月的拉斯维加斯消费电子展上盛大亮相，但这未能实现。奥根认为，比亚迪打入美国市场的一大障碍源自从特朗普任内对中国制造的电动车部件（如电池）征收的关税。

比亚迪登陆美国市场似乎最终不可避免。尽管有种种地缘政治动荡，美国汽车厂商极度依赖在中国这个世界上最大的汽车市场里销售产品，因而也难以在美国游说反对中国汽车厂商进入，担心中国以牙还牙也将它们拒之门外。再者，比亚迪可能会带来价格不到四万美元的电动车，将有助美国大众汽车市场走向电动化。而且，假如其他方式都行不通，比亚迪至少可以借助丰田来打入美国市场，特别是如果两者在中国的合资企业变成渐入佳境的伙伴关系的话。

目前来看，可以有把握地说，丰田意识到比亚迪带来的不止有机遇，还有挑战。和丰田一样，比亚迪没有自吹自擂，而是悄悄拿出成果。这是让它有别于特斯拉的另一点。 ■



Schumpeter

China's BYD is overtaking Tesla as the carmaker extraordinaire

It's the Toyota of EVs

TO GET A sense of why Toyoda Akio announced on January 26th that he would hand over the keys to the world's biggest carmaker to Sato Koji, his number two, watch the surreal video from 2021 of the two of them driving Toyota's first Lexus electric vehicle (EV). Mr Toyoda is at the wheel. At first, it is clear that he is a bit of an EV sceptic: he notes that the car feels heavy to drive. Then he puts his foot to the floor, and as the speed picks up he whoops with joy like an overexcited Top Gun pilot. It is cringeworthy—but pertinent. Toyota is seen by many as an EV laggard. In announcing his decision to vacate his position to Mr Sato, who is 13 years younger, the chairman-designate made clear it was time for a new generation to speed up the move into the electric era.

Much of the media commentary surrounding Mr Toyoda's move casts it as a response to Tesla. That is too Western-centric. Tesla may be the world's biggest EV producer and, according to Elon Musk, its boss, so far ahead of the competition that he cannot see the number two with a telescope. Yet it ignores a Chinese newcomer that, for all Mr Musk's bombast, Toyota no doubt takes as seriously as it does Tesla. It is BYD, which this year may overtake Tesla as the biggest global seller of pure EVs (not including hybrids, which it also makes). BYD is Toyota's EV partner in China as well as a rising competitor globally. More important, it emulates many of the traits that for decades have made Toyota the world's most successful car company.

Both East Asian firms share historical parallels. They did not start in the car industry. The company that gave rise to Toyota made automatic looms. BYD's inaugural products were batteries for mobile phones. From the outset,

they were so far behind their global carmaking rivals that they looked to do things differently. In pre-war Japan, Toyota toyed with using charcoal as a fuel instead of petrol. BYD used its battery expertise to focus on EVs and plug-in hybrids, known in China as new-energy vehicles (NEVs). They both honed their skills domestically and when they went abroad started in relatively underdeveloped car markets.

Yet these tentative carmaking beginnings quickly developed a life of their own. In a six-year stretch from 1955 until 1961, Toyota's exports grew more than 40-fold and it has not looked back since. BYD says it took 13 years to manufacture its first million NEVs. It took a year to get to the second million. Six months later it reached 3m. It lists operations in dozens of countries and says it has production bases in places ranging from China to Brazil, Hungary, India and beyond. It makes electric buses in California's Mojave desert. It is now the world's second-biggest producer of lithium-ion batteries, behind CATL of China, as well as a maker of commercial vehicles, such as lorries and taxis, and electronic gadgets. These give it a bridgehead for global expansion.

It is on the factory floor and at the bottom line where things really matter, though. And here, too, BYD is what Tu Le of Sino Auto Insights, a consultancy, calls "the new Toyota". The Japanese firm has been the industry's manufacturing genius for decades; "The Toyota Way" is a combination of continuous improvement, or kaizen, lean manufacturing and unparalleled supply-chain management. BYD does things differently. It is one of the world's most vertically integrated companies, making everything from its own seats to batteries and semiconductors. But like Toyota, it is a model of efficiency. Mr Le uses a Silicon Valley term, GSD, to describe its manufacturing prowess. It stands for "Get shit done". Taylor Ogan, whose investment firm, Snow Bull Capital, has a stake in BYD, is awestruck by its level of automation. "The only humans you see in these factories are doing end-of-the-line inspections or fixing the robots. BYD has

redefined auto manufacturing like Toyota did.” Warren Buffett, an icon of American investing, is also a fan—and a big shareholder.

Efficiency is the engine oil of profitability. BYD gives out maddeningly little up-to-date information about its operations. But on January 30th it gave a preliminary estimate of net profit in 2022. At \$2.4bn-2.5bn it was more than five times higher than in 2021. Based on this, Mr Ogan says his firm’s calculations imply that in the past quarter the gross margin of BYD’s auto business surpassed that of Tesla, hitherto the most profitable big carmaker. He believes this reflects the fact that BYD, whose bread and butter comes from building plug-in cars for the mass market, is increasingly selling higher-margin premium EVs. Unlike Tesla, it has a wide variety of ranges and styles, and brings out new models regularly.

The big unknown is America, where BYD currently sells no cars. It is not the first foreign carmaker to fear a backlash in the homeland of Detroit. Toyota, like other Japanese carmakers, fell victim to a US-Japan trade war in the 1980s. With Sino-American rivalry close to boiling point, the geopolitical pressures facing BYD are immense. It was expected to make a big inaugural splash at the Consumer Electronics Show in Las Vegas in January, but this did not happen. A big hurdle to entering America, says Mr Ogan, are the tariffs, dating back to Donald Trump’s presidency, on Chinese-made EV components, such as batteries.

Eventually its launch in America seems inevitable. For all the geopolitical turmoil, American carmakers are so dependent on sales in China, the world’s biggest car market, that they cannot afford to lobby against Chinese entrants at home, lest China shuts them out in response. Moreover, BYD may offer the sort of EVs that, at less than \$40,000 a pop, will electrify the mass market. And, if all else fails, BYD can seek Toyota’s help in cracking America, especially if their joint venture in China turns into a budding partnership.

For now, it is safe to assume that Toyota recognises as much of a challenge from BYD as it does an opportunity. Like Toyota, BYD doesn't shout about its strengths yet quietly delivers results. That is another thing that sets it apart from Tesla. ■



巴托比

AI和人类的关系

ChatGPT这类技术给员工和客户带来了什么问题？

假如你向眼下爆红的人工智能（AI）工具ChatGPT提问，得到的是几乎即时、十分有底气但常常是错误的答复。有点像跟经济学家对话。相比之下，关于ChatGPT这类技术引发的疑问，答案却模糊犹疑得多。但是这类问题才是管理者应该开始提出的。

一个问题是处理员工对饭碗的担忧。担心是自然的。让你处理报销时更省力的AI是一回事，在晚宴上你愿意坐在它身边的AI又是另一回事。如果向员工讲清楚可以怎样把AI帮助释放的时间和精力改用在其他方面，员工的接受度就会上升。赋予员工主导感也有同样的效果：《麻省理工斯隆管理评论》（MIT Sloan Management Review）和波士顿咨询公司的研究发现，如果员工觉得自己有能力推翻AI的指令，就更有可能使用AI。

至于人们是否真的需要了解一个AI系统的内部原理，答案就没那么清晰了。直觉反应会是，能弄懂算法背后的推理逻辑应该比不懂要好。但哈佛大学、麻省理工学院和米兰理工大学的学者的一项研究表明，解释太多可能也是个问题。

他们给拥有多个奢侈品牌的Tapestry集团的员工提供了一个预测模型，可以指导他们在店铺之间调配库存。一组人用的是逻辑可被解释的模型，另一组使用的是更像个黑箱的模型。结果显示，员工往往会因为确信自己的直觉（尽管是错误的）而推翻他们能理解的模型所做的决定。但他们更愿意接受自己无法理解的模型所做的决定，因为信任模型建构者的专业性。AI开发人员的资历很重要。

人们对人类和算法的不同反应是个快速发展的研究领域。在近期一篇论文中，得克萨斯大学奥斯汀分校的吉泽姆·亚尔钦（Gizem Yalcin）和合著者研究了消费者对机器和人类所做的决定（例如贷款或乡村俱乐部会员资格

的审批)是否有不同反应。他们发现，在被拒绝时，人们对两者的反应是一样的。但当被批准时，如果他们得知决定是由算法而非人类做出的，他们对相关机构的好感会降低。原因何在？人们善于为于己不利的决定找理由自我开解，不管决定是谁做的。但如果是由机器评估，就不容易把申请成功归结为自己有魅力、招人喜欢。人们希望感到自己很特别，而不愿意沦为一个数据点。

与此同时，在即将发表的一篇论文中，华盛顿大学的亚瑟·加哥（Arthur Jago）和斯坦福大学商学院的格伦·卡罗尔（Glenn Carroll）的关注点从人们多想归功于自己转向了有多愿意认可他人的功劳，特别是对于那些并非由某个人独力完成的工作。他们先是向实验志愿者展示某件被归为某人出品的东西，比如一件艺术品或一份商业计划书，然后再告诉他们它是在算法或其他人的帮助下做出来的。得知背后有帮助后，所有志愿者都会认为创作人的功劳没那么大了，而这种效应在有人帮助的作品上更为明显。志愿者不仅认为监督算法运行比指挥人工作更难，还觉得把其他人的工作一并算在自己头上不太公平。

由印度管理学院艾哈迈达巴德分校的阿努杰·卡普尔（Anuj Kapoor）与他人合著的另一篇论文研究了在帮助人们减轻体重时AI和人谁更有效。作者们收集分析了印度一款手机应用订阅用户的减重数据，其中一些人只用AI教练，另一些人也跟随人类教练。结果发现，同时也跟人类教练锻炼的用户减重更多，为自己设定的目标难度更大，也更仔细记录自己的活动。但在同样也请人类教练的情况下，BMI指数较高者的减重成果不如那些指数较低的人。论文作者推测，体重较高者在与他人互动时可能更容易感到尴尬。

这些研究呈现的图景很混乱。它也是动态的：技术在演进，人们的态度也会变化。但有一点非常清晰。ChatGPT和其他AI的影响不仅取决于它们本身的能耐，还取决于它们带给人类的感受。■



Bartleby

The relationship between AI and humans

What questions do technologies like ChatGPT raise for employees and customers?

IF YOU ASK something of ChatGPT, an artificial-intelligence (AI) tool that is all the rage, the responses you get back are almost instantaneous, utterly certain and often wrong. It is a bit like talking to an economist. The questions raised by technologies like ChatGPT yield much more tentative answers. But they are ones that managers ought to start asking.

One issue is how to deal with employees' concerns about job security. Worries are natural. An AI that makes it easier to process your expenses is one thing; an AI that people would prefer to sit next to at a dinner party quite another. Being clear about how workers would redirect time and energy that is freed up by an AI helps foster acceptance. So does creating a sense of agency: research conducted by MIT Sloan Management Review and the Boston Consulting Group found that an ability to override an AI makes employees more likely to use it.

Whether people really need to understand what is going on inside an AI is less clear. Intuitively, being able to follow an algorithm's reasoning should trump being unable to. But a piece of research by academics at Harvard University, the Massachusetts Institute of Technology and the Polytechnic University of Milan suggests that too much explanation can be a problem.

Employees at Tapestry, a portfolio of luxury brands, were given access to a forecasting model that told them how to allocate stock to stores. Some used a model whose logic could be interpreted; others used a model that was more of a black box. Workers turned out to be likelier to overrule models they could understand because they were, mistakenly, sure of their own

intuitions. Workers were willing to accept the decisions of a model they could not fathom, however, because of their confidence in the expertise of people who had built it. The credentials of those behind an AI matter.

The different ways that people respond to humans and to algorithms is a burgeoning area of research. In a recent paper Gizem Yalcin of the University of Texas at Austin and her co-authors looked at whether consumers responded differently to decisions—to approve someone for a loan, for example, or a country-club membership—when they were made by a machine or a person. They found that people reacted the same when they were being rejected. But they felt less positively about an organisation when they were approved by an algorithm rather than a human. The reason? People are good at explaining away unfavourable decisions, whoever makes them. It is harder for them to attribute a successful application to their own charming, delightful selves when assessed by a machine. People want to feel special, not reduced to a data point.

In a forthcoming paper, meanwhile, Arthur Jago of the University of Washington and Glenn Carroll of the Stanford Graduate School of Business investigate how willing people are to give rather than earn credit—specifically for work that someone did not do on their own. They showed volunteers something attributed to a specific person—an artwork, say, or a business plan—and then revealed that it had been created either with the help of an algorithm or with the help of human assistants. Everyone gave less credit to producers when they were told they had been helped, but this effect was more pronounced for work that involved human assistants. Not only did the participants see the job of overseeing the algorithm as more demanding than supervising humans, but they did not feel it was as fair for someone to take credit for the work of other people.

Another paper, by Anuj Kapoor of the Indian Institute of Management Ahmedabad and his co-authors, examines whether AIs or humans are more

effective at helping people lose weight. The authors looked at the weight loss achieved by subscribers to an Indian mobile app, some of whom used only an AI coach and some of whom used a human coach, too. They found that people who also used a human coach lost more weight, set themselves tougher goals and were more fastidious about logging their activities. But people with a higher body mass index did not do as well with a human coach as those who weighed less. The authors speculate that heavier people might be more embarrassed by interacting with another person.

The picture that emerges from such research is messy. It is also dynamic: just as technologies evolve, so will attitudes. But it is crystal-clear on one thing. The impact of ChatGPT and other AIs will depend not just on what they can do, but also on how they make people feel. ■



巴托比

为什么说指责无益

老板们又为什么比任何人都更爱责怪他人

指责是人的本性使然：当出现糟糕局面时，人们总是忍不住想怪罪别人，而不是自己承担责任。但是指责这种行为也有破坏作用。相互责备会削弱团队凝聚力，还会让人们不太可能坦承错误，组织也就不太可能从中吸取教训。2015年发表的研究表明，甩锅文化（“不能怪我”）的影响能体现在股价中。那些管理者用外部因素来为自身不足开脱的公司的业绩不如那些自我检讨的公司。

一些行业早就认识到挑毛病的弊端。航空业在减少事故方面创下了骄人的记录，部分原因就是坠机和侥幸脱险事故的调查流程采取“不指责”的原则。负责调查美国交通事故的国家运输安全委员会（National Transportation Safety Board）明确表示，它的职责不是指责或归责于某方，而是找出问题所在，并提出建议，避免事故重演。

医疗保健行业也有类似的教训。当出现医疗问题时，不同国家补偿患者的机制各不相同。英国等一些国家依赖诉讼程序，必须要找出过错方。其他国家如瑞典则不要求追究责任，如果病人遭受的伤害被认为是“可避免的”，就会给予赔偿。一个英国议会委员会去年发表的一份报告强烈建议放弃基于证明医疗过失的制度：“它成本极高，会引发对抗心理，还会推动让个人受过而不是集体学习改进。”

在安全至关重要、生命处于险境的航空和医疗行业，从错误中学习的动机尤其强烈。但当风险较低时，这种动机也不会消失。这就是为什么软件工程师和开发人员经常做“非指责性事后调查”，比如查明网站崩溃或服务器瘫痪是哪里出了问题。

显然，人们对积极采纳不责怪原则也有顾虑。如果那个闹心的网站一直崩溃，而犯错的总是同一个人该怎么办？毕竟，有时候人们也合该受指责。

心理学家詹姆斯·瑞森（James Reason）在20世纪90年代发展出了“公正文化”的概念，设法解决无能和坏心眼的人会侥幸躲过惩罚的担忧。英国航空监管机构在无心之失和其他错误之间划出一条界限，这是个很好的起点。它承诺了这样一种文化：人们“不会因为做出了与自身经验和训练相称的行动、疏忽或决定而受到惩罚”。这缩小了指责的空间，但并没有完全消除指责。

在试图摆脱爱责备人的倾向时，存在两个更大的问题。首先，这需要付出很多努力。指责他人成本低又快捷：“是奈杰尔的错”一秒就能说出口，听起来也真实可信。记录错误并确保流程随之改变则需要做出多得多的周密安排。例如，非指责性事后调查早已成为谷歌文化的一部分，谷歌为此专门设置了模板、评议和讨论组。

第二个问题出在老板身上。有权力的人尤其爱指手画脚。加州大学圣地亚哥分校和新加坡南洋理工大学的学者近期发表的一篇论文发现，掌握职权的人更有可能认为其他人并非别无选择，进而把失败归咎于他们。

例如，在一项实验中，研究人员给参与者随机分配了主管和员工的角色，向他们展示了一份有错误的录音文字稿，并转达了转录员的歉意，说网络不稳导致他们无法好好完成任务。结果，扮演主管角色的人认同转录员应该为错误负责、想要拒绝向其支付报酬的可能性要高得多。权力和苛责相伴而生。

指责似乎也有传染性。2009年发表的一篇论文写道，研究人员让志愿者阅读关于一场政治失败的新闻报道，然后写下他们自己的某次失败。那些读到政客怪特殊利益集团把事情搞砸的参与者更有可能将自己的失败怪在他人头上，而那些读到政客承担起责任的人更有可能承认自己的过失。老板是公司里最受瞩目的人，他们若爱责备人，其他人也会跟风。如果你的公司有指责的文化，问题就出在这儿了。 ■



Bartleby

Why pointing fingers is unhelpful

And why bosses do it more than anyone

CASTING BLAME is natural: it is tempting to fault someone else for a snafu rather than taking responsibility yourself. But blame is also corrosive. Pointing fingers saps team cohesion. It makes it less likely that people will own up to mistakes, and thus less likely that organisations can learn from them. Research published in 2015 suggests that a Shaggy culture (“It wasn’t me”) shows up in share prices. Firms whose managers pointed to external factors to explain their failings underperformed companies that blamed themselves.

Some industries have long recognised the drawbacks of fault-finding. The proud record of aviation in reducing accidents partly reflects no-blame processes for investigating crashes and close calls. The National Transportation Safety Board, which investigates accidents in America, is explicit that its role is not to assign blame or liability but to find out what went wrong and to issue recommendations to avoid a repeat.

There are similar lessons from health care. When things go wrong in medical settings, the systems by which patients are compensated vary between countries. Some, like Britain, depend on a process of litigation in which fault must be found. Others, like Sweden, do not require blame to be allocated and compensate patients if the harm suffered is deemed “avoidable”. A report published by a British parliamentary committee last year strongly recommended moving away from a system based on proving clinical negligence: “It is grossly expensive, adversarial and promotes individual blame instead of collective learning.”

The incentives to learn from errors are particularly strong in aviation and health care, where safety is paramount and lives are at risk. But they also exist when the stakes are lower. That is why software engineers and developers routinely conduct “blameless postmortems” to investigate, say, what went wrong if a website crashes or a server goes down.

There is an obvious worry about embracing blamelessness. What if the wretched website keeps crashing and the same person is at fault? Sometimes, after all, blame is deserved. The idea of the “just culture”, a framework developed in the 1990s by James Reason, a psychologist, addresses the concern that the incompetent and the malevolent will be let off the hook. The line that Britain’s aviation regulator draws between honest errors and the other sort is a good starting-point. It promises a culture in which people “are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training”. That narrows room for blame but does not remove it entirely.

There are two bigger problems with trying to move away from the tendency to blame. The first is that it requires a lot of effort. Blame is cheap and fast: “It was Nigel” takes one second to say and has the ring of truth. Documenting mistakes and making sure processes change as a result require much more structure. Blameless postmortems have long been part of the culture at Google, for instance, which has templates, reviews and discussion groups for them.

The second problem is the boss. People with power are particularly prone to point fingers. A recent paper by academics at the University of California, San Diego, and Nanyang Technological University in Singapore found that people who are in positions of authority are more likely to assume that others have choices and to blame them for failures.

In one experiment, for example, people were randomly assigned the roles

of supervisor and worker, and shown a transcript of an audio recording that contained errors; they were also shown an apology from the transcriber, saying that an unstable internet connection had meant they could not complete the task properly. The person in the supervisor role was much more likely to agree that the transcriber was to blame for the errors and to want to withhold payment. Power and punitiveness went together.

Blame also seems to be contagious. In a paper from 2009, researchers asked volunteers to read news articles about a political failure and then to write about a failure of their own. Participants who read that the politician blamed special interests for the screw-up were more likely to pin their own failures on others; those who read that the politician accepted responsibility were more likely to shoulder the blame for their shortfall. Bosses are the most visible people in a firm; when they point fingers, others will, too. If your company has a blame culture, the fault lies there. ■



经济过热，货币高估

通货膨胀对巨无霸指数意味着什么

快餐国家的竞争优势

在过去两年的大部分时间里，经济学家们围绕价格问题激烈争论。在美国和其他地区的通胀率超过央行目标之时，分析师们已经仔细拆解了生活成本的不同构成，包括商品、服务、能源和房租的价格等。

那么巨无霸又如何呢？麦当劳的这款经典汉堡既包含了牛肉、面包和奶酪，也包含了房租、电和人工等因素。因此其价格反映了更广泛的通胀压力。而且，由于无论你身在世界何处，巨无霸大体上都一个样，所以其价格也可以反映通货膨胀如何改变了不同国家的相对成本。

以美国为例，过去两年里巨无霸的中位数价格上涨逾6%，均价达到5.36美元。（大城市的价格往往略高一些。）根据购买力平价理论，在其他条件相同的情况下，当一国的价格上涨时，其货币应当会贬值。这使得该国的价格不会与世界其他地方背离太多。

然而在过去两年里，美元对大多数其他大型经济体的货币都是升值而非贬值。从2020年12月到2022年12月，美联储公布的美元贸易加权汇率指数增长了9%以上。造成这种情况的其中一个原因是美国的许多贸易伙伴也出现了通胀重新抬头，事实上许多地方的通胀比美国更严重。过去两年，巨无霸的价格在欧元区上涨了14%，在英国上涨了15%。但是美元对欧元和英镑的升值已经超出了抵消这种通胀差异的需要。

物价上涨和货币升值共同作用，有可能让美国的物价与世界其他地方背离。例如，两年前日本的巨无霸比美国便宜26%。理论上，这表明日元被低估了，应该对美元升值才是。但实际情况却恰恰相反。如今日本巨无霸的价格比美国便宜了40%以上。

也有几个购买力平价理论依旧成立的例外。尽管阿根廷比索兑美元的汇率

下跌，但该国物价上涨得更快。现在阿根廷一个巨无霸的价格相当于5.31美元。这一价格既高于本国两年前的水平，也高于巴西目前4.44美元的价格。如果把这两个拉美国家按照目前的汇率组建成一个货币联盟，阿根廷就会发现自己处于相当大的竞争劣势。至少从巨无霸的价格看，它的货币比它面积更大的邻国贵了近20%。

自1986年以来，《经济学人》一直在进行此类比较。将各国巨无霸的价格换算成美元，总会发现同样的汉堡在不同国家的价格存在很大差异。衡量一种货币“公允价值”的标准之一是会消除这些差异的汇率。当然，汇率并不是唯一可调节的手段。一个国家的物价也可以比另一个国家上涨得更快。在以往长期的低通胀时代，物价并不是调节发生的地方。过去两年里许多国家的物价在变动。可惜这几次通货膨胀并没有使各国的巨无霸价格变得更加接近。 ■



Overheated and overvalued

What inflation means for the Big Mac index

The competitive advantage of fast-food nations

FOR MUCH of the past two years, economists have argued fiercely about prices. As inflation in America and elsewhere has exceeded central-bank targets, analysts have dissected different components of the cost of living, including the prices of goods, services, energy and rents.

But what about the Big Mac? The iconic McDonald's burger is an amalgam of rent, electricity and labour, as well as beef, bread and cheese. Its price is therefore indicative of broader inflationary pressures. And because the burger is basically the same wherever you are in the world, its price can also reveal how inflation has changed the relative costliness of different countries.

In America, for example, the median price of a Big Mac has risen by more than 6% to an average of \$5.36 in the past two years. (The price tends to be a bit higher in big cities.) According to the theory of purchasing-power parity, when a country's prices rise, its currency should fall, everything else equal. This stops the country's prices moving too far out of line with those elsewhere in the world.

Yet the dollar has risen, not fallen, over the past two years against the currencies of most other big economies. A trade-weighted exchange-rate index published by America's Federal Reserve increased by more than 9% from December 2020 to December 2022. One reason for this is that inflation has also returned to lots of America's trading partners. Indeed, in many places it is worse. Big Mac prices have risen by 14% over the past two years in the euro area and by 15% in Britain. But the dollar's rise against the euro

and pound has been more than required to offset this inflation gap.

The combination of rising prices and a rising currency threatens to move American prices out of whack with those elsewhere in the world. Two years ago, for example, the Big Mac was 26% cheaper in Japan than America. In principle, this suggests the yen was undervalued and should have risen against the dollar. In fact, the opposite occurred. A Big Mac is now more than 40% cheaper in Japan.

There are exceptions where the theory of purchasing-power parity has held. Although Argentina's peso has fallen against the dollar, prices in the country have risen even faster. A Big Mac now costs the equivalent of \$5.31. That is high compared with the price two years ago and also compared with today's price in Brazil (\$4.44). If the two Latin American countries were to form a currency union at today's exchange rate, Argentina would find itself at a hefty competitive disadvantage. It would be almost 20% more expensive than its larger neighbour, at least judging by burger prices.

The Economist has been making comparisons of this kind since 1986. Converting Big Mac prices into dollars always reveals big differences in the cost of the same burger in different countries. One measure of the "fair value" of a currency is the exchange rate that would eliminate these gaps. But, of course, exchange rates are not the only thing that can adjust. Prices can also rise faster in one country than another. In the long era of low inflation, this was not where the action was. Over the past two years, prices have been on the move in many countries. Unfortunately, these bouts of inflation have done little to move burger prices closer together. ■



大而无当店铺

亚马逊能再创辉煌吗？

这家开创性的电子商务巨头正在努力应对成本飙升和传统业务停滞不前【深度】

很难不佩服亚马逊。它是史上最伟大的公司之一。它最初是贝索斯在1994年创立的在线书店，并不起眼，后来逐渐被他培育成科技巨头，所售产品从玉米糖浆到云计算无所不包。云计算这个未来的万亿美元产业差不多就是亚马逊的发明（见图表1）。如今，它是世界上市值第五高、营收第三高的公司，也是第二大私营雇主。它的仓库、数据中心、商店和办公室占地加起来几乎有曼哈顿那么大。消费者、竞争对手和政客都在猜想亚马逊是将主宰世界，还是将止步于对卫星宽带企业柯伊伯（Kuiper）的大力投资。

尽管有各种光环加身，同样不难看出亚马逊有些惊慌。随着其最大市场美国的经济可能会陷入低迷，消费者纷纷捂紧钱袋子，企业IT部门也在削减云支出。亚马逊的市值自2021年年中达到顶峰以来下跌了约一万亿美元（见图表2），抹去了疫情带来的所有增长——当时顾客们争相加入Prime订阅服务，企业纷纷将数据转移至其云部门亚马逊云科技（AWS）。去年12月，亚马逊宣布裁减1.8万个白领职位，占其员工总数的6%。等到2月2日发布第四季度财报时，其年收入可能首次仅有个位数增长，远低于2021年的22%。去年10月，亚马逊警告称它在2022年最后三个月中可能利润很低或没有利润。

亚马逊经历的这个从顶点坠落的伊卡洛斯时刻在大型科技公司中并非特例。由于人们不再因疫情封锁而关在家里，也不再有邮递员上门送来政府发放的经济刺激支票，对数字产品的需求下降了，其他科技巨头也全都受到了打击。但是，在原先掌管AWS、后在2021年7月贝索斯卸任后接任CEO的安迪·贾西（Andy Jassy）的领导下，亚马逊的扩张比Alphabet、苹果、Meta和微软都要积极得多（见图表3）。那样的兴奋劲头让公司眼下陷入了困境，因为它要应对三大挑战：零售业务不景气、现金引擎AWS和新广

告业务发展速度放缓，以及日益激烈的竞争。低调的贾西能否克服这些挑战，把亚马逊庞大的帝国转变为盈利稳健的企业？

要了解亚马逊何以会走到了当前的处境，得从疫情快要暴发时说起。这家公司当时已经在计划大规模扩张仓库规模和物流网络，目的是给更多Prime会员提供涵盖更多产品的一日送达服务。当各国封锁创造了在线购物热潮时，亚马逊开始双倍押注。2020年4月，贝索斯告诉投资者：“如果你是亚马逊的股东，那你可能得坐稳了，因为我们可不打算小打小闹。”

在之后的两年里，亚马逊将其物流网络扩大了一倍。据咨询公司Evercore ISI的马克·马哈尼（Mark Mahaney）计算，2020年和2021年，亚马逊的全球仓储面积每年都增加了约1.3亿平方英尺（1200万平方米，相当于近四个中央公园）。那两年里，亚马逊的累计资本支出达到了1000亿美元，多于全球其他任何公司。去年它可能又投资了600亿美元，再次名列第一。其中约一半用于扩建仓库和购买车辆，其余大部分投入了AWS数据中心。亚马逊的员工人数也从2019年的80万人增加到了160万人。

2022年第一季度，亚马逊承认，与2021年相比，过度招聘和过度建设各增加了20亿美元的季度成本。燃料价格上涨及工资增长意味着每季度又要额外增加20亿美元的成本。2022年4月，斯塔腾岛（Staten Island）的一个仓库的工人投票决定成立工会，并要求制定“更合理”的生产率目标及提高工资。据摩根士丹利估计，如果亚马逊同意工会的要求，仅斯塔腾岛这一处的仓库就可能让年度运营成本增加两亿美元左右。与此同时，零售销售放缓，12月美国消费者的支出比前一个月减少了1.1%。亚马逊的零售亏损因此在不断增加。研究公司SVB MoffettNathanson的迈克·莫顿（Mike Morton）估计，如果剔除广告利润，零售部门（加上设备、娱乐和其他较小部门）的年度运营亏损约达300亿美元。

广告业务本身是另一个关切点。在过去几年里，它从几乎不存在变成了规模全球第四，年收入达360亿美元。据估计，其营业利润率约为30%，与该行业的两大巨头Alphabet和Meta相当。但盈利能力可能正在下滑。据报道，亚马逊斥资约10亿美元获得了部分美式橄榄球比赛的转播权以及一些

相关广告业务，和在自己的网站上打横幅广告的成本相比，这是一笔巨资。与此同时，广告销售的同比增长大幅放缓，从2021年第三季度的53%降至2022年同期的25%。

随着企业客户削减数字预算，亚马逊的主要现金引擎AWS也在减速。由于能源价格飙升（尤其在欧洲），维持数据中心这个耗电大户的运营成本高了很多。更重要的是，AWS尤其容易受到创业公司订单减少的影响，这些公司往往更青睐AWS而不是微软Azure等竞争对手。科技股大跌，创业公司的风险投资人的口袋捂得越来越紧，这些年轻的科技公司正在大幅削减它们的云支出。去年10月，亚马逊首席财务官布赖恩·奥尔萨夫斯基（Brian Olsavsky）承认，AWS的年销售额增长率已降至25%左右，为历史最低水平。AWS合同的平均剩余期限在最近一个季度也有所下降，表明客户签定的合同数量减少或合同期缩短。第二大云服务提供商微软在1月24日表示，预计本季度其云部门的销售额增长将放缓四五个百分点。

还有一个问题是竞争加剧。随着新冠疫情将购物者推向网上，传统零售商将注意力转向了电子商务。自2022年初以来，沃尔玛将其“最后一英里”的送货能力提高了三倍。另一家传统连锁超市塔吉特（Target）利用在2017年收购的在线购物平台Shipt来完善自己的数字销售渠道。根据SVB MoffettNathanson的数据，从2018年到2021年，包括沃尔玛和塔吉特在内的六大传统零售商在美国电子商务支出中的总份额从8%增加到了12%。同期内，为商家提供在线销售工具的加拿大公司Shopify将其在美国的市场份额从5%扩大到了10%。该公司正大力投资于它在2019年推出的自有配送服务。

竞争对手也在威胁亚马逊的非零售业务。AWS在云领域里稳健的先发优势正在被不断削弱。数据供应商Synergy Research Group的数字显示，在过去三年中，AWS的云业务全球市场份额大致稳定在30%多一点。它的两个主要国内竞争对手微软和Alphabet加在一起已经能大致与它持平。在广告方面，苹果的业务规模虽小但不断增长，微软也在试水，于去年签订了一项合作协议，为奈飞由广告支持的新流媒体服务提供广告。

零售亏损、盈利引擎减速和竞争日益激烈这三重挑战打击了亚马逊的盈利能力。该公司2022年第三季度的整体营业利润率仅为2%，为2017年以来的最低水平。在过去四个季度中，亚马逊的自由现金流（公司扣除资本投资后产生的现金）损失了260亿美元。

这些问题很少能直接归咎于贾西。贝索斯卸任让这位新老板失去了一些身经百战的副手。此前负责零售业务并被视为另一位潜在接班人的戴夫·克拉克（Dave Clark）辞职去了供应链咨询公司Flexport做掌门人。才华横溢的AWS主管查理·贝尔（Charlie Bell）跳槽去了微软。包括公关和政策主管杰伊·卡尼（Jay Carney）与媒体主管杰夫·布莱克本（Jeff Blackburn）在内的贝索斯时代的其他中坚高管也纷纷离职。此外，公司一位资深高管表示，亚马逊如今规模惊人，贝索斯培育起来的类似创业公司的创新文化难以维续。

至于那些雄心勃勃的扩张计划，它们是在贝索斯的领导下策划的，他现在仍担任执行董事长。贾西说话轻声细语（你在人稍多些的房间里注意不到他也情有可原），他曾说他大约每周会咨询一次他的前老板。很难说现任首席执行官做出的决定如果换作亚马逊创始人会有所不同，除了贝索斯深度参与的Echo智能音箱部门成为裁员重灾区可能是个例外。

由于贝索斯全情投入于他的火箭公司蓝色起源（Blue Origin）以及富豪们所钟情的其他追求，目前看来贾西的位子还保得住。但他的工作非常艰巨。首要任务是控制支出和提高回报。经纪公司盛博的马克·舒姆里克（Mark Shmulik）指出，距离亚马逊上一次缩减资本支出已经有一段时日，它时不时就缩减一次，好向股东展示它的盈利能力。

现在可能即将采取这样的措施。去年2月，美国的Prime会员费首次上涨，从每年119美元涨到139美元。欧洲Prime会员费也有类似上涨。2022年，亚马逊商城的商家为物流服务支付的费用涨幅超过往年，除此之外，亚马逊还针对通胀和节日购物季额外征收附加费。它正在寻求转租约3000万平方英尺的过剩仓储空间，并已开始为商家提供长期仓储。

为控制成本，贾西正在砍掉大批项目。亚马逊已取消或推迟了几十个仓库的建设，关闭了几十家实体店，包括所有Amazon Books实体书店和四星门店（专门出售在网上获得四星或以上评级的商品）。视频通话设备Amazon Glow和家用机器人Astro 2.0也被砍掉了。据报道Echo部门年均亏损约50亿美元，那里的裁员看起来像是贾西在试图缩小该部门的规模。

贾西似乎不愿意做的一件事是按照一些投资者敦促的那样，把AWS分拆出去成为一家独立公司。据报道，一年前，对冲基金Third Point的老板丹尼尔·洛布（Daniel Loeb）对他的客户说，将云业务从零售业务中分拆出来可以产生一萬亿美元的股东价值。沃尔玛等一些潜在大客户之所以绕道AWS正是因为它是由自己的零售竞争对手运营的。分拆也会安抚反垄断机构，这些机构迫切想打破在它们看来不负责任的科技垄断。

然而，分拆也会切断云部门和零售部门之间可能创造利润的联系。例如，AWS拥有新的人工智能（AI）工具，让广告主可以在亚马逊的电子商务网站上向购物者精准投放广告。广告创业公司Perpetua的联席总裁亚当·爱泼斯坦（Adam Epstein）表示，这两项业务之间的界限正在变模糊。零售部门已经催生了多个AWS产品，例如首次在亚马逊杂货业务中试用的供应链工具。舒姆里克认为AWS可能会开始销售它的一项智能直播技术，该技术是在Prime Video上直播《周四橄榄球之夜》开发的。

事实上，未来AWS可能会更紧密地融入亚马逊帝国的其他部门。假以时日，这可能会让亚马逊从主要向消费者销售商品转变为向个人和企业销售日益依赖AI辅助的服务。疫情前，亚马逊主要的企业业务部门的销售额占比为31%，高利润服务占营收的37%。如今，这两个数字分别为46%和53%。亚马逊对卫星网络柯伊伯和自动驾驶汽车公司Zoox投下了十亿美元计的重注，可能使得这两个数字进一步上涨。对医疗保健的投资也是如此。去年，亚马逊收购了初级保健供应商One Medical，并推出了线上诊所Amazon Clinic，为20多种常见疾病提供线上问诊。1月24日，它推出了面向Prime会员的药物续订服务。

如果贾西能够在资本纪律和少数集中下注之间做好平衡，亚马逊有可能重

现辉煌。与贝索斯攀登世界之巅相比，这个商业故事可能没那么鼓舞人心，但获利未必会少。 ■



The too-much-of-everything store

Can Amazon deliver again?

The pioneering e-commerce giant battles soaring costs and a stagnating legacy business

IT IS HARD not to be in awe of Amazon. It is one of history's greatest companies. Jeff Bezos nurtured the firm from the humble online bookshop he founded in 1994 into a tech juggernaut, selling everything from corn syrup to cloud computing, a future trillion-dollar industry that Amazon more or less invented (see chart 1). Today it is the world's fifth-most-valuable company, third-largest revenue generator and second-biggest private employer. Its warehouses, data centres, shops and offices cover an area almost the size of Manhattan. Consumers, competitors and politicians have been left to wonder if Amazon would take over the world. Or whether it would stop there—it is investing heavily in Kuiper, a satellite-broadband venture.

All the superlatives notwithstanding, it is equally hard not to recognise that Amazon finds itself in something of a funk. With a downturn on the cards in America, its biggest market, shoppers are tightening their purse strings and corporate IT departments are paring back cloud spending. Amazon's market value is down by around \$1trn since its peak in mid-2021 (see chart 2), erasing all the gains of the covid-19 pandemic, when customers rushed to join its Prime subscription service and businesses were shifting their data to its cloud division, Amazon Web Services (AWS). In December Amazon announced 18,000 white-collar lay-offs, amounting to 6% of its corporate workforce. When it reports fourth-quarter earnings on February 2nd its annual revenue growth may for the first time ever come in at single digits, down from 22% in 2021. In October the company warned it might make little or no profit in the last three months of 2022.

Amazon's Icarus moment is not unique in big tech. All its fellow tech high-fliers have been hit as demand for their digital wares declines now that people are no longer locked down at home and postmen no longer bring pandemic-stimulus cheques from the government. But under Andy Jassy, the AWS chief who took over as CEO after Mr Bezos retired in July 2021, Amazon has expanded much more aggressively than Alphabet, Apple, Meta and Microsoft (see chart 3). This exuberance leaves the company in a tough spot as it contends with three big challenges: a sputtering retail business; decelerating cash engines of AWS and a newish advertising business; and growing competition. Can the understated Mr Jassy overcome them, and turn Amazon's sprawling empire into a dependably profitable business?

To understand how Amazon found itself in its current predicament, go back to just before the pandemic. The firm was already planning a big expansion of its warehouse and logistics network. The aim was to offer one-day delivery for more products to more Prime members. When national lockdowns created a boom in online shopping, Amazon doubled down. In April 2020 Mr Bezos told investors: "If you're a shareowner in Amazon, you may want to take a seat, because we're not thinking small."

Over the next two years Amazon doubled the size of its fulfilment network. Mark Mahaney of Evercore ISI, an advisory firm, calculates that Amazon added about 130m square feet (12m square metres, or nearly four Central Parks) to its global footprint in both 2020 and 2021. In those years Amazon's cumulative capital spending reached \$100bn. No company anywhere in the world invested more in that period. Last year it may have invested another \$60bn, again more than anyone else. Around half that sum went on warehouses and vehicles; most of the rest on AWS data centres. Amazon also increased its payroll to 1.6m, from 800,000 in 2019.

In the first quarter of 2022 Amazon admitted that overhiring and overbuilding were each adding \$2bn to its quarterly costs, relative to 2021.

Pricier fuel and higher wages meant a further \$2bn a quarter. In April 2022 workers at a warehouse on Staten Island voted to unionise, and called for “more reasonable” productivity targets and more pay. If Amazon agrees to the union’s demands, the Staten Island warehouse alone could add \$200m or so to annual operating costs, estimates Morgan Stanley, a bank. At the same time, retail sales slowed; in December American consumers spent 1.1% less than the month before. Amazon’s retail losses are thus piling up. Mike Morton of SVB MoffettNathanson, a research firm, estimates that when you strip out profits from ads, annual operating losses from the retail division (plus devices, entertainment and other smaller units) amount to about \$30bn.

The ad operation itself is another point of concern. In the past few years it has gone from virtually non-existent to the world’s fourth-biggest, with yearly revenues of \$36bn. Its operating margins are reckoned to be around 30%, on a par with the industry’s two giants, Alphabet and Meta. But profitability may be slipping. Amazon has reportedly splurged around \$1bn for the rights to stream some American-football matches, and alongside them some ads—a fortune compared with the cost of posting banners on its own website. At the same time, year-on-year growth in ad sales has slowed sharply, to 25% in the third quarter of 2022, from 53% the year before.

Amazon’s main cash engine, AWS, is also decelerating as business customers trim their digital budgets. Soaring energy prices, especially in Europe, made it much costlier to keep the power-hungry data centres whirring. What is more, AWS is particularly vulnerable to shrivelling orders from startups, which tend to favour it over rivals such as Microsoft Azure. As their venture-capitalist backers grow stingier amid the tech rout, the young tech firms are slashing their cloud spending. In October Brian Olsavsky, Amazon’s chief financial officer, admitted that AWS’s annual sales growth had declined to around 25%, the slowest on record. The average remaining lifetime of AWS contracts also ticked down in the most recent quarter,

suggesting that customers are signing fewer deals or shorter ones. Microsoft, the second-biggest cloud provider, said on January 24th that it expects sales growth at its cloud unit to decelerate by four or five percentage points this quarter.

Another problem is stiffening competition. As covid pushed shoppers online, traditional retailers switched their focus to e-commerce. Walmart increased its last-mile-delivery capacity four-fold just since the start of 2022. Target, another legacy supermarket chain, has used its acquisition in 2017 of Shipt, an online-shopping platform, to spruce up its digital-sales channels. Between 2018 and 2021 six big conventional retailers, including Walmart and Target, increased their collective share of American e-commerce spending from 8% to 12%, according to SVB MoffettNathanson. In the same period Shopify, a Canadian firm which offers merchants tools to sell online, expanded its market share in America from 5% to 10%. It is investing heavily in its own fulfilment service, which it launched in 2019.

Rivals are making their presence felt in Amazon's non-retail businesses, too. AWS's healthy first-mover lead in the cloud is being eaten away. Numbers from Synergy Research Group, a data provider, show that its global market share in the business has more or less stabilised at just over 30% in the past three years. Its two main domestic rivals, Microsoft and Alphabet, have more or less drawn level with it when taken together. In advertising, Apple has a small but growing operation and Microsoft is dipping its toe in the water, signing a deal last year to provide adverts for Netflix's new ad-supported streaming service.

The combination of loss-making retail, slowing profit motors and growing competition is hammering Amazon's profitability. The firm's overall operating margin in the third quarter of 2022 was just 2%, the lowest since 2017. In the past four quarters Amazon lost \$26bn in free cashflow (the money companies generate after deducting capital investments).

Little of this can be laid directly at Mr Jassy's door. Mr Bezos's departure stripped the new boss of some battle-hardened lieutenants. Dave Clark, who ran the retail arm and was seen as another possible successor, left to run Flexport, a supply-chain consultancy. Charlie Bell, a talented AWS executive, jumped ship to Microsoft. Other Bezos-era stalwarts, including Jay Carney, head of public relations and policy, and Jeff Blackburn, head of media, are also moving on. Moreover, the startup-like culture of innovation Mr Bezos cultivated is hard to maintain at Amazon's staggering size, says one longtime executive.

As for the ambitious expansion plans, they were hatched under Mr Bezos, who remains executive chairman. The soft-spoken Mr Jassy, whom you would be forgiven for not noticing in a moderately crowded room, has said he consults his former boss about once a week. With the possible exception of concentrating the lay-offs in the Echo smart-speaker unit, in which Mr Bezos was deeply involved, it is hard to point to decisions the current CEO has made that Amazon's founder wouldn't have.

With Mr Bezos preoccupied with his rocketry firm, Blue Origin, and other plutocratic pursuits, Mr Jassy looks safe in his job for the time being. But he has his work cut out. The first task is to rein in spending and boost returns. It has been a while since Amazon dialled back its capital expenditure, which it does every now and again to show shareholders just how profitable it is, notes Mark Shmulik of Bernstein, a broker.

Now such moves may be in the offing. Last February the price of Prime membership in America rose for the first time, from \$119 a year to \$139. European Prime members have seen a similar increase. Fees that merchants on Amazon's marketplace pay for fulfilment grew by more than usual in 2022, and on top of that the company levied additional surcharges for inflation and the holiday shopping season. It is trying to sublet some 30m square feet of unneeded space and has begun offering long-term storage for

vendors.

In an effort to contain costs, Mr Jassy is binning plenty of projects. Amazon has cancelled or delayed the construction of dozens of warehouses, and closed dozens of physical shops, including all Amazon Books and 4-star outlets, which sold items that received a rating of four stars or higher online. Amazon Glow, a video-calling device, and Astro 2.0, a home robot, were also killed off. The Echo lay-offs look like an attempt by Mr Jassy to downsize a unit that was reportedly losing around \$5bn a year.

One thing Mr Jassy seems loth to do is hive off AWS into a separate company, as some investors have urged. A year ago Daniel Loeb, boss of Third Point, a hedge fund, reportedly told his clients that splitting the cloud business from the retail one could generate \$1trn in shareholder value. Some big potential customers, such as Walmart, shun AWS because it is run by a retailing rival. A sale would also placate trustbusters, eager to break up what they perceive as unaccountable tech monopolies.

A spin-off would, however, also sever potentially lucrative links between the cloud and retail arms. For instance, AWS has new artificial-intelligence (AI) tools for advertisers to target shoppers on Amazon's e-commerce site. The line between the two businesses is blurring, says Adam Epstein, co-president of Perpetua, an ad startup. The retail unit, for its part, has spawned several AWS offerings, such as a supply-chain tool first trialled in Amazon's grocery business. Mr Shmulik thinks AWS may start selling the clever live-streaming technology it developed to broadcast Thursday Night Football on Prime Video.

Indeed, the future may involve weaving AWS more tightly into other parts of the empire. In time that could turn Amazon from primarily a seller of goods to consumers into a seller of increasingly AI-assisted services to both individuals and businesses. Before the pandemic, the share of Amazon's

sales coming from its main business-facing segments was 31% and high-margin services made up 37% of revenue. Today the figures are 46% and 53%, respectively. The company's multibillion-dollar bets on Kuiper, the satellite network, and Zoox, a self-driving-car venture, hint that those shares may rise further. So do investments in health care. Last year Amazon bought One Medical, a provider of primary care, and launched Amazon Clinic, which offers virtual consultations for more than 20 ailments. On January 24th it unveiled a drug-subscription service for Prime members.

If Mr Jassy can balance capital discipline with a few focused wagers, Amazon could return to greatness. That would be a less inspiring business tale than Mr Bezos's pursuit of world domination. But it needn't be less lucrative. ■



监控技术

Wi-Fi信号可能助力间谍活动

路由器发出的信号可以描绘出一幅室内活动的图景【新知】

和所有无线电波一样，Wi-Fi信号在遇到物体（包括人体）时也会发生细微的变化。这些变化可以揭示有关这些物体的形状和运动状态的信息，某种程度上类似于蝙蝠的叫声能发现障碍物和猎物。

从这一假设出发，位于匹兹堡的卡内基梅隆大学的耿嘉琦、黄东和费尔南多·德拉特里（Fernando De la Torre）想知道，在无法以其他方式观察室内人员的情况下，能否通过Wi-Fi来记录他们的行为。他们在预印本平台arXiv上发布的文章称，他们发现这是可行的。这篇名为《来自Wi-Fi的密集姿态识别》（DensePose from Wi-Fi）的论文描述了他们如何让一套人工智能算法读取来自一个装有合适的路由器的房间里的Wi-Fi信号。该算法用人们做各种已知活动时产生的信号训练过，能够重现室内每个人行动的数字图像，这被称为姿态估计。

耿嘉琦、黄东和德拉特里并不是最先想到做这项实验的人。但他们似乎取得了一项重大进展。这方面的早期实验设法获得了基于人体上多达17个“矢量点”（如头部、胸部、膝盖、肘部和手）的二维（2D）姿态估计。而他们这篇新论文描述了对24个矢量点进行追踪后得到的“2.5D”图像（见图片）。黄东表示，该团队现在已经建构了一个增强版的姿态估计，能够生成完整的3D人体图像，追踪数千个矢量点。而且，这项研究用的是家用Wi-Fi路由器中使用的那种标准天线，而之前的研究要用到增强天线。

用标准版路由器进行基于Wi-Fi的详尽人体追踪将会有许多用途。耿嘉琦、黄东和德拉特里谈到用它来“监测老年人的健康状况”。由佛罗里达州立大学的任一力领导的一个团队正在研究类似的技术，他们指出可将其用于交互式游戏和运动监测。早在2016年，麻省理工学院计算机科学与人工智能实验室（Computer Science and Artificial Intelligence Laboratory）的

迪娜·卡塔比（Dina Katabi）、赵明民和法德尔·阿迪布（Fadel Adib）就演示了如何使用类似Wi-Fi的无线电信号远程检测志愿者的心跳（从而检测其情绪状态）。

这些想法会让人忽略一个重点，那就是任何此类系统几乎从一开始就肯定会被用于监控和间谍活动。例如，2018年，加州大学圣芭芭拉分校的朱炎子及其同事展示了守在屋外的黑客是如何通过拦截外泄的Wi-Fi信号来跟踪屋内人员活动的（尽管当时无法看出他们的姿势）。

不难想象谁可能会对可以把任何一座建筑的Wi-Fi网络变成一个迷你“全景监狱”的能力感兴趣。黄东拒绝透露是谁在资助他的团队。不过，他们的另一个项目——开发能够识别视频监控记录中的特定人类行为的技术——是由美国情报高级研究计划局（IARPA）资助的，而IARPA是统领美国间谍活动的国家情报总监办公室（Office of the Director of National Intelligence）下属的研究中心。■



Surveillance technology

Wi-Fi signals could prove useful for spies

A router's emissions can paint a picture of activity in a room

LIKE ALL radio waves, Wi-Fi signals undergo subtle shifts when they encounter objects—human beings included. These can reveal information about the shape and motion of what has been encountered, in a manner akin to the way a bat's chirps reveal obstacles and prey.

Starting from this premise Jiaqi Geng, Dong Huang and Fernando De la Torre, of Carnegie Mellon University, in Pittsburgh, wondered if they could use Wi-Fi to record the behaviour of people inside otherwise unobservable rooms. As they describe in a posting on arXiv, they have found that they can. “DensePose from Wi-Fi”, the paper in question, describes how they ran Wi-Fi signals from a room with appropriate routers in it through an artificial-intelligence algorithm trained on signals from people engaging in various, known activities. This algorithm was able to reconstruct moving digital portraits, called pose estimations, of the individuals in the room.

Mr Geng, Dr Huang and Dr De la Torre are not the first to think of doing this. But they seem to have made a significant advance. Earlier experiments had managed to obtain two-dimensional (2D) pose estimations based on as many as 17 “vector points” on the body—such as head, chest, knees, elbows and hands. The new paper, by contrast, describes “2.5D” portraits that track 24 vector points (see picture). And, according to Dr Huang, the team has now built an enhanced version capable of generating complete 3D body reconstructions that track thousands of vector points. Moreover, this work employed standard antennas of the sort used in household Wi-Fi routers. Previous efforts have relied on souped-up versions of the equipment.

Detailed Wi-Fi-based body-tracking with a standard-issue router would have many uses. Mr Geng, Dr Huang and Dr De la Torre talk of employing it to “monitor the well-being of elder people”. A team working on similar technology, led by Yili Ren of Florida State University, suggests it could be used in interactive gaming and exercise monitoring. And, in 2016, Dina Katabi, Mingmin Zhao and Fadel Adib of the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology demonstrated how Wi-Fi-like radio signals could detect a volunteer’s heartbeat (and thus his or her emotional state) remotely.

These ideas are, however, distractions from what any such system would almost certainly be used for to start with, namely surveillance and espionage. In 2018, for example, Yanzi Zhu of the University of California, Santa Barbara and his colleagues showed how hackers posted outside someone’s home could track the movements (though not then visualise the postures) of people inside, by intercepting escaping Wi-Fi signals.

It is easy to imagine who might be interested in the ability to turn any building’s Wi-Fi network into a mini panopticon. Dr Huang declined to say who is sponsoring his team’s work. However, another of their projects—developing techniques for detecting specific human behaviours in video-surveillance footage—is paid for by IARPA, the research hub of the Office of the Director of National Intelligence, which oversees America’s spies. ■



【首文】救市，再循环

中国的房地产萧条在缓解，但这不会持久

如果不改革，这个行业注定不断地盛衰往复

爱恨交织的关系仍在继续。近两年来，中国领导人打击用于建设和押注房地产的借贷，令市场陷入危机。现在，在新冠“清零”政策的种种问题拖累经济之后，政府又在着急拯救房地产业。中国住房和城乡建设部部长倪虹表示，他今年的目标是恢复市场信心；过去几个月宣布了一系列措施，让开发商更容易筹措资金。这些努力正在重振房地产市场。不幸的是，它们让这个行业一如既往地在繁荣和萧条间循环往复。

房地产业2022年的衰退是近年来最严重的一次。销售面积的下滑幅度前所未见。房地产投资自1999年有记录以来首次下降。开发商融资额减少了四分之一。在过去15年里，中国的房价大体上都是上涨的。而在过去六个月里，各地房价像白蚁侵蚀的地板一般陷落。

造成这种痛苦的原因之一是政府想要斩断中国对靠债务融资的房地产的依赖。超过三分之二的城市家庭财富和房地产捆绑在一起，房地产业支撑着五分之一的GDP。开发商已经积累了巨额债务，在2021年6月约为33.5万亿元。2020年，政府切断了资本市场对许多公司的供给，要求它们降低负债。数十家房地产商违约，将痛苦扩散给了贷款机构和客户。许多新建房屋没有完工，尽管已经预售出去。购房者暂停偿还房贷以示抗议。

再加上习近平的新冠“清零”政策，这轮打压最终给经济带来了一场灾难。去年GDP仅增长3%，是几十年来表现最差的年份之一。疫情封控也加剧了房地产危机，因为能实地看房的潜在买家减少了，而且许多年轻人对一个不确定的未来忧心忡忡，推迟了购房这类大额开销。

现在清零政策已经结束，政策制定者正急于重振“动物精神”。对部分开发商的贷款额度限制已经暂时放开。中央政府要求银行救助未完工的项目。一些地方政府也在为开发商提供担保，以便它们能拿到更多贷款。

这些措施为市场注入了新的活力。截至2022年12月的一年里，新住宅竣工数量仅下降6%，而在截至2022年11月的一年里，这一数字下降了18%。政府资金似乎正流向停滞的已售出项目。看到付过房款的人终于开始拿到新房的钥匙，潜在的买家可能会消除疑虑，忍不住去买自己的房子。

2023年头十天的现房销量相比一个月前增长了20%以上。一些开发商不再以折扣价出售住宅。而且，至关重要的是，一家房地产公司在1月中旬从外国投资者那里借到了美元债，这是一年多以来的第一次。

所有这些都意味着中国经济在短期内应该会更快反弹，帮助推动全球经济增长。但是，现在的危险是中国救市过头。

技术官僚倾向于用大量流动性应对危机。在2007年到2009年全球金融危机期间，中国的巨额刺激资金大部分流向了房地产业。2014年的房地产低迷引发了一轮货币宽松，一些地方的房价在不到一年的时间里翻了一番。还有些地方出现了严重过度建设；中国部分地区因此出现了空置楼宇林立的鬼城。

与此同时，地方政府的收入仍然高度依赖土地拍卖，所以它们有动力维持房屋销售。目前它们已经开始介入，为大型开发商的商业票据提供担保。如果它们得偿所愿，房地产市场将会重新红火起来。

重燃这些力量对中央政府来说将是灾难性的。它们会把房价推至新高，并让开发商再次积累不可持续的债务。官员们将被迫再次打击杠杆，重复一个他们已经经历过几次的循环。

你可能会认为，经济复苏会提供空间来做更审慎的思考。但中国领导人长期以来一直缺乏实施必要改革的意愿。例如已经提出过多次的房产税。征收房产税能抑制投机，还能为地方政府提供急需的收入。但是把大部分财富存储在房子上的城市精英们会厌恶这种做法。到目前为止，只有少数试点方案得以实施。

所以地方政府的融资模式仍然没变。地方官员会继续努力刺激房屋销售、

提振房价。但是谁会入住这些新房呢？摩根士丹利估计，未来十年将会有9000万新城市家庭。但在高峰时期，中国每年新增住房约1500万套。如果供给要匹配需求，新房建设就必须大幅放缓，尤其是在中国人口萎缩的情况下。今天的纾困可能会让中国房地产业复苏，但如果没有任何真正的改革，这个行业注定又会重启盛衰循环。■



Rescue and repeat

China's property slump is easing, but the relief will be short-lived

Without reforms, the sector is doomed to cycles of boom and bust

THE LOVE-HATE relationship goes on. For almost two years China's leaders cracked down on borrowing to build and bet on property, plunging the market into a crisis. Now that the economy has been weakened by the failures of the “zero-covid” policy, the government is racing to rescue real estate. Ni Hong, China's housing minister, has said his ambition this year is to restore confidence; a series of measures announced in the past few months seek to make it easier for developers to raise capital. These efforts are reviving the property market. Unfortunately, they leave it just as vulnerable to boom and bust as ever.

The downturn of 2022 was the most severe in recent memory. Sales of floor space plunged more sharply than ever before. Property investment fell for the first time since records began in 1999. Funds raised by developers fell by a quarter. For the past 15 years house prices in China mainly went up. They have spent the past six months sagging like a termite-weakened floor.

One reason for the pain was the government's attempt to break the country's addiction to debt-financed property. More than two-thirds of urban households' wealth is tied up in real estate and the industry underpins a fifth of GDP. Developers have built up huge debts, worth about 33.5trn yuan (\$5.2trn) in June 2021. In 2020 the government cut off many firms from capital markets, requiring them to reduce their debts. Dozens defaulted, spreading the pain to lenders and customers. Many new homes went unfinished, although they had been paid for. Borrowers suspended mortgage payments in protest.

Together with President Xi Jinping's zero-covid policy, the crackdown proved a disaster for the economy. GDP grew by just 3% last year, one of the worst performances in decades. The covid lockdowns also worsened the housing crisis, as fewer prospective buyers were able to visit empty flats and many young people, worried about an uncertain future, put off big purchases.

Now zero-covid is over and policymakers are rushing to revive animal spirits. Limits on how much some developers are allowed to borrow have been suspended. The central government has ordered banks to rescue unfinished projects. Some local authorities are putting up guarantees for developers so that they can raise more debt.

These measures are breathing new life into the market. The number of new homes that are being completed fell by only 6% in the 12 months to December, having plunged by 18% in the year to November. It appears that government funds are being channelled to pre-paid projects that have stalled. As people who have paid for homes finally start to get their hands on the keys, prospective buyers may be reassured and tempted to bid for pads of their own.

Sales of existing homes rose by more than 20% in the first ten days of 2023, compared with a month earlier. Some developers are no longer offering their flats at a discount. And, crucially, a property firm was able to raise dollar debts from foreign investors in mid-January, the first such instance in more than a year.

All this means that the Chinese economy should bounce back more quickly in the near term, helping to propel global growth. The danger now, however, is that China goes too far.

Technocrats tend to respond to crises with lots of liquidity. During the

global financial crisis of 2007-09 much of China's vast stimulus flowed into bricks and mortar. A property downturn in 2014 led to a bout of monetary easing that saw house prices in some places double in less than a year. Elsewhere the result was rampant overbuilding; hence the high-rise ghost cities that loom over parts of China.

Local governments, meanwhile, still rely heavily on land auctions for revenue, so they have an incentive to keep sales going. They are already stepping in to support large developers by guaranteeing their commercial paper. If they have their way, the property market will come roaring back.

A rekindling of such forces would be disastrous for the central government. They would lift home prices to new heights and lead to another build-up of unsustainable debts among developers. Officials would be forced once again to crack down on leverage, repeating a cycle they have already been through several times.

You might think that the recovery would instead offer room for more considered thinking. But China's leaders have long lacked the will to implement the necessary reforms. A housing tax, for example, has been floated several times. It would curb speculation and generate much-needed income for local governments. But the urban elite, which stores much of its wealth in property, would hate it. So far only a few pilot schemes have been tried out.

And so the funding model for local governments remains unchanged. Local officials will keep trying to pep up sales and prices. But who will live in all the new homes? Morgan Stanley, a bank, estimates there will be 90m new urban households in the next decade. But at its peak, China was adding about 15m homes a year. If supply is to match demand, construction will have to slow dramatically, especially as China's population shrinks. Today's bail-out may be reviving Chinese property, but without real reforms the

sector will be doomed to boom and bust again. ■



熊彼特

萨提亚·纳德拉将如何把握微软的ChatGPT时刻？

他的整个职业生涯都在努力让微软重回科技巅峰

见过萨提亚·纳德拉（Satya Nadella）的人大都对他有好感。而对于那些没见过他的人来说，翻一翻这位微软老板的自传，会认同他属于德才兼备的那种人。他为人谦逊，热爱板球运动。他善于倾听，不仅鼓励员工分享自己的职业梦想，也鼓励他们分享个人梦想。他写到了佛教，但不是“新时代”那一路。他的儿子出生时患有脑瘫，因此他力图理解苦难。有时候，当他无法抑制自己对微软的新技术感到的兴奋之情时，他也会像跳跳虎一样兴高采烈。他描述了其中一个这样的“顿悟时刻”，那是他第一次戴上微软的HoloLens混合现实头显，借助美国国家航空航天局（NASA）的火星探测器实时传来的信号，他看到自己在这颗红色星球上行走。这是对未来的惊鸿一瞥，他写道。“这次体验太鼓舞人心、太感人了，我领导团队里的一个人都哭了。”

如今，纳德拉再次陶醉于“这就是未来”的狂喜中。1月23日，微软宣布对OpenAI的第三次投资，金额估计为100亿美元。这家公司打造了ChatGPT，这款先进的AI工具可以让用户提问，它会像人类一样做出回答，通常答案还很有趣。在过去的几个月里，它占据了新闻头条，成为时代潮流的一部分。紧接着就有了对这项神奇技术（尽管容易出错）的种种描绘：它可能成为Alphabet的子公司谷歌的“柯达时刻”、是癌症研究的福音、终结传统意义上的编程，以及让考试作文寿终正寝等。换句话说，这是技术炒作周期的打鸡血阶段。

说一句可能有点冒犯的话：需要指出的是，在纳德拉的HoloLens顿悟时刻过去七年后，微软在这种混合现实技术方面的热闹劲已落入死一般的沉寂。据报道，HoloLens受到了微软近期万人大裁员的影响。不过，鉴于ChatGPT用起来已经是如此简单方便，很难想象它会是昙花一现。不难看出，凭借自身在云计算和商业软件方面的优势，微软可以利用OpenAI的

底层GPT模型来振兴一整套产品。尽管纳德拉崇尚专注当下的“正念”，但他也极其渴望让微软重回科技创新的巅峰——在社交媒体和智能手机出现后，微软就失去了这一地位。这会是属于他的时刻吗？

从微软的股价看，答案是否定的。自去年11月29日也就是OpenAI公开推出ChatGPT的前一天以来，微软的股价几乎没有上涨过（除了1月24日微软公布了略好于预期的季度收益后，股价有过一次短暂的回升）。考虑到经济放缓（这正在降低对微软的软件和云服务的需求）的风险，投资者有着太多的短期担忧，不大顾得上纳德拉画下的AI风味大饼。

然而，投资者不应低估他传教士般的热情。他在谷歌如日中天之时领导微软的搜索引擎必应（Bing）。他还曾领导微软的云服务业务（如今叫Azure），当时它是电子商务巨头亚马逊的AWS的手下败将。长期以来，他一直怀着超越美国西海岸竞争对手的激情。这使得他对单纯的AI研究没什么耐心。他希望把AI嵌入到微软的产品中以征服顾客。因此，在美国只占7%搜索份额的必应很快会把ChatGPT整合进来，以从谷歌手中夺取市场份额。为了提高软件开发人员的工作效率，微软的编码工具GitHub正在其Co-pilot产品中使用OpenAI技术。微软很可能会用GPT技术彻底改造Office和Windows等产品，这样聊天机器人就可以承担制作Powerpoint和Excel电子表格的苦差事了。在云服务方面，OpenAI已在Azure上构建和训练了自己的GPT模型，可以为Azure的客户提供最先进的聊天机器人服务，这也令微软受益。这些服务被用得越多，就会进化得越好。

微软不会独霸这一领域，这一领域也不会成为赢家通吃的市场。就其他云供应商来说，比如Alphabet，它拥有比GPT更强大的基础模型。但就目前而言，其竞争能力受到了限制。如果类人AI放大了对当前消费科技的偏误和隐私关切，被批评“监控资本主义”的人士诟病的Alphabet就会面临巨大的声誉风险。Alphabet正受到监管部门的责难：1月24日，美国司法部联合八个州提起诉讼，要求拆分谷歌的广告技术业务。此外，谷歌常规搜索的成本非常低，而在搜索中加入类似ChatGPT的技术会耗费很多算力，从而提高成本。至于微软的商业软件竞争对手，比如陷入困境的Salesforce，它们正在努力削减成本，无法指望跟上微软对先进AI的投

资，投资公司盛博的马克·莫德勒（Mark Moerdler）表示。

简而言之，微软占得了宝贵的先机，纳德拉不愿意浪费它。然而，最大的问题不是谁会赢。在这些事情还处于起步阶段时问这样的问题，就好比在19世纪之初问谁将在工业革命中一马当先。更重要的是，各家公司做了多少准备来处理引入技术可能造成的影响——它们将承担以往由人完成的工作，而这些公司既无能力也没有道德标准来检验其工作的可靠性。传播疏忽失误（或者更糟糕，失实和虚假信息）的风险很大。如果知识工作者觉得自己的饭碗受到威胁，那么社会抵制的风险也很大——尽管从长远看，如果这样的技术取得成功，很可能是创造就业的福音。

微软最初应对潜在风险的做法很精明。投资OpenAI能让自己在ChatGPT出问题时与之撇开干系。但最终，随着GPT逐渐融入微软所有的产品，它将对结果负有重大责任。在这种情况下，微软自身的道德标准将会受到关注，纳德拉的人品也将经受考验。 ■



Schumpeter

How will Satya Nadella handle Microsoft's ChatGPT moment?

He has spent a career trying to return Microsoft to the pinnacle of tech

MANY WHO have met Satya Nadella like him. For those who haven't, a skim through his autobiography endorses the view that the boss of Microsoft is an intelligent, decent sort of person. He is unassuming, with a passion for cricket. He is a listener, who encourages employees to share their personal as well as professional dreams. He writes about Buddhism, but not in a new-agey way. His son was born with cerebral palsy, so Mr Nadella seeks to understand suffering. At times, there is something gleefully Tigger-like about him, when he can barely contain his excitement about Microsoft's new technologies. He describes one such "eureka moment" the first time he put on one of the firm's HoloLens mixed-reality headsets and, thanks to a live feed from NASA's Mars rover, visualised himself walking on the red planet. It was, he wrote, a glimpse into the future. "The experience was so inspiring, so moving, that one member of my leadership team cried."

Once again Mr Nadella is giddy with "this-is-the-future" euphoria. On January 23rd Microsoft announced its third investment, estimated at \$10bn, in OpenAI, the company behind ChatGPT. The advanced artificial-intelligence (AI) tool lets users ask questions and get human-like, often funny responses. In the past few months it has grabbed headlines and become part of the zeitgeist. In no time, the wizardry of the technology, however error-prone, has led to its portrayal as a potential Kodak moment for Alphabet-owned Google, a boon to cancer research, the end of coding as you know it, and a nail in the coffin of the exam essay. In other words, it's the tech hype cycle on steroids.

At the risk of sounding churlish, it is worth noting that seven years after Mr

Nadella's HoloLens epiphany, the whole mixed-reality buzz at Microsoft has gone deathly quiet. HoloLens was reportedly affected by the firm's 10,000 recent lay-offs. That said, ChatGPT is already so accessible and intuitive to use that it is hard to imagine it will be a flash in the pan. It is not difficult to see how Microsoft, with its strength in cloud computing and business software, could use OpenAI's underlying GPT models to rejuvenate a whole range of products. And Mr Nadella, for all his mindfulness, burns with an ambition to restore the company to the pinnacle of tech innovation that it vacated with the onset of social media and the smartphone. Could this be his moment?

Microsoft's share price suggests not. It has barely advanced since November 29th, the day before OpenAI publicly launched ChatGPT (save for a brief rally after Microsoft reported quarterly earnings results on January 24th that were a bit better than expected). Given the risks of an economic slowdown, which is cooling demand for Microsoft's software and cloud services, investors have too many short-term concerns to pay much heed to Mr Nadella's promises of AI-flavoured jam tomorrow.

Yet they shouldn't underestimate his missionary zeal. He led Bing, Microsoft's search engine, when Google was on a tear. He led its cloud provider, now called Azure, when it was an also-ran to Amazon Web Services, owned by the e-commerce giant. He has long nurtured a passion to leapfrog his west-coast rivals. That makes him impatient with AI research for its own sake. He wants it embedded in products that wow customers. Hence Bing, with a mere 7% of search queries in America, will shortly incorporate ChatGPT to wrestle share away from Google. GitHub, Microsoft's coding tool, is using OpenAI technology in its Co-pilot product, aimed at accelerating the work rate of software developers. Microsoft is likely to overhaul products like Office and Windows with GPT technology, so that chatbots can take the drudge out of creating PowerPoints and Excel spreadsheets. As for the cloud, Microsoft benefits because OpenAI has built

and trained its GPT models on Azure, and it can offer state-of-the-art chatbot services to Azure's customers. The more they are used, the better they get.

Microsoft will not have the field to itself, nor will it be a winner-takes-all market. Among other cloud providers, Alphabet, for one, has foundational models that are more powerful than GPT. For now, though, its ability to compete is constrained. Alphabet, loathed by critics of surveillance capitalism, bears a big reputational risk if human-like AI amplifies the biases and privacy concerns of current consumer technology. It is under regulatory fire: a lawsuit filed on January 24th by America's Department of Justice and eight states calls for the break-up of Google's ad-tech business. Moreover, the cost of the average Google search is exceedingly cheap; adding ChatGPT-like searches, heavy on computing power, would raise it. As for Microsoft's business-software competitors, such as beleaguered Salesforce, they are trying to cut costs and cannot hope to match Microsoft's advanced AI investments, says Mark Moerdler of Bernstein, an investment firm.

In short, Microsoft has a valuable head start and Mr Nadella is loth to squander it. The big question, however, is not who will win. In these early days that would be like asking, at the dawn of the 19th century, who will come out top from the Industrial Revolution. It is more a matter of how well-equipped is any company to handle the potential implications of introducing technology that will do work previously done by humans, but with neither the ability nor the moral compass to check the reliability of its work. The risks of propagating errors or, worse, misinformation, are serious. So is the danger of societal backlash if knowledge workers feel their jobs are threatened—though if the technology succeeds, over the long term it is likely to be a boon to job creation.

Microsoft's initial approach to the potential pitfalls is shrewd. Investing in OpenAI puts ChatGPT at arm's length if something goes wrong. But eventually, with GPT infused in all of its products, it will bear a big

responsibility for the outcome. In that case, the attention will focus on Microsoft's own moral compass—and Mr Nadella's human decency will be put to the test. ■



繁荣还是萧条？

中国重新开放对拉美意味着什么？

中国疫情后的复苏对一些国家是福音，对另一些不是

几个世纪以来，拉丁美洲的经济一直表现为短期的繁荣和突然的萧条，通常是紧跟大宗商品的周期。1545年在玻利维亚高原发现银矿后，波托西（Potosí）这个村庄一度成为地球上人口最密集的地方之一，因为这里供应了世界超过三分之二的白银。一个世纪后，随着矿山枯竭，这里成为一座鬼城。

随着中国在封控近三年后重新开放，拉美一些国家正准备迎接下一次经济繁荣。摩根士丹利认为2023年中国经济可能增长5.7%。这将引发对拉美商品的需求上升。中国的石油消费量占全球16%以上，铜消费量占全球一半以上，铁矿石消费量占五分之三以上。去年，市场流出疫情限制措施将被取消的传闻时，铜价在一天内应声上涨了7%。

这些对智利和巴西等大宗商品出口国来说都是好消息。智利铜出口足有67%流向中国；巴西大豆出口有70%流向中国。但是，就像过去的挖银热和淘金热一样，好时光可能并不会持久。尽管今年很可能出现强劲增长，但长远而言，中国与拉美地区的经贸关系可能会不尽人意。

在2002年后的十年里，按美元计，拉丁美洲的GDP每年增长超过3%，原因是工业化引发的大宗商品繁荣。2005至2020年期间，国家开发银行和中国进出口银行等政府主导的“政策性银行”向拉美提供了逾1380亿美元的贷款。随着中国购买该地区的谷物、金属和油气，拉美贫困人口减少，政府财力膨胀。

与中国的贸易额从2000年的120亿美元（占拉美GDP的0.6%）增长到2021年的4450亿美元（占该地区GDP的8.5%）。到2021年，中国已在拉美贸易总额中占到18%，高于2005年的5%。如果不计入墨西哥，这一比例还会上升到24%（见图表）。虽然中国成了南美的头号贸易伙伴，美国仍是墨西

哥和中美洲的最大贸易伙伴。巴西、智利和秘鲁对中国均保持贸易顺差。

蓬勃发展的贸易让拉美的一些政客志得意满。华盛顿智库美洲对话组织（Inter-American Dialogue）的玛格丽特·迈尔斯（Margaret Myers）说，许多人预期两地关系一直都会是如此。但这忽略了中国的结构性问题，例如国内房地产市场低迷，以及与美国贸易战的影响。已有迹象显示中国与拉美部分地区的往来接触正在减弱。

自2020年以来，中国的政策性银行没有再向该地区批准新的贷款（见图表）。尽管商业银行和私募基金填补了部分缺口，但它们出手不像政府那么大方。委内瑞拉过去曾占中国对拉美融资额的三分之二，如今只得到用以维持对华石油出口的信贷。

中国在几番糟糕的经历之后调整了贷款政策。在委内瑞拉独裁总统马杜罗（Nicolás Maduro）于2013年上台以及油价下跌后，中国难以收回与该国的石油换贷款协议中数以百万美元计的贷款。在其他地方，由于环保组织的抵制以及政府更替后的政策变化，投资也停步不前。

根据弗吉尼亚州威廉与玛丽学院（College of William and Mary）的研究机构AidData的数据，2000年至2017年期间，拉美与中国“一带一路”倡议有关的大额交易被暂停或取消的数量几乎高于世界其他任何地区。联合国研究机构拉丁美洲和加勒比经济委员会（CEPAL）的研究也显示，中国的投资在2010至2014年间达到顶峰，此后持续下降。

即使中国重新开放后与拉美的往来再次升温，也不会遵循同样的模式。随着中国经济转向服务业和以高科技产品、电动汽车和可再生能源产品为主的制造业，中国的进口和海外投资也将发生转变。中国的原油进口将会减少，而关键金属的进口会增加。2005年至2009年，中国对拉美95%的外国直接投资流向了原材料领域。而在2015年至2021年，该比例已降至46%，其余分别流向了制造业和服务业。

2017至2021年间，拉美对中国用于制造太阳能板的铝的出口量是此前四年的28倍。同期，中国每年从厄瓜多尔进口的用于风力涡轮机的轻木增加了

57%。锂可能尤其受重视。用于动力电池的碳酸锂的五年平均价格原先是在每吨1.4万美元，在2021和2022年飙升至7.2万美元。

其他大宗商品的前景可能较不明朗。高盛预计，铜价在未来12个月将从目前的每吨9000美元升至每吨1.1万美元。但智利大学的安德烈斯·博尔克斯（Andrés Bórquez）认为对铜的需求可能会减少——而如果中国补充铜储备（目前处于15年来的最低水平），需求最终将趋于平稳。这可能会冲击一些太过依赖这种需求的国家，比如智利：该国38%的出口流向中国，其中铜占了四分之三以上。

中国的投资也在变得更具战略性。电力是一个重点领域。波士顿大学全球发展政策研究中心（Global Development Policy Centre）的数据显示，2017至2021年期间，对电力行业的投资占了中国在拉美并购交易的71%。2021年，两家中国国有企业总计斥资60亿美元收购了智利和秘鲁的电力公司。这两个项目都是两国迄今为止获得的最大外国投资之一。

中国对其他基础设施的投资似乎正在加速。墨西哥国立自治大学（National Autonomous University）的一项调查指出，在2005至2021年间中国参与的192个地区基础设施项目中，有57个是在2020年和2021年实施的。这可能与中国加强粮食安全的战略计划有关。一家国有企业正在利马以北50公里处修建一个港口以增加中国的粮食供应。（到目前为止，秘鲁的抗议活动对其似乎并无影响。）

这一切触怒了华盛顿。2020年，特朗普政府向巴西施压，要求其禁止中国电信巨头华为参与5G竞标。巴西政府不为所动，但正在为政府机构建设一个单独的网络，将华为排除在外。同样，特朗普政府向厄瓜多尔提供贷款，帮助该国偿还对中国的数十亿美元债务，条件是厄瓜多尔将中国电信公司排除在其5G网络之外。2021年，七国集团（G7）推出了“重建更美好世界”（Build Back Better World）计划，在全球基础设施投资领域与中国竞争。该计划一败涂地，去年不得不重新包装。

与中美洲相比，南美取悦美国并不会得到那么多好处。巴西与中国搞好关

系“就很合理”，巴西国际关系研究中心（Centre for International Relations）的拉丽莎·瓦霍尔兹（Larissa Wachholz）表示。“这对双方都有利。”她认为，拉美在道路、港口和公用事业方面缺乏投资，而这恰恰是中国所能提供的。现在巴西由左翼的卢拉执政，其政府可能向中国进一步示好。

有几个国家正试图减少对这个亚洲超级大国的依赖。尽管厄瓜多尔的中右翼总统正与中国敲定一项自由贸易协定，但其政府也希望加入太平洋联盟（Pacific Alliance）——由智利、哥伦比亚、墨西哥和秘鲁组成的贸易集团。乌拉圭60%以上的牛肉出口到中国，正寻求与中国达成自由贸易协议，同时也试图加入其他自贸协定。然而，纵观拉美，没有哪个国家在考虑如果中国的复苏最终不及过去强效，它们该如何适应。即将到来的繁荣可能并不长久。 ■



Boom or bust?

What does China's reopening mean for Latin America?

The country's post-covid rebound will be a boon for some countries, but not for all

FOR CENTURIES Latin America's economies have been characterised by short booms and sudden busts, often on the back of commodity cycles. When silver was discovered in the highlands of Bolivia in 1545, the village of Potosí briefly became one of the most densely inhabited places on Earth as it provided more than two-thirds of the world's supply. A century later, with the mines depleted, it was a ghost town.

As China reopens after almost three years of lockdowns, some countries in Latin America are preparing for another boom. Morgan Stanley, a bank, thinks China's economy could grow by 5.7% in 2023. That would trigger rising demand for the region's goods. China consumes more than 16% of the world's oil, over half of its copper and more than three-fifths of its iron ore. When rumours circulated last year that covid-19 restrictions would be lifted, the price of copper jumped by 7% in a day.

All this is good news for commodities exporters such as Chile and Brazil. Fully 67% of Chile's copper exports go to China; Brazil sends 70% of its soyabean exports to China. But, like the silver and gold rushes of the past, the good times may not last. Although strong growth this year is likely, the longer-term relationship between China and the region could disappoint.

In the decade after 2002 Latin America's dollar GDP grew by more than 3% a year, thanks to a commodities boom triggered by Chinese industrialisation. China's state-directed "policy banks", including China Development Bank and Export-Import Bank, provided more than \$138bn in loans to Latin America between 2005 and 2020. Poverty fell and government coffers

swelled as China bought the region's grains, metals and hydrocarbons.

Trade with China grew from \$12bn in 2000, or 0.6% of Latin America's GDP, to \$445bn in 2021 (8.5% of the region's GDP). By 2021 China accounted for 18% of Latin American trade, up from 5% in 2005. Excluding Mexico, the share rises to 24% (see chart). Whereas China became South America's top trading partner, the United States remains that of Mexico and Central America. Brazil, Chile, and Peru all run trade surpluses with China.

Booming trade has led to complacency among some Latin American politicians. Many expect the relationship to always stay the same, says Margaret Myers of the Inter-American Dialogue, a think-tank in Washington, DC. But this overlooks structural issues in China, such as a domestic property slump and the fallout from a trade war with the United States. There are already signs that China's engagement with some parts of the region is weakening.

Since 2020 China's policy banks have approved no new loans to the region (see chart). Although commercial banks and private-equity funds have filled part of the gap, they are not as generous. Venezuela, which used to get two-thirds of Chinese finance in the region, today only receives credit to help it maintain oil shipments to China.

Chinese lending changed after several bad experiences. China struggled to recover millions of dollars in oil-for-loans deals with Venezuela after Nicolás Maduro, the autocratic president, came to power in 2013 and oil prices fell. Elsewhere, pushback from environmental groups also stalled investments, as did shifting policies under different administrations.

According to AidData, a research institute at the College of William and Mary in Virginia, between 2000 and 2017 more high-value transactions linked to China's Belt and Road Initiative were suspended or cancelled in

Latin America than almost anywhere else. Similarly, work by CEPAL, a UN-linked research organisation, shows that Chinese investment peaked between 2010 and 2014 and has fallen since then.

Even if engagement with the region increases again as China reopens, it will not follow the same pattern. As China's economy shifts towards services and manufacture of high-tech goods, electric vehicles and renewable-energy products, its imports and investments abroad will change. China's imports of crude oil will fall, while those of critical metals will increase. From 2005 to 2009, 95% of total foreign direct investment (FDI) by China in the region went into raw materials. By 2015 to 2021, this share had fallen to 46%, with the balance split between manufacturing and services.

Between 2017 and 2021 Latin American exports to China of aluminium, used in solar panels, were 28 times as large as in the previous four years. China's annual imports of balsa wood from Ecuador, used in wind turbines, rose by 57% over the same period. Lithium may be particularly prized. The price of lithium carbonate, used in batteries for electric vehicles, soared in 2021 and 2022 from a five-year average of \$14,000 per tonne to \$72,000.

Other commodities may have a trickier future. The price of copper is expected by Goldman Sachs, a bank, to rise from \$9,000 per tonne today to \$11,000 in the next 12 months. But Andrés Bórquez at the University of Chile thinks that less of it may be needed—and that if China replenishes its copper reserves, which are at their lowest for 15 years, demand will eventually plateau. That could hurt certain overexposed countries, such as Chile: 38% of its exports go to China, over three-quarters of which are copper.

Chinese investments are also becoming more strategic. Electricity is a key area. Between 2017 and 2021 investments in this sector made up 71% of Chinese mergers and acquisitions in the region, according to Boston

University's Global Development Policy Centre. In 2021 two Chinese state-owned firms splurged \$6bn collectively to buy Chilean and Peruvian electricity companies. Both projects were among the largest foreign investments ever received by either country.

Chinese investment in other infrastructure appears to be accelerating. A survey by Mexico's National Autonomous University reckons that of 192 regional infrastructure projects with Chinese involvement undertaken between 2005 and 2021, 57 were carried out in 2020 and 2021. The reasons may have to do with strategic projects linked to strengthening China's food security. A state-owned firm is building a port 50km (30 miles) north of Lima in order to increase China's supply of food. (So far the protests in Peru do not appear to have affected it.)

All this has ruffled feathers in Washington. In 2020 Donald Trump's administration put pressure on Brazil not to allow Huawei, a Chinese telecoms giant, to participate in a 5G auction. The Brazilian government went ahead anyway, but is creating a separate network for government agencies that excludes Huawei. Similarly, the Trump administration extended a loan to Ecuador to help it pay off billions of dollars' worth of debt to China on the condition that it exclude Chinese telecoms firms from its 5G network. In 2021 the G7 launched "Build Back Better World", to compete with Chinese infrastructure investment around the world. It was such a flop that it had to be rebranded last year.

South America has less to gain than Central America from cosying up to the United States. Brazil's relationship with China "just really makes sense", says Larissa Wachholz, at Brazil's Centre for International Relations. "It's beneficial for both sides." She thinks the investment that is lacking in Latin America—in roads, ports and utilities—is exactly what China can offer. Now that the leftist Luiz Inácio Lula da Silva is in power in Brazil, its government is likely to make more overtures to China.

A few countries are trying to lessen their reliance on the Asian superpower. Although Ecuador's centre-right president is finalising a free-trade agreement with China, his administration also wants to join the Pacific Alliance, a trade bloc composed of Chile, Colombia, Mexico and Peru. Uruguay, which exports more than 60% of its beef to China, is seeking a free-trade deal with China as well as trying to join other free-trade agreements. Yet across the region, few countries are thinking about how to adapt if China's comeback turns out to lack the potency of the past. The coming boom may not last long. ■



返还发件人

中国的再全球化悖论

2023年入境旅客会增加，出口订单会减少

在近期于瑞士达沃斯举行的世界经济论坛年会上，中国经济大总管刘鹤见到了因漫长战“疫”而久违的一些“老朋友”。在一场恳切的演讲中，他承认面对面交流的重要性，哀叹世界分裂，呼吁经济“再全球化”。在一句哲学性的题外话中，他还强调了事物的“二相性”。

中国最近放弃了新冠“清零”政策，之前这一政策切断了中国与世界其余地区的联系，加剧了刘鹤所哀叹的分裂。但中国这段孤立时期本身有着明显的二相性。虽然中国的出入境人员流动大受限制，但从中国去往世界其他地区的货物流动却非常可观。根据1月13日公布的数据，尽管有各种干扰，2021年中国出口按美元计算还是增长了近30%，2022年再增长7%。也许面对面交流的作用被高估了。

事实证明，中国时不时的封控对贸易的损害并不像人们当初担心的那般严重。去年四、五月上海封城停摆时，许多人担心国际供应链将堵塞，推高全球通胀。但是大量货运转由附近的宁波处理。由纽约联储的经济学家创建的全球供应链压力指数在2021年——也就是中国去年苦战奥密克戎之前——达到顶峰。之后一直回落，虽然上海封城和俄罗斯入侵乌克兰令回落一度中断，但持续时间不久（见图表）。从价格上看情况也类似。去年6月，美国整体通胀升至9.1%的峰值，但美国进口中国货物的平均价格仅同比上升3.3%。

随着中国突然取消清零政策，人员跨境流动（如刘鹤出访瑞士）已经重启。12月，国航国际航线的乘客数量比前一个月增加了三分之一。踏入新的一年，中国经济的其他领域也将逐步复苏。去年零售支出下滑，要不是人们恐慌性囤积食品和药品，数字可能还会更疲软，但预计今年将迎来复苏。房地产销售的前景应该也会改善，2022年房屋销售萎缩超过四分之

一，是有记录以来的最大降幅。刘鹤在达沃斯表示，政府已给房地产开发商“输血”，帮助他们筹措资金，并采取措施刺激市场，他希望这些行动能帮助急需资金的开发商提升收入。

尽管前景愈趋光明，出口却是个刺眼的例外。在中国重开国门的新一年，出口很可能反而比处于封控阴影下的去年更糟。事实上，最近发布的三次月度出口数据均落入负值。瑞银的数据显示，2023年中国商品出口按美元计算将整体萎缩4%。这将是1980年以来仅仅第五次下降。在中国的人员流动再全球化的同时，中国的商品却可能趋向去全球化。中国将吸引更多外国旅客，出口却会流失。

一个重要方面是，中国重开国门让国内出口商的日子变难了。中国放弃清零政策促使人民币回升，自11月初以来，人民币兑美元汇率已上升8%，中国的出口竞争力因而下降。刘鹤邀请他在达沃斯的听众再访中国，但全球资本家人还没到，全球资本就已急冲冲地重新涌向中国资产，抬高了人民币价格。出口商也把更多美元收入兑换为人民币。

然而，出口走向萧条的主因在中国之外。世界经济放缓，对中国产品的需求将下降。而且不一定是软着陆。例如去年12月，中国对美国、欧盟和日本出口较上年同期下降了17%。野村证券的陆挺担心中国将承受所谓的“牛鞭效应”。正如手腕轻轻一抖就会打出一记响鞭，消费者需求小幅下降就可能导致上游供应商的订单大幅减少。

即使全球消费水平实际上能保持强韧，它的构成也对中国越来越不利。在美国和其他富裕国家，消费已从居家办公者看重的各种电子产品转移到人们能自由出行交际时享用的各色服务。在最新的贸易数据中，中国的计算机及其零部件的全球出货量缩减35%。在封控威胁笼罩全球供应链时，人们曾担心中国出口商是世界经济的一道软肋，而现在事实证明，世界经济才是中国出口商的软肋。 ■



Return to sender

China's re-globalisation paradox

In 2023 the world will visit more and buy less

AT THE ANNUAL World Economic Forum meeting this week in Davos, Switzerland, China's economic tsar, Liu He, met a number of "old friends" he had not seen during his country's long battle with covid-19. In a solicitous speech, he acknowledged the importance of in-person meetings, lamented the fragmentation of the world and called for economic "re-globalisation". In a philosophical aside, he also emphasised the "duality" of things.

China's recently abandoned "zero-covid" policy cut the country off from the rest of the world, contributing to the fragmentation Mr Liu bemoaned. But China's period of isolation had a notable duality of its own. Although the movement of people across China's borders was sharply curtailed, the movement of goods from China to the rest of the world was spectacular. Despite all the disruptions, China's exports grew by almost 30% in dollar terms in 2021 and by another 7% in 2022, according to figures released on January 13th. Perhaps in-person meetings are overrated.

China's episodic lockdowns proved less damaging to trade than feared at the time. When Shanghai was brought to a standstill in April and May, many worried it would clog international supply chains and push up global inflation. But a lot of trade passed through nearby Ningbo instead. An index of global supply-chain pressure, created by economists at the Federal Reserve Bank of New York, peaked at the end of 2021, before China's fraught battles with Omicron last year. The index's decline since then was interrupted by the Shanghai lockdown and Russia's invasion of Ukraine, but not for long (see chart). Prices tell a similar story. In June, when the headline inflation rate in the United States peaked at 9.1%, the average price

of Chinese imports into America rose by only 3.3%, compared with a year earlier.

With the abrupt removal of China's zero-covid policy, the flow of people, like Mr Liu, across the mainland's borders has resumed. The number of passengers on Air China's international routes rose by a third in December compared with the previous month. Other parts of the economy will also improve as the year unfolds. A recovery is expected in retail spending, which fell last year and would have been even weaker had it not been for the anxious stockpiling of food and medicines. The outlook should also improve for home sales, which shrank by more than a quarter in 2022, the sharpest decline on record. The government has given property developers a "blood transfusion", Mr Liu reported in Davos, helping them raise finance. It has also taken steps to quicken the pulse of the market, which he hopes will help developers raise much-needed revenue.

But the glaring exception to this brighter outlook is exports. They are likely to fare worse in China's year of reopening than in its last year of lockdowns. Indeed, the monthly figures have been negative in the past three releases. According to UBS, a bank, merchandise exports will shrink by 4% in dollar terms in 2023 as a whole. This would be only their fifth such fall since 1980. The re-globalisation of China's people will coincide with a deglobalisation of its goods. China will attract many more foreign visitors and fewer foreign sales.

In one important respect, China's reopening has made life harder for its exporters. The turnaround in China's zero-covid policy has contributed to a revival of the yuan, which has risen by 8% against the dollar since the start of November, making Chinese exports less competitive. Mr Liu invited his audience in Davos to visit China again. But even before the global capitalists arrive, global capital has rushed to reacquaint itself with Chinese assets, bidding up the price of its currency. Exporters have also converted more of

their dollar earnings into yuan.

The main reason for the export bust, though, lies outside China. The slowdown in the world economy will cut demand for its wares. And the landing will not necessarily be soft. In December, for example, China's sales to America, the EU and Japan fell by 17% compared with a year earlier. Ting Lu of Nomura, another bank, worries that China will suffer from the so-called bullwhip effect. A small dip in demand from consumers can lead to pronounced drops in orders for upstream suppliers, just as a small flick of the wrist can lead to a vicious crack of the whip.

Even if the level of global spending proves resilient, the mix is becoming less favourable to China. In America and other rich countries consumption has shifted from the sorts of electronic goods that are prized by people working from home to the services people enjoy when they are able to move and mingle. China's global shipments of computers and their parts shrank by 35% in the latest trade figures. When the threat of lockdowns dangled over global supply chains, people worried that China's exporters were a source of vulnerability for the world economy. Instead, the world economy is proving a source of vulnerability for China's exporters. ■



巴托比

如何在职场释放创造力

忘记嗑药和吊床吧。试试枯燥乏味

学者们并不会比赛看谁能写出年度最有意思的研究论文。不过，现在供职于弗吉尼亚大学的王育珍（音译）、华盛顿大学的克里斯托弗·巴恩斯（Christopher Barnes）和新加坡国立大学的任启智应该能获此殊荣。在2022年发表的一项研究中，三人检验了大麻能够提升创造力这一普遍观点。

研究人员招募了一群吸大麻做消遣的美国人，并让他们参加一些衡量创造力的标准化测试（从为一块砖找到新用途到为一支乐队想出赚钱的点子）。一些参与者在吸食大麻后立即接受测试，而对照组在上一次放纵过了12小时后才接受测试。独立评估者评估他们想法的创新性。

研究人员发现，大麻提升了使用者的愉悦感，这种情绪被认为有助于横向思维。使用大麻还令人们对自己和其他参与者的创造力给出了更高的评价。问题是，独立评估者看不出它对人们想法的实际质量有什么影响。吸食大麻吸“嗨”了的人自然会觉得一切都令人兴奋，不管事实是不是真的如此。这篇论文得出的干巴巴的结论之一是，“领导者可能还是希望员工保持清醒，尤其是在评估创意的时候”。

你可能会觉得这是句废话。但高管们为了寻找释放创造力的方法似乎都神经错乱了。人们开始对在工作场所使用迷幻剂感兴趣，不仅当它是一种保健福利，还当它是激发创新思维的手段。不过先别急着向出版商提交你构思的新书《蘑菇上最聪明的人》。科学期刊《自然》去年发表的一项研究测试了服用低剂量迷幻蘑菇的影响，得出了与上述关于大麻的论文相似的结论：参与者可能确实踏上了一段旅程，但并无太多证据表明他们最后到达了创造力爆发的目的地。

激发人们创新思维的手段多种多样，嗑药是最极端的一种。有一些旨在鼓

励“发散思维”的具体练习，比如给你旁边的人画一幅素描，或者设计一个独一无二的三明治（放点牛百页和少许酸葡萄怎么样？）还有各种团建活动，比如玩转碟、K歌、密室逃脱、走火路（安全警告：如果你在参与这项活动时脑中闪过一个好点子，千万不要为了把它写下来而停下脚步）。

此外，世界各地的人们似乎都痴迷于将办公室的局部变成游戏室：色彩鲜艳的家具、吊床、黑板，还有对成年人来说实在太低的椅子。其理念是运用非传统的空间可以帮助激发创新想法。但这在很大程度上还是取决于手头的任务。

欧洲工商管理学院（INSEAD）的曼努埃尔·索萨（Manuel Sosa）和卡耐基梅隆大学的李善基（音译）开展了一项实验，给参与者一张上面印有40个圆圈的纸，让他们画出现实世界中包含该形状的物体。被安排在非常规工作空间的参与者的表演逊于那些在普通办公室里的人，因为前者的注意力全被周围的圆形物体吸引去了（在那些不会像这样受到周围环境影响的测试中，他们的表现优于“格子间居民”）。

集体活动无疑也有它该去的地方，那就是地狱。但是，不顾一切地去召唤创造力可能会弄巧成拙，就像告诉自己不睡不行了只会让你越发睡不着一样。大量证据表明，干脆什么都不做是更好的选择。任思绪神游是个解锁奇思妙想的好方法。著名编剧亚伦·索尔金（Aaron Sorkin）为了摆脱写作瓶颈，一天会洗好几次澡。

单调乏味本身可能是激发灵感的妙招。研究人员在一项发表于2013年的研究中发现，在参加创造力测试之前抄写电话号码的人表现优于没有这么做的人（仅仅是朗读电话号码效果还要更好）。尼采觉得无聊是灵魂中令人不快的“风平浪静”，忍过去便会迎来愉快的航行和怡人的微风。没有什么比无聊更能促使你提笔写作了——年轻的阿加莎·克里斯蒂赞同这一点。或许，如果她有一个懒人沙发、一些乐高玩具和一根大麻烟，她取得的成就还会大得多。又或许，创造力其实并没那么公式化。■



Bartleby

How to unlock creativity in the workplace

Forget drug use and hammocks. Try tedium instead

ACADEMICS DO NOT contend to write the most entertaining research paper of the year. But Yu Tse Heng, now at the University of Virginia, Christopher Barnes of the University of Washington and Kai Chi Yam of the National University of Singapore should take a bow nonetheless. In a study published in 2022, the trio tested the widespread notion that cannabis increases creativity.

The researchers recruited a bunch of Americans who take the drug recreationally, and asked them to take some standardised tests of creativity (from thinking of novel uses for a brick to coming up with money-spinning ideas for a music band). Some participants underwent the test immediately after taking cannabis; a control group only did so if 12 hours had elapsed since they last indulged. Independent evaluators assessed the innovativeness of their ideas.

The researchers found that cannabis increased users' joviality, which is thought to encourage lateral thinking. Drug use also led people to rate their own creativity, and that of other participants, more highly. The problem is that the independent assessors could discern no effect on the actual quality of people's thoughts. Cannabis users got high and duly found everything mind-blowing, regardless of whether it was or not. "Leaders may want employees to be sober, especially while evaluating ideas" is one of the paper's dry conclusions.

You might think that doesn't need saying. But the search for ways to unleash creativity seems to scramble executives' brains. There is rising interest in

the use of psychedelics in the workplace, not simply as a health-care perk but also as a way of stimulating innovative thinking. But before you submit your book pitch for “The Smartest Guys on the Mushroom”, take a minute. A study published last year in *Nature*, a scientific journal, tested the effects of taking low doses of psilocybin and reached a similar conclusion to the cannabis paper: participants may have gone on a trip but there wasn’t much evidence to suggest it ended in a creative destination.

Drug use is at the extreme end of a range of techniques whose purpose is to jolt people into a more innovative mindset. There are specific exercises designed to encourage “divergent thinking”, such as sketching the person next to you or designing a unique sandwich (how about tripe and a dash of sour grapes?). There are team-building activities, from plate-spinning and karaoke to escape rooms and fire-walking (safety warning: if you have a brainwave during this exercise, never stop to write it down).

And there is a near-universal obsession with turning bits of offices into playrooms: brightly coloured furniture, hammocks, blackboards, chairs that are far too low to the ground for adults. The idea is that using an unconventional space can help stimulate innovative thoughts. But much depends on the task at hand.

In an experiment conducted by Manuel Sosa of INSEAD business school and Sunkee Lee of Carnegie Mellon University, participants were given a sheet of paper with 40 circles on it and asked to draw real-world objects that contained that shape. People who had been put in an unconventional workspace performed worse than those in a bog-standard office because they became fixated on the circular objects in their vicinity (they did better than cubicle-dwellers on tests that could not be influenced by their surroundings in this way).

Group activities undoubtedly have their place: it’s called hell. But desperate

efforts to induce creativity can be self-defeating, in the same way that telling yourself that you must get to sleep is bound to keep you awake. Plenty of evidence suggests that doing absolutely nothing is a better option. Allowing the mind to wander is a good way to unlock bright ideas. Aaron Sorkin, a celebrated screenplay writer, showered multiple times a day as a way of getting around writer's block.

Tedium itself can be a useful spur to inspiration. In a study presented in 2013 researchers found that people who had copied telephone numbers out—or, even better, just read them—before taking a creative test outperformed those who had not. Boredom, reckoned Friedrich Nietzsche, is that disagreeable “windless calm” of the soul that precedes a happy voyage and cheerful breeze. There is nothing like boredom to make you write, agreed a young Agatha Christie. Maybe she could have achieved much more if she had a beanbag, some Lego and a zoot. Or maybe creativity is just a bit less formulaic than that. ■



古老的混凝土

古罗马的土木工程可供现代世界借鉴

所用的混凝土会自我修复，并且超前的绿色环保【新知】

古罗马人是建筑大师。他们的许多杰作，从万神殿（见上图）、古罗马斗兽场，到高卢南部的加尔桥，还有西班牙塞戈维亚（Segovia）同样让人惊叹的古罗马输水道，都经受住了岁月的考验。这些建筑遭到的破坏通常是因为石材被盗挖，而不是本身结构破损。

另一种古罗马作品也流传了几个世纪。《建筑十书》（De Architectura）是由马库斯·维特鲁威·波利奥（Marcus Vitruvius Pollio）写下的十卷书籍。许多学者认为这位公元前一世纪的工程师和建筑师曾在凯撒大帝的一些军事行动中与之合作过。这套书里包含着各种各样的秘诀，以确保建筑物“不会日久年深成为废墟”。

古罗马工程师成功的一个原因是混凝土。（万神殿的屋顶是世界上最大的无支撑混凝土圆顶。）众所周知，罗古马混凝土经受了几个世纪的考验，其结实程度却没有下降多少。实际上，它甚至可能随着时间的流逝而愈加坚固了。其中诀窍直到现在才浮出水面。

部分原因在于罗马东南部的阿尔班山（Alban Hills）和那不勒斯附近波佐利（Pozzuoli）等地区的火山岩。它们提供了关键的成分。正如维特鲁威自己描述的那样，古罗马人用来粘合混凝土骨料的是石灰和火山灰的混合物。（这些骨料本身通常是沙子或破碎的火山岩，修建万神殿还用到了浮石，这样结构更轻。）

近年的几项研究表明，火山灰不仅提高了混凝土的强度和耐久性，还增强了混合料固化成型后骨料颗粒之间的粘聚力。因为当水渗入时，一些火山矿物溶解产生了钙铝硅酸盐水合物（C-A-S-H），这是混凝土的主要粘结材料。这也减缓了微小裂缝的增多。此外，在一些墙面的裂缝处也发现了C-A-S-H，说明古罗马混凝土有一定的自我修复能力。

其中一项研究发表于2021年，犹他大学的玛丽·杰克逊（Marie Jackson）和麻省理工学院的阿米尔·马西克（Admir Masic）领导的团队描述了塞西莉亚·梅特拉（Caecilia Metella）的墓中一堵砖墙的灰浆（一种精细的混凝土）结构。这座墓位于罗马和阿尔班山之间的亚壁古道（Appian Way）旁。一定程度上因为它坚固的砖石结构（非常坚固，甚至在中世纪时被用来修建城堡的主楼），这座建筑是这条古罗马大道上保存最完好的遗迹之一。

研究人员研究了富含钾的火山矿白榴石是如何溶解在水中，并且让胶合剂和骨料之间的化学键重新组合，增强它们之间的连接，且让整个结构更具韧性。

不过，这种火山灰只是秘诀的一部分。古罗马混凝土的另一种成分石灰也在混凝土固化后的增强中发挥了作用。至少马西克及其同事另一篇论文的结论是这样，这篇论文刚刚发表在《科学进展》（Science Advances）上。

这一次，研究人员从普利弗纳姆（Privernum）的一处城墙上采集了样本，普利弗纳姆同样是罗马东南部的一处遗址。这些建筑可以追溯到公元前2世纪。他们发现，在这里主要是石灰填补了裂缝和裂纹，修复了小破损而使之不至于不断扩大而变得严重。

这里所说的石灰并不是维特鲁威描述的纯白色粉末。更确切地说，它是约一毫米大小的块状物，在制备混凝土时未能溶解。人们常常在古罗马混凝土中发现这样的团块。它们的作用似乎是个用于自我修复的碳酸钙水库，渗透到微小裂缝中的水会溶解这些物质，然后它们在裂缝中重新沉淀，把裂缝填满。

此外，这些团块的分布和形状表明，石灰是以生石灰的形式添加到混合物中，而不是今天常见的熟化（经过水合的）石灰。这说明古罗马混凝土至少部分是通过热搅拌制成的，因为给生石灰加水释放出的热量足以让混凝土混合物的温度升至80°C以上。现在，混凝土大多是冷拌，因为热拌有让

混凝土膨胀的缺点。另一方面，热搅拌可以更快地固化。可能这就是古罗马工程师更喜欢这一做法的原因。

这种方式可能对今天的建造者有借鉴意义。比利时布鲁塞尔自由大学（Free University of Brussels）的结构设计工程师迪迪埃·斯诺克（Didier Snoeck）说：“现代水泥在生产过程中排放了大量的二氧化碳，古罗马混凝土让我们看到，想得到坚固耐用的混凝土，并不是非得这么做不可。”他说：“我们无法用火山灰材料取代所有的硅酸盐水泥，因为建造基础设施需要大量的混凝土，但可以替代一部分。我们还可以用粉煤灰、高炉炉渣和石灰石煅烧粘土做替代品。”

研究古罗马混凝土还可以帮助现代工程师开发出更耐久的能自我修复的混凝土配方。延长混凝土的使用寿命意味着可以减少维修或翻新，有助建筑更长久屹立。有些说不定能比万神殿和罗马斗兽场存在得更长久。■



Ancient concrete

Roman civil engineering has lessons for the modern world

The concrete used was self-healing and anachronistically green

THE ROMANS were master builders. Many of their works, from the Pantheon (pictured above) and the Colosseum in Rome itself, to the Pont du Gard in southern Gaul and the equally impressive aqueduct of Segovia, in Spain, have withstood the ages. What damage has been done to such constructions is more often the result of stone robbery than structural failure.

Roman work of another sort has survived the centuries, too. “De Architectura” is a ten-book series by Marcus Vitruvius Pollio, an engineer and architect of the first century BC, who is believed by many scholars to have worked with Julius Caesar on some of his military campaigns. These volumes include various tips intended to ensure that buildings “don’t fall into ruins over a long passage of time”.

One reason for Roman engineers’ success was concrete. (The Pantheon’s roof is the largest unsupported concrete dome in the world.) Roman concrete is known to defy the centuries without losing much of its firmness. Indeed, it can even get stronger with age. How this happens is only now coming to light.

Part of the explanation lies in the volcanic rocks of areas such as the Alban Hills, south-east of Rome, and Pozzuoli, near Naples. These provided crucial ingredients. As Vitruvius himself describes, the cement Romans used to bind the aggregates of concrete was a mixture of lime and volcanic ash. (The aggregates themselves were generally sand or crushed volcanic rock—which, in the case of the Pantheon, included pumice, to make the

structure lighter.)

Several recent studies have shown that the ash not only contributed to the concrete's strength and durability, but also enhanced cohesion between the aggregate particles after the mixture had been cured. This happened when water seeped in, dissolving some of the volcanic minerals and creating calcium aluminosilicate hydrates (C-A-S-H), the main binding material in the concrete. That also slowed the propagation of microscopic cracks. Moreover, some crack walls showed C-A-S-H infill—an indication that Roman concrete possessed a certain self-healing power.

In one of these studies, published in 2021, a team led by Marie Jackson of the University of Utah and Admir Masic of the Massachusetts Institute of Technology described the structure of the mortar (a fine form of concrete) of a brick wall in the tomb of Caecilia Metella, which stands beside the stretch of the Appian Way between Rome and the Alban Hills. In part because of its solid masonry (so solid that it was repurposed as the keep of a castle during the Middle Ages), this building is one of the best-preserved monuments decorating that antique Roman highway.

The researchers studied how leucite, a potassium-rich volcanic mineral, dissolved in the water and reconfigured the chemical bonds between the cement and the aggregates, strengthening the interfaces between them, and making the whole structure more resilient.

This volcanic touch is, though, only part of the story. Lime, the other ingredient of Roman cement, also had a role in the post-curing strengthening of concrete. That, at least, is the conclusion of another paper by Dr Masic and a group of colleagues, which has just been published in *Science Advances*.

This time the researchers took samples from a city wall in Privernum, an

archaeological site also to the south-east of Rome. These dated from the second century BC. They discovered that in this case it was mainly the lime that had caused cracks and fissures to be sealed, thus healing damage that might have gone on, if not nipped in the bud, to become serious.

The lime involved here was not the pure white powder described by Vitruvius. Rather, it was clumps a millimetre or so across that had failed to dissolve when the concrete was being prepared. Such clumps are often found in Roman concrete. Their role seems to have been as a reservoir of calcium carbonate for the processes of self-healing, permitting that material to be dissolved by seeping water admitted by tiny cracks and then re-precipitated in those cracks to seal them up.

Moreover, the distribution and the shape of the clumps suggest that the lime was added to the mix as quicklime, rather than, as is common today, slaked (hydrated) lime. This would mean that Roman concrete was made, at least partly, by hot mixing—for slaking quicklime with water releases enough heat to raise the temperature of a concrete mix above 80°C. Today, concrete is mostly mixed cold, for hot mixing has the disadvantage that the concrete can expand. On the other hand, the practice allows faster curing. Possibly that is why Roman engineers preferred it.

This approach may hold lessons for today's builders. "Roman concrete", says Didier Snoeck, a structural-design engineer at the Free University of Brussels, in Belgium, "shows that modern cement, of which the production emits huge amounts of CO₂, is not indispensable for strong and durable concrete." "We can't", he says, "replace all Portland cement with volcanic material, due to the necessary volumes of concrete to build infrastructure, but we can do it partially. And we can also use fly ashes, blast furnace slags and limestone calcined clays instead."

Studying Roman concrete could also help modern engineers develop

recipes for more durable, self-healing concrete. Increasing concrete's lifespan would mean less repair and renovation was needed, helping buildings last longer. Who knows? Some of them might even outlast the Pantheon and the Colosseum. ■



【首文】好莱坞对战硅谷

从迪士尼的困境看技术如何改变文化产业

一百岁的米老鼠仍可能活蹦乱跳，但它要面对新一类对手

“我们为什么一定要长大？”华特·迪士尼（Walt Disney）曾经发出这样的疑问。1月27日启动了百年庆典的华特迪士尼公司（Walt Disney Company，以下简称迪士尼）一直深受年轻人和人老心不老的人喜爱。今年，这家好莱坞最大的电影公司在原创内容方面的投资将超过任何其他公司。它称霸全球票房，在去年的十大热映影片中占了四部，其流媒体订阅量也一马当先。迪士尼把IP转化成了饭盒到光剑等各式周边商品，并用于在主题公园生财，就在新冠疫情持续期间，这些主题公园依旧利润不俗。迪士尼不仅是一家企业，可能还是全球史上最成功的文化工厂。

所以撼动迪士尼的这次剧变的影响远超其商业帝国本身。其庞大的娱乐业务组合未来的盈利能力成疑，导致公司股价大起大落。它在去年11月把时任首席执行官扫地出门，很快还会更换董事长。迪士尼还面对一家希望获得一个董事会席位的维权投资公司的抗争，可能会上演自2005年时任首席执行官迈克尔·艾斯纳（Michael Eisner）被赶走以来最激烈的交锋。迪士尼面临的考验并不只是一场董事会争斗大戏。从华纳兄弟到奈飞，其他领先的文化工厂也在遭遇类似的危机。原因是一场技术革命正在颠覆好莱坞。

迪士尼这家百年老店历久不衰，频频打脸各种预测。自1928年米老鼠在第一部作品《威利号汽船》（Steamboat Willie）中亮相以来，视频娱乐供应经历了爆炸式发展。电视、有线电视、家庭录像以及之后的互联网提供的选择越来越多。现在谁都可以用手机录制视频并发布出来，供亿万人免费观看。每小时上传到YouTube的内容比迪士尼+的整个流媒体目录中的内容还要多。

许多人预言小众内容激增会拖垮主流内容制作商，他们基本上猜错了。选

择无限的娱乐内容摧毁的是作品平庸的公司，之前人们观看这些内容只是因为没有其他选择，广播收视率的崩塌就是例证。但行业顶尖公司一派繁荣。当任何人都可以自由选择看什么时，人们自然都要看最好的。像奈飞和亚马逊这样的全球流媒体公司拥有超过两亿直接订户，这在以往是难以想象的数字。

在票房萎缩的大势下，表现最佳的是那些拥有大热IP的制作商。由于人们上影院的次数减少，竞争加剧，制片公司会把资金投入到即使每年只上三四次影院的人也会去看的作品上。美国去年票房最高的十部电影全部都是续集或系列电影；迪士尼即将推出的影片中，80岁高龄的哈里森·福特再度饰演印第安纳·琼斯第五次踏上探险之旅。现在并非电影的黄金时代，但对顶尖电影公司而言，这是个有利可图的时代。

如今技术正再度颠覆这个行业。在线发行吸引了制造流媒体硬件和软件的科技公司。相比好莱坞，硅谷的体量完全是另一个数量级（亚马逊的广告业务持续增长，已经达到迪士尼的三倍），科技大亨们根本不需要靠流媒体业务盈利，只当它是主业的附加项目。好莱坞当初瞧不起这些科技宅，而现在这些人有足够的资本承担创意风险。去年，进军电影业不到三年的苹果公司凭借《健听女孩》（CODA，部分使用手语演绎的喜剧片）拿下了奥斯卡最佳影片奖。这些新晋制片公司出品并以低于成本价出售的精良内容越多，老牌电影公司从媒体业顶流跌入危险中游的风险就越大。

同时，新技术让那些处于“长尾”更远端的公司更有机会爬上有利可图的顶端。游戏引擎（可用以创建虚拟场景）这类发明正在降低行业的准入门槛。生成式AI已经可以制作简单视频，最终可能令门槛进一步下降。第一批得益者是美国以外的电影公司，之前它们一直难以做出第一流的特效，现在难关不再。去年全球票房最高的电影中有两部是中国电影，待中国疫情消退，预计数字还会上升。中国尚未扭转外国观众的口味接受像《战狼2》这种大片（宣传语为“犯我中华者，虽远必诛”）。但别以为情况就一定不会变了。中国已经有一款全球流行的社交媒体应用TikTok，还制作了不少风行国际的电子游戏，例如由腾讯出品、全球手游收入最高的《王者荣耀》。

技术颠覆文化产业最富戏剧性的方式也许是创造新的娱乐片类型。富裕国家的年轻人花在电子游戏上的时间已经超过了广播电视台。好莱坞追赶潮流的步伐缓慢，而其硅谷竞争对手正在争抢游戏IP。微软计划收购拥有《使命召唤》（Call of Duty）和《糖果传奇》（Candy Crush）等游戏的动视暴雪（Activision-Blizzard），出价几乎是亚马逊收购米高梅（拥有系列电影《邦德》和《洛奇》）的十倍。游戏衍生的电影逐渐变得和电影衍生的游戏一样受欢迎。改编自末日游戏《最后生还者》（The Last of Us）的同名美剧似乎大获成功。《刺猬索尼克》（Sonic the Hedgehog）是去年最火的电影之一，而《马里奥》（Mario）很可能成为今年的票房大热门。任天堂将于本月揭幕新的马里奥主题公园，竟然就在好莱坞。

好莱坞的顶尖创意工厂要生存下去就必须做出适应和改变。再创辉煌新时代并非遥不可及。迪士尼的作品从放映机转到有线电视和录影带，再到如今的数字载体，这家公司的百年史就是不断创新的历史，无论是在商业运作还是在艺术创作上。创新可能还将继续。不过，已有迹象表明，接下来的一百年，许多流行文化将在好莱坞以外的地方造梦而来。对于厌倦了看续集的观众而言，这可能是个可喜的剧情转折。 ■



Hollywood v Silicon Valley

Disney's troubles show how technology has changed the business of culture

At 100, the mouse can still roar. But it faces a new kind of rival

“WHY DO WE have to grow up?” Walt Disney once wondered. As it launches its centenary celebrations on January 27th, the Walt Disney Company has sustained its appeal to the young and young-at-heart. This year Hollywood’s biggest studio will invest more in original content than any other firm. It dominates the global box office, with four of last year’s ten biggest hits, and has more streaming subscriptions than anyone else. Its intellectual property (IP) is turned into merchandise ranging from lunchboxes to lightsabers, and exploited in theme parks that are churning out healthy profits even as covid-19 lingers. More than just a business, Disney is perhaps the most successful culture factory the world has ever known.

So the upheaval rocking the company today has relevance far beyond its empire. Uncertainty about the future profitability of Disney’s enormous entertainment portfolio has caused a rollercoaster ride in its share price. It threw out its chief executive in November and will soon replace its chairman. It also faces a rebellion from an activist investment firm that wants a board seat in what could turn into the biggest face-off since Michael Eisner, a previous CEO, was forced out in 2005. Disney’s trials are not just a boardroom drama. Similar crises are unfolding at other leading culture factories, from Warner Bros to Netflix. The reason is a technological revolution that is turning Hollywood upside down.

The continuing pre-eminence of a centenarian like Disney has confounded many predictions. Since the days of “Steamboat Willie”, Mickey Mouse’s first outing in 1928, there has been an explosion in the supply of video

entertainment. Television, cable, home video and then the internet have offered increasing amounts of choice. Anyone with a phone can record video and make it accessible to billions of people, free of charge. More content is uploaded to YouTube every hour than Disney+ holds in its entire streaming catalogue.

Many predicted that this surge of niche content would bring down mainstream hit-makers. They were mostly wrong. Infinite choice in entertainment has ruined the companies which produced middling content that people watched because there was nothing else on—witness the collapse in broadcast-television ratings. But those at the very top of the business have thrived. When anyone can watch anything, people flock to the best. Global streamers like Netflix and Amazon have more than 200 million direct subscribers, once an unimaginable number.

Those who have fared best at a shrinking box office are the owners of IP that is already popular. As people visit cinemas less often and competition intensifies, studios have pumped money into films people will turn out to see even when they go only three or four times a year. America's ten biggest films last year were all sequels or parts of a franchise; Disney's upcoming slate includes an 80-year-old Harrison Ford returning for a fifth outing as Indiana Jones. It has not been a golden age for cinema, but for those at the top it has been a profitable one.

Now technology is shaking things up again. Online distribution has enticed tech firms that make the hardware and software used for streaming. Silicon Valley is of a different scale from Tinseltown (Amazon's growing advertising business is already three times bigger than Disney's) and its moguls have no need to make money from streaming, which they see as an add-on to their main business. Hollywood initially wrote off the nerds. But the nerds have enough money to take creative risks. Last year Apple won the best-picture Oscar with "CODA", a comedy-drama partly in sign language, less than three

years after it entered the film business. The more fine content these new producers make and sell below cost, the greater the risk that older studios will fall from the top tier of media into the perilous middle.

At the same time, new technology is allowing those lower down the “long tail” a better chance of reaching the profitable top. Inventions like game engines, which help with the creation of virtual sets, are lowering barriers to entry. Generative artificial intelligence, which can already make rudimentary video, may eventually lower them further. The first beneficiaries have been non-American film studios, which until recently struggled to nail first-class special effects. No longer. Two of the world’s highest-grossing films last year were Chinese—and when covid ebbs in China, expect that number to rise. China has yet to convert foreign audiences to hits like “Wolf Warrior 2” (tagline: “Anyone who offends China, wherever they are, must die”). But don’t bet that this will always be the case. China already has a globally successful social-media app in TikTok and produces video games that are international hits, including Tencent’s “Honour of Kings”, which is the world’s highest-earning mobile game.

Perhaps the most dramatic way technology could disrupt the culture business is by creating new categories of entertainment. Young adults in rich countries already devote more time to gaming than to broadcast television. Hollywood has been slow to catch on, but its Silicon Valley rivals are snapping up gaming IP. Microsoft’s proposed acquisition of Activision-Blizzard, whose games include “Call of Duty” and “Candy Crush”, is worth nearly ten times what Amazon paid for Metro-Goldwyn-Mayer, home of James Bond and Rocky Balboa. Movies based on games are becoming as popular as games based on movies. A series based on “The Last of Us”, a post-apocalyptic game, seems to be a critical success. Sonic the Hedgehog was among last year’s biggest films and Mario is likely to be among this year’s. Nintendo is opening a new Mario theme park this month—in Hollywood, no less.

The great creative factories of Hollywood will have to adapt if they want to survive. Another successful era is not beyond their reach. Disney's century has been one of endless reinvention, in business terms as well as artistic ones, as the company has moved its output from projectors to cables to cassettes and now bytes. It will probably continue to innovate. Still, there are already signs that much of the coming century's popular culture will be dreamt up in places other than Hollywood. For audiences tiring of sequels, that may be a welcome twist. ■



虫吃鸟

螳螂攻击雏鸟

昆虫捕食脊椎动物很罕见

虫子是鸟儿的美餐，而不是反过来。但在伊朗克尔曼省（Kerman），阿瓦耶·多纳耶·哈克斯塔里研究所（Avaye Dornaye Khakestari Institute）的马赫穆德·科涅加里（Mahmood Kolnegari）和英国诺丁汉大学的康纳·潘特（Connor Panter）通过放在一只紫色太阳鸟的鸟巢旁的摄像头，发现了角色颠倒的情况。两人在发表于《生态与进化》（Ecology and Evolution）的论文中称，他们的摄像头捕捉到了一只螳螂杀死了一只雏鸟并啃食鸟肉的画面。螳螂以性情凶猛著称，但即便如此，这次攻击还是让两位研究人员感到惊讶。他们以为这只是一个离奇的个案，直到一个月后，他们又拍到了一只螳螂杀死并取食一只凤头百灵雏鸟的画面。他们检索文献以查看之前是否有类似的捕食记录，结果找到了一个世纪前的一份报告记录有一项类似的发现。他们在互联网上做了更大范围的搜索，发现了两份记录螳螂捕食雏鸟的非科学报告，分别来自台湾和巴西。■



Bug bites bird

A praying mantis attacks a nestling

It is rare for insects to be predators of vertebrates

BIRDS FEAST on bugs, not the other way around. But that role-reversal is what Mahmood Kolnegari of the Avaye Dornaye Khakestari Institute, in Iran, and Connor Panter of the University of Nottingham, in Britain, saw when they put a camera near the nest of a purple sunbird, in Kerman province, Iran. As they report in *Ecology and Evolution*, their camera captured footage of a praying mantis killing a nestling and eating from it. Praying mantises are known for their aggression, but even so, the attack was a surprise to the researchers. They assumed it was a bizarre one off until, a month later, they caught a second mantis killing and feeding on a nestling crested lark. Searching the literature to see if such predation had been noted before, they found a single, century-old report documenting a similar finding. A more general internet search revealed a couple of non-scientific reports, from Taiwan and Brazil, of mantids eating nestlings. ■



数十亿美元不翼而飞

寻找FTX下落不明的财富

美国破产法院那一套对萨姆·班克曼-弗里德的烂摊子来说不对症

本月5日，萨姆·班克曼-弗里德（Sam Bankman-Fried）现身他亲手打造的加密货币帝国的葬礼。他对FTX的破产程序提起申诉，要求从指定给债权人的冻结资产中获得五亿美元。班克曼-弗里德想用这笔钱来支付他刑事审判的法律费用，他被指控从这家加密货币交易所侵吞了数十亿美元的客户存款供自己使用（他拒不认罪）。

这将是一场漫长而混乱的战斗，班克曼-弗里德提出的要求就是打响的第一炮。美国的破产法经过了几个世纪的演变以严苛处理一般公司破产，现在律师们必须匆忙研究出如何将之应用于加密货币公司。去年11月，FTX根据破产法第11章提出破产申请，这一章允许破产公司进行重组而不是清算。在此过程中，破产公司与其债权人之间通常会发生需法律裁决的纠纷。公司在被法院告知所欠债务后，会试图说服借款人接受公司的股份而非现金。如果协商成功，公司会继续存活，减少了负债，制定全新的发展计划；如果协商不成，就会关门大吉。一次大型重组可能有100个债权人。时间长一点的会持续一年。复杂的重组至少需要两三年。

在1月11日的听证会上的情况是，FTX的债权人可能多达900万个——这让它成为（以债权人数量衡量）有史以来企业破产最严重的烂摊子。FTX的崩盘引发了27个司法管辖区的134家实体破产，从尼日利亚的交易所FTX Zuma到游戏开发商Good Luck Games，不一而足。诉讼程序可能会持续十年，其间可能会出现更多的不当行为指控。班克曼-弗里德的继任者，也就是FTX的现任老板约翰·雷三世（John Ray III）在收拾乱局的过程中成了事实上的联邦调查员。不久前他在国会承诺，如果他偶然发现了可疑之人，会向当局呈报供刑事指控考虑。

破产法院的第一个任务是找到被欠钱的人。通常情况下债权人会很积极地

站出来。但在加密货币破产案中就不是这样了。许多人之所以选择加密货币存储财富，就是被它的匿名性吸引。提出索赔需要核实身份，因此债权人必须想明白自己有多在乎隐私。包括科技界一些最有名望的投资方在内的投资人也不大愿意承认自己卷入其中。为了让他们不再躲藏，法院采取了一项极不寻常的举措——同意为FTX的50个最大债权人保密。

与此同时，雷正忙着查找资产的下落。这就涉及从财务记录中重建公司账目，而他说自己从没见过这么糟糕的记录。FTX甚至没有记录客户的存款金额。其姐妹公司——交易公司阿拉米达（Alameda）有数十亿美元下落不明。直到去年11月29日，律师们还认为FTX至少可以说几乎没有外部贷款。但随后，另一家破产的交易所BlockFi要求获得FTX在股票交易平台Robinhood持有的五亿美元股票，它坚称FTX已将这些股票用作抵押向它借款。

到目前为止，雷只查明了几十亿美元的资产。而且查到资产下落只是成功的一半——更大的难题是拿到这些资产。在早期的纷争中，美国和巴哈马当局打了几个月的口水仗，最后才同意将价值至少35亿美元的代币转入美国的诉讼程序。雷同时也在寻找FTX捐款的去向。班克曼-弗里德曾向政客和有效利他主义慈善机构大举撒币。雷已表示他会提起诉讼来追回这些钱。

迄今为止，美国法院还没有完成过一起重大的加密货币公司重组案。这就产生了问题。尽管加密货币已经存在了15年，但没有人能就它到底是什么达成一致。代币交换由区块链上的软件记录在虚拟账本上，而区块链并不由哪个具体的人操控。这与物权法不相符——物权法认为，人们拥有某物是因为法律认定他们拥有或者他们实际上拥有该物的实体。股票有所有权证书；椅子有主人坐着。而法律不能对加密货币账本采取强制行动，在区块链上记录的代币也不会变成真实的硬币。

因此，即使是站出来的债权人也可能得不到全额补偿。股票交易所倒闭时，客户受到《统一商法典》（Uniform Commercial Code）的保护，这是美国用于管理商业交易的法律。FTX的使用条款明确表示不受这一法律

的约束。1月4日，在另一宗加密货币公司破产案中，法官裁定，部分客户不拥有其存款的所有权。FTX的客户可能要等上好几年才能知道自己会拿回些什么。

如果达成和解协议，储户还会面临最后一个风险。FTX大部分的可收回价值可能会存在于加密代币中。律师和政客们一致认为这种代币不是货币，因为货币必须有政府背书。而看起来到了瓜分FTX资产之时，法院将不得不以美元支付债权。这就引发了使用哪一天的汇率的问题。FTX的现存财产中的代币之多，拍卖它们可能会引发一场大甩卖，摧毁它们的市场价值。

另一种方法是将FTX的账户转卖给有偿付能力的交易所。这样就不用设法从那些没人想要的代币中榨出现金，但这会让加密货币史上最大的尴尬在未来几年里一直余波荡漾，再者还要能找得到这样一个买家才行。1月5日，美国监管机构出手阻止了一项交易——全球最大的加密货币交易所币安（Binance）打算以十亿美元收购另一家破产公司Voyager的资产。对于即将到来的诉讼程序，有一点是肯定的——FTX曾在令人惊叹的混乱中挺立，也将在令人惊叹的混乱中倒下。 ■



Absent billions

The hunt for FTX's missing riches

Bankruptcy courts are not built for Sam Bankman-Fried's mess

ON JANUARY 5TH Sam Bankman-Fried turned up at the funeral of his own crypto empire. He lodged a complaint against FTX's bankruptcy proceedings, demanding \$500m in frozen assets earmarked for creditors. Mr Bankman-Fried wants the money in order to pay legal fees for his criminal trial, in which he is accused of sucking billions of dollars of customer deposits from the crypto exchange for his own use (he has pleaded not guilty).

The demand is an opening salvo in what will be a long, chaotic battle. America's bankruptcy laws have evolved over centuries to pick apart regular businesses. Now, on the fly, lawyers must work out how to apply them to crypto companies. In November FTX filed for bankruptcy under Chapter 11, which allows a bankrupt firm to reorganise rather than liquidate. The process usually plays out as a legally refereed tussle between a company and its creditors. The firm, told by a court what it owes, tries to convince lenders to accept stakes in the business rather than cash. If successful, it emerges with less borrowing and a shiny new growth plan. If unsuccessful, it shuts up shop. A big restructuring might have 100 creditors. A long one lasts a year. A complex one takes at least a couple.

In a hearing on January 11th, it emerged that FTX may have as many as 9m creditors—making it, by this measure, the ugliest corporate carcass ever seen. The firm's breakdown has left 134 insolvent entities in 27 jurisdictions. They range from FTX Zuma, a Nigerian exchange, to Good Luck Games, a game developer. The proceedings could take a decade, and turn up more allegations of wrongdoing. As he sorts through the mess, John Ray III, Mr

Bankman-Fried's successor as boss of FTX, has become a de facto federal investigator. In a recent visit to Congress he promised to recommend more suspects for criminal charges if he stumbled across candidates.

The bankruptcy court's first task is to find those owed money. Creditors are usually keen to come forward. Not in bankruptcies dealing with crypto. For many, the attraction of storing wealth this way is its facelessness. Lodging a claim requires an ID check, so creditors must decide quite how deep their desire for privacy runs. Investors, who include some of tech's most illustrious funders, are also reluctant to fess up to their involvement. To coax them out of hiding, the court has—in a highly unusual move—agreed to keep FTX's 50 biggest creditors under wraps.

At the same time, Mr Ray is scrambling to locate assets. This involves constructing corporate accounts from what he calls the worst record-keeping he has have ever seen. FTX did not even keep note of how much customers deposited. Billions of dollars were lost by Alameda, a sister trading firm. Until November 29th lawyers thought there were at least next to no external loans. Then BlockFi, another bankrupt exchange, demanded \$500m in shares that FTX held in Robinhood, a share-trading platform, insisting FTX had put them up as collateral for borrowing.

So far, Mr Ray has pieced together just a few billion dollars of assets. And finding assets is only half the battle—getting at them is harder still. In an early fracas, American and Bahamian authorities spent months sniping at one another, before agreeing to bring tokens worth at least \$3.5bn into American proceedings. Mr Ray is also hunting FTX's donations. Mr Bankman-Fried gave freely to politicians and effective-altruist charities. FTX's new boss has said he will sue for the money.

American courts have yet to complete a significant crypto restructuring. This poses problems. Crypto has been around for 15 years, but nobody can

agree on what it is. Token swaps are recorded on virtual ledgers by software on a blockchain, which no single person controls. This does not fit with property law, which assumes people own things because the law says they do or they physically have them in hand. Stocks have certificates of ownership; chairs are sat on by their owners. In contrast, the law does not enforce crypto ledgers and recording something on a blockchain does not conjure a physical coin.

Thus even creditors that do come forward may not be fully compensated. When an exchange trading stocks goes under, customers are protected by the Uniform Commercial Code, a law that governs commercial transactions in America. FTX's terms of use explicitly disregard this law. On January 4th the judge in another crypto bankruptcy ruled that some of the customers lack ownership rights over their deposits. FTX's customers may have to wait years to find out what they will receive.

If a settlement is agreed on, depositors face a final danger. Most of FTX's recoverable value will probably be in crypto tokens. The one thing such tokens are not—lawyers and politicians agree—is currency, since money must be backed by a government. It seems that when the time comes to carve up FTX's assets, the court will have to dish out claims in dollars. This raises the question of which day's exchange rate to use. FTX's estate holds so many tokens that auctioning them could spark a fire sale, burning the tokens' market value.

Another route would be to sell accounts to a solvent exchange. That would avoid the need to squeeze cash out of tokens no one wants, but would keep debris from the worst embarrassment in crypto's history floating around for years to come—and require a buyer to be found. On January 5th American regulators intervened to stall a deal that would have seen Binance, the world's largest crypto exchange, take on \$1bn in assets from Voyager, another bankrupt firm. There is one certainty from the proceedings to come.

FTX will go down as it lived: in breathtaking chaos. ■



模糊的企业

技术重绘公司边界

企业正在数字化巨变的余波中自我重组【深度】

技术和商业密不可分。企业家利用技术进步的成果，凭借技能以及运气将其转化为可盈利的产品。反过来，技术也改变了公司的运作方式。电力出现后，由于不再需要依赖集中供应的蒸汽动力，催生了更大型、更高效的工厂；电子邮件已经取代了大部分信函。但新技术也以一种更微妙、更深刻的方式影响着商业。它们不仅改变了公司做事的方式，也改变了它们做什么——以及更关键的，不做什么。

工业革命结束了“散工制”，即企业获取原材料，但将生产外包给个体手工业者，他们在家工作，按件计酬。工厂出现后，工人直接接受雇佣、按时计酬，与工作场所之间的联系加强了。电报、电话，以及过去一个世纪里的集装箱航运和更发达的信息技术（IT）使跨国公司能够将越来越多的工作任务分包到越来越多的地方。中国成为了世界工厂；印度成为了世界后台。全球疫情爆发近三年来，技术显然正又一次深刻地重新划定企业的边界。

在富裕国家，高速宽带、Zoom或微软Teams等应用让人们在三分之一的工作日里都可以远程工作。工作岗位正从大城市的公司总部慢慢流向较小的城镇和偏远地区。与同事、自由职业者或是其他公司之间协作的界限正变得模糊。

从云计算到人力资本，企业正在更多地利用共有资源池。据一项估计，2021年美国技能型自由职业者的收入达2470亿美元，高于2018年的约1350亿美元。美国和欧洲最大的公司正在外包更多白领工作。自疫情爆发以来，六大新兴市场的商业服务出口每年增长16.5%，超过疫情前的6.5%（见图表1）。1月9日，印度IT巨头塔塔咨询服务公司（Tata Consultancy Services）报告了利润的又一轮增长。

罗纳德·科斯（Ronald Coase）在1937年发表题为《企业的性质》（The nature of the firm）的论文可以帮助我们理解这些变化。如果保持小体量，企业就无法获得规模效率。如果扩张得太大，企业就会变得尾大不掉——正如苏联式的命令与控制型经济。多数商业处于这两个极端之间。科斯的洞察为他赢得了诺贝尔经济学奖，他认为，公司的边界——什么自己做，什么不自己做——是由公司内部和公司之间的交易与信息成本差异所决定的。有些事情在公司内部完成效率最高。其余的交给市场。

例如，从1980年代至2010年代，全球化和IT的蓬勃发展促进了规模经济，推动市场集中度提高。但它们也加大了竞争压力，并降低了公司之间沟通与协作的成本。最后结果是许多公司缩小了业务范围。罗切斯特大学（University of Rochester）的洛伦兹·埃克特（Lorenz Ekerdt）和吴恺颉去年发表的一项研究发现，1977年至2017年间，美国制造商积极参与的行业的平均数量减少了一半。到2000年代，许多涉猎广泛的综合企业集团——例如曾经横跨从金属到医药等各个领域的德国德固赛（Degussa），以及尝试造车的英国宇航公司（British Aerospace）——已经自我拆解掉庞杂的业务，而聚焦于主业（这两家分别是化工和飞机）。

如今，科斯所说的决定性因素带来了一种新型的企业组织。它类似于21世纪的散工制——但不是面向手工业者，而是现代西方经济中标志性的白领专业人士。以色列人才市场Fiverr为全球的自由职业者和公司牵线搭桥，老板米夏·考夫曼（Micha Kaufman）观察到，公司已经越来越懂得如何根据劳动者的实际产出来衡量其工作表现，而不是根据工作时长。对于员工和分包商都是如此。这导致企业重新组织其内部架构，以及与经济体内其他公司的关系。

先看企业内部。根据美国就业和工资季度普查（QCEW）的数据，本刊研究了三个特别适合远程工作的行业：技术、金融和专业服务。我们发现，自疫情暴发以来，这些工作在美国各地的分布变得广泛了许多。大都市区的吸引力被较小的城市甚至乡村赶超。自2019年第四季度以来，这三个行业的就业人数在农村地区的增幅比旧金山和纽约高出六个百分点。

企业也在跨国分配更多的工作。新加坡招聘创业公司Glints的杨贺翔说，他的公司在不同国家成批招聘员工。杨贺翔解释说，这有助新招募的员工与同胞建立起人际联系，同时也扩大了Glints的人才库。时差小的地方会有更大的优势。对于Glints来说，印尼之类的国家就很理想。

美国公司通常会考虑加拿大。于1985年开设第一个加拿大办事处的微软去年在多伦多新设立了一个大型办公室。谷歌正将其加拿大员工数量增加两倍，达到5000人。房地产公司世邦魏理仕（CBRE）去年研究了美国和加拿大拥有最多科技就业者的50个城市，发现前十名中有四个是加拿大城市。这四个城市在2016年至2021年间总共增加了18万个科技工作岗位，增长39%，而前四位的美国城市仅增加了8.6万个工作岗位，增幅为8%。生活成本更低是因素之一，这四个加拿大城市位居50个城市中住房成本最低的16个之列。

哈佛商学院的普利特维拉·乔杜里（Prithwiraj Choudhury）说，移民障碍是迫使公司将目光投向海外的另一个因素。乔杜里的研究显示有一类公司在增多，它们帮助雇主在不直接雇用外国人的情况下与之建立起稳定的劳务关系。MobSquad是其一，这家公司招募无法获得美国签证的技能型工人，让他们在加拿大受雇。其美国客户包括投资公司Betterment和生物技术公司Guardant Health。

MobSquad招募的人员介于外包临时工和全职员工之间。这种安排反映出更大的科斯式转变——企业如何划分哪些任务由自己完成、哪些分包出去。

亚特兰大联储去年对近500家美国公司的一项调查发现，18%的公司使用的独立承包商比过去几年增加了，2%表示减少了。除此之外，13%的公司变得更加依赖借调员工，而1%的公司减少了这种依赖。劳动力管理公司MBO Partners估计，每周至少从事15小时独立工作的美国劳动者数量从2019年的1500万人增加到2022年的2200万。美国劳工统计局的数据较为保守，但仍显示美国自雇人员数量与2020年初相比增加了近100万人。疫情时代的失业迫使人们接受不那么理想的工作安排，但这并不能完全解释这

些变化；2007至2009年全球金融危机之后就没出现类似的自雇激增。

这种转变同样是由技术进步促成的，特别是自由职业工作平台的普及。自雇比例从2000年占全美劳动力的9%缓慢增长到2018年的11%，如今日益普遍。零工不再只是开网约车或送外卖。Taskrabbit等早期平台专注于例行常规任务，而新兴的平台则招募自由职业者从事复杂的工作。Upwork专门从事网站开发；Fiverr以媒体制作闻名。连亚马逊也找自由职业平台Tongal帮忙招募一支团队，给自己的Prime电视节目快速制作社交媒体内容。

除了方便企业借力非受雇人员以外，技术也让它们能够与其他企业更顺畅地合作。2020年，众多企业首选的即时通讯平台Slack推出了一个功能，让用户像在组织内沟通一样与外部公司联系。在《财富》排名中收入排在前100位公司中超过70%使用了这一功能。亚特兰大联储的调查发现，16%的受访公司增加了国内外包，6%扩大了离岸外包。从2019年第三季到去年同期，在印度拥有大量业务的六家大型IT服务公司——高知特（Cognizant）、HCLT、印孚瑟斯（Infosys）、塔塔咨询服务、马衡达信息技术（Tech Mahindra）和维普罗（Wipro）——的总收入已经增长了25%。

要确定公司对外部工人的依赖程度不容易——公司不会大肆宣扬这种事。为了有直观了解，两位经济学家凯蒂·文（Katie Moon）和戈登·菲利普斯（Gordon Phillips）研究了企业未来一年的对外采购承诺在其销售成本中的占比。这个“外包强度”的衡量指标只是经济的一幅快照，必须谨慎看待；它并不涵盖所有类型的外包，而且不同公司核算外部采购的方式也不尽相同。但它仍然可以展现出随着时间推移而发生的变化。

本刊利用部分美国和欧洲大型上市公司的财报数据计算了这一指标。公司对外部的依赖度确实越来越高。在我们的样本中，平均外包强度从2005年的11%增加到有数据的最近一年的22%，翻了一番。苹果和微软等科技巨头的这种增长尤其明显；发展较慢的企业，如零售巨头沃尔玛，则只出现小幅增长。这与有关研究结果一致：随着企业规模扩大和采用更多技术而

变得更加复杂和臃肿，它们就会外包更多的业务——与科斯揭示的规律完全一致。

随着技术进一步发展，公司的边界也会不断演变。公司可能会获得更大的灵活性，去找新的工人在新的地方完成新的任务。葡萄牙为数字游民创制了签证，让他们可以到该国远程工作一年。阿根廷希望为向国外销售服务的自由职业者提供优惠汇率：“科技美元”将确保他们不受比索迅速贬值的影响。

对于西方白领来说，更激烈的工作竞争可能会压缩薪酬。根据哈佛商学院的阿尔贝托·卡瓦略（Alberto Cavallo）及其同事去年发表的一篇工作论文，那些更容易被外包的职业在不同国家之间的工资差异较小。这意味着较贫穷国家工人的生活水平提高，而他们雇主的利润可能增加了。对科斯来说，这意味他的思想仍未过时。 ■



The fuzzy corporation

How technology is redrawing the boundaries of the firm

Companies are reorganising themselves in the wake of digital upheaval

TECHNOLOGY AND business are inextricably linked. Entrepreneurs harness technological advances and, with skill and luck, turn them into profitable products. Technology, in turn, changes how firms operate. Electricity enabled the creation of larger, more efficient factories, since these no longer needed to depend on a central source of steam power; email has done away with most letters. But new technologies also affect business in a subtler, more profound way. They alter not just how companies do things but also what they do—and, critically, what they don't do.

The Industrial Revolution ended the “putting-out system”, in which companies obtained raw materials but outsourced manufacturing to self-employed craftsmen who worked at home and were paid by output. Factories strengthened the tie between workers, now employed directly and paid by the hour, and workplace. The telegraph, telephone and, in the last century, containerised shipping and better information technology (IT), have allowed multinational companies to subcontract ever more tasks to ever more places. China became the world's factory; India became its back office. Nearly three years after the pandemic began, it is clear that technology is once again profoundly redrawing the boundaries of the firm.

In the rich world, fast broadband and apps like Zoom or Microsoft Teams are allowing a third of working days to be done remotely. Jobs are trickling out from big-city corporate headquarters to smaller towns and the boondocks. And the line between collaborating with a colleague, a freelance worker or another firm is blurring.

Companies are drawing on common pools of resources, from cloud computing to human capital. By one estimate, skilled freelance workers in America earned \$247bn in 2021, up from about \$135bn in 2018. The biggest firms in America and Europe are outsourcing more white-collar work. Exports of commercial services from six large emerging markets have grown by 16.5% a year since the pandemic began, up from 6.5% before it (see chart 1). On January 9th Tata Consultancy Services (TCS), an Indian IT-outsourcing giant, reported another bump in profits.

A useful lens for understanding these changes was offered by Ronald Coase in his paper from 1937 entitled “The nature of the firm”. Stay small and you forgo the efficiencies of scale. Grow too big and an enterprise gets unwieldy—think of Soviet-style command-and-control economies. Most commerce happens in between those extremes. Coase, whose insights earned him a Nobel prize in economics, argued that firms’ boundaries—what to do and what not to do yourself—are determined by how transaction and information costs differ within firms and between them. Some things are done most efficiently in-house. The market takes care of the rest.

For example, between the 1980s and the 2010s, globalisation and the IT boom boosted economies of scale, which encouraged market concentration. But they also increased competitive pressures and cut the cost of communication and collaboration between firms. The net result was for many companies to shrink their scopes. In research published last year Lorenz Ekerdt and Kai-Jie Wu of the University of Rochester found that the average number of sectors in which American manufacturers were active fell by half between 1977 and 2017. By the 2000s many sprawling industrial conglomerates like Germany’s Degussa, which had a hand in everything from metals to medicine, or British Aerospace, which was poking at cars, had untangled themselves and picked the knitting to stick to (chemicals and aircraft, respectively).

Today Coasean forces are ushering in a new type of corporate organisation. It resembles a 21st-century putting-out system—not for artisan craftsmen but for the white-collar professionals who epitomise modern Western economies. Micha Kaufman, boss of Fiverr, an Israeli marketplace which matches freelances with business around the world, observes that firms are getting better at measuring workers' performance based on their actual output rather than time spent producing it. This is true both of employees and subcontractors. The result is a reorganisation of businesses both internally, and in relation to other companies in the economy.

Start on the inside. Using data from America's Quarterly Census of Employment and Wages, The Economist has examined jobs in three sectors particularly compatible with remote work: technology, finance and professional services. We find that such jobs have become far more distributed across America since the pandemic. Big metropolitan areas have lost out to smaller cities and even the countryside. Since the fourth quarter of 2019, the number of jobs in the three sectors has grown by six percentage points more in rural areas than in San Francisco and New York.

Firms are also distributing more work across borders. Oswald Yeo, who runs Glints, a recruiting startup in Singapore, says his firm hires employees in batches by country. That helps the new recruits to form in-person bonds with compatriots, while expanding Glints's talent pool, Mr Yeo explains. There is a premium for places with a small time difference. In Glints's case, that is countries like Indonesia.

For American firms, it is often Canada. Microsoft, which opened its first Canadian office in 1985, created a big new one in Toronto in 2022. Google is tripling its Canadian workforce to 5,000. A study last year by CBRE, a property firm, of the 50 cities in America and Canada with the most tech workers found that four of the top ten were Canadian. Together, the four added 180,000 tech jobs between 2016 and 2021, an increase of 39%, while

the top four American cities gained just 86,000 jobs, or 8%. Lower living costs help; the Canadian quartet were among the 16 cheapest cities in the group in terms of housing.

Barriers to immigration are another factor forcing firms to look abroad, says Prithwiraj Choudhury of Harvard Business School. Mr Choudhury has documented a growing class of firms that help employers forge stable relationships with foreign employees without hiring them directly. One example is MobSquad, a firm that enlists skilled workers unable to obtain visas to America and employs them in Canada instead. Its American clients include Betterment, an investment firm, and Guardant Health, a biotechnology company.

MobSquad's recruits sit somewhere between outsourced temps and full-time employees. This sort of arrangement points to the bigger Coasean shift—to how firms demarcate which tasks they perform on their own account and which they subcontract.

A survey of nearly 500 American firms by the Federal Reserve Bank of Atlanta last year found that 18% were using more independent contractors than in previous years; 2% said they used fewer. On top of that, 13% relied more on leased workers, compared with 1% who reduced this reliance. MBO Partners, a workforce-management firm, estimates that the number of American workers engaged in independent work for at least 15 hours a week increased from 15m in 2019 to 22m in 2022. Figures from the Bureau of Labour Statistics are more conservative, but still show that nearly 1m more Americans are self-employed than at the start of 2020. Pandemic-era job losses forcing people into less desirable work arrangements cannot be the whole story; a similar surge in self-employment did not occur after the global financial crisis of 2007-09.

The shift is again made possible by technology, notably the spread of

platforms for freelance work. Having grown slowly, from 9% of America's labour force in 2000 to 11% in 2018, self-employment is becoming more common. Gig work is no longer just about ride-hailing or food delivery. Whereas earlier platforms, such as Taskrabbit, focused on routine tasks, emerging new ones recruit freelances for complicated work. Upwork specialises in web development; Fiverr is known for media production. Amazon turned to Tongal, another freelancing platform, when it needed a team to rapidly produce social-media content for its Prime TV shows.

Besides making it easier to tap non-employees, technology is enabling companies to collaborate more seamlessly with other businesses. In 2020 Slack, the messaging platform of choice in many a workplace, launched a feature that lets users communicate with outside firms as they would within their own organisations. More than 70% of the Fortune 100 list of America's biggest firms by revenue use the feature. The Atlanta Fed's survey found that 16% of responding firms had increased domestic outsourcing and 6% had offshored more. Already, combined revenues for six big IT-services firms with large operations in India—Cognizant, HCLT, Infosys, TCS, Tech Mahindra and Wipro—grew by 25% between the third quarter of 2019 and the same period last year.

Pinning down just how much firms depend on outsiders is tricky—companies do not advertise this sort of thing. To get an idea, Katie Moon and Gordon Phillips, two economists, look at a firm's external purchase commitments in the upcoming year as a share of its cost of sales. As a snapshot of the economy, this measure of "outsourcing intensity" must be treated with caution; it does not capture all types of outsourcing and different firms account for external purchases in different ways. But it usefully illustrates changes over time.

The Economist has calculated the measure using data from financial reports for a sample of large listed firms in America and Europe. They are indeed

growing more reliant on others. Average outsourcing intensity in our sample has doubled from 11% in 2005 to 22% in the most recent year of data. This growth is especially pronounced among tech titans such as Apple and Microsoft; businesses that grew more slowly, such as Walmart, a retailing giant, saw small increases. This is consistent with research which finds that as firms grow larger and adopt more technologies, thus becoming more complex and unwieldy, they outsource more operations—precisely as Coase would have predicted.

As technology evolves further, so will the contours of the firm. Companies may gain more flexibility to seek out new workers for new tasks in new places. Portugal has created a visa for digital nomads, who will be able to work from the country for a year. Argentina wants to introduce a preferential exchange rate for freelance workers selling their services abroad: the “tech dollar” would ensure that they were not exposed to the rapidly devaluing peso.

For Western white-collar types, stiffer competition for jobs may compress pay. According to a working paper published last year, by Alberto Cavallo of Harvard Business School and colleagues, wages differ less between countries for occupations that are more prone to outsourcing. That means higher living standards for workers in poorer countries and, possibly higher profits for their employers. And for Coase, it means continued relevance. ■



经济学人视频

商业界如何运用元宇宙？（上）

元宇宙已经为影视行业的创作开辟了全新的领域。



The Economist Film

How will business use the metaverse? Part 1

The metaverse is already opening up new frontiers for creativity in the film and television industry.



认证图像

证明图片是假的是一回事。证明它不假又是另一回事

但是，这对于报道战争罪行很重要

早就有这样的警句，“战争来临时，首先倒下的是真相”。最新的例证便是，目前发生在乌克兰和叙利亚的战争中出现了大量无中生有的图像和视频。其中一些是彻头彻尾的造假。另一些则是对真实拍摄的素材做了篡改。去年就出现过一段乌克兰总统泽连斯基貌似命令乌克兰士兵投降的假视频。

然而，这类虚假影像的泛滥还导向了第二种更隐秘的“用图像撒谎”的行径。利用它们已经无处不在这一点，可以让人们对那些会给一些人带来麻烦的真实照片也心生怀疑。

例如，去年俄罗斯入侵乌克兰之后不久，美联社发布的一段视频显示，医生没能救活一名在马里乌波尔（Mariupol）炮击中受伤的小女孩。这段视频很快被打上“虚假”的标记，出现在俄罗斯的电视节目中。由于很难反过来证实真实可靠（例如素材未经篡改），这样的证据可能因此受到质疑，甚至在法庭上可能也是如此，结果就是基于这些证据的犯罪指控可能无法成立。

因此，能证实数字影像真实性的方法会很有价值。现在已经有了一个。“镜对镜”（glass-to-glass）警示系统创建了专门的软件“生态系统”。在该系统中拍摄、存储和传输的图片和视频会向观看者发出关于内容已被更改的提醒，无论这些更改是在何时何地进入一则影像从镜头到屏幕的过程中。

位于伦敦的慈善机构eyeWitness to Atrocities开发了这样一个系统。作为系统核心的应用有两个功能。首先，当安装有该应用的手机拍摄照片或视频时，它会记录下事件发生的时间和地点，而这些时间和地点是由GPS卫星、附近的手机基站和Wi-Fi网络等难以否认的“电子证人”报告的。这被

称为元数据的受控捕获，它比从手机上收集这类元数据更可靠，因为手机时间和位置的设置是可以更改的。

第二，该应用读取图像的整个数字序列（用0和1呈现），并使用标准数学公式计算出该图像独有的由字母和数字组成的数值，即哈希值。这些全部完成后，该应用将元数据和哈希值写入一个与图像分开存放的叫作证据包的文件中，并将图像及其证据包的加密副本发送到一个专用服务器。

eyeWitness的负责人温迪·贝茨（Wendy Betts）形容这个服务器是一个数字证据库。如果需要验证图像的真实性，只要重新扫描其数字序列，重新计算其哈希值，然后查询数据库是否包含相同的哈希值就可以了。即使图像的单个像素被更改，重新计算出的哈希值也会与原始数值不一致。如果确实一致，则表明图像没有被改动过。

作为一项附加服务，每周大约有80名律师无偿为该慈善机构工作几个小时，检查传入的图像。他们将那些看上去记录了暴行的图像汇总，然后送到欧洲刑警组织（欧盟的执法机构）、国际刑事法院（International Criminal Court）和乌克兰总检察长办公室（Ukraine's Office of the Prosecutor-General）等检察机关。

乌克兰总检察长安德烈·科斯廷（Andriy Kostin）自己就是eyeWitness系统的爱好者，这不仅仅是因为该系统为法庭所要求的真实性提供了保障。他青睐该系统，还因为它有助于克服自己工作中的另一个障碍，即证人们都担心自己被发现。

在乌克兰被俄罗斯占领的地区，取证有很大风险。例如，如果把守检查站的俄罗斯士兵发现某人的手机上有本人收集的战争罪行的视频证据，那么后果可能会很严重。为了降低这种情况发生的可能性，该应用的图标没有显示自己的用途。而且，如果之后负责调查的官员点击该应用，并输入了错误的密码，就会打开正常的手机相册。基辅人权组织Truth Hounds的首席调查员马林娜·斯洛博迪纽克（Maryna Slobodianiuk）谈到自己通过eyeWitness收集到的袭击证据时说，“即使我被抓……也没人能拿到它。”

eyeWitness系统的第一版（免费使用）发布于2015年，所以它的大多数漏洞都已经修复。过去的一年中它在乌克兰的使用量飙升。贝茨表示，2022年她的团队收到的四万份被认为对调查有价值的材料中，有2.7万多份来自乌克兰。

该系统尤其受到警察和新闻工作者的欢迎。基辅一家智库乌克兰医疗事务研究中心（Ukrainian Healthcare Centre）的分析师也是其拥趸，他们用它来收集医疗设施遇袭的证据。

eyeWitness并不是唯一一家提供“镜到镜”服务的公司。位于纽约州瓦尔哈拉（Valhalla）的Guardian Project发布了一款名为ProofMode的智能手机应用。和eyeWitness一样，ProofMode将受控捕获的元数据和图像的哈希值一起放到一个证据包中。但ProofMode没有自己运营接收服务器，而是使用由其他公司（如谷歌）运营的存储库，这些存储库以公证人的方式记录那些元数据和哈希值。观看者可以将使用ProofMode拍摄的图像上传到Guardian Project网站，该网站会重新计算其哈希值，并检查与存储库中的哈希值是否一致。如果不一致，则表明图像已被更改。

不久后，Guardian Project还将添加一个新功能“同步”。它将把图像的拍摄位置和时间与在线世界地图OpenStreetMap，以及过去几年对全球天气状况的详细地理记录（具体使用哪一个气候数据库还有待决定）关联起来。如果某人声称的照片拍摄地点和时间与当天当地的景观和天气状况不相符，就很容易被检查出来。这个想法是要将“图像与当时的现实世界同步”，Guardian Project的创始人内森·弗雷塔斯（Nathan Freitas）表示。他希望还能与其他数据库关联起来，包括那些记录街头抗议发生的时间和地点的数据库。

第三家运营商是位于加州拉荷亚（La Jolla）的Truepic，它采取了更加商业化的经营方式。慈善机构可以免费使用其软件，但如果是企业用它来监视供应链、建筑工地进度、贷款条约遵守情况以及昂贵设备的去向和状况等事务，则必须付费。

Truepic提供两种服务。一种是扫描智能手机，寻找用来帮助伪造元数据的恶意软件。另一种是识别所谓的“重播攻击”，即给经篡改的图像拍照以创建新图像，这样其代码中就没有了篡改痕迹。现任Truepic公共事务主管的穆尼尔·易卜拉欣（Mounir Ibrahim）曾是美国外交使团的成员（他供职过的地方包括大马士革，那里是假图像的温床），他对Truepic如何实现这一功能讳莫如深。但他指出，诀窍在于检查一张图像的所有像素点是否记录了一个平整的平面。

2021年，Truepic联合Adobe、安谋（ARM）、BBC、英特尔和微软成立了内容来源和真实性联盟（Content Provenance and Authenticity，简称C2PA）。此举是要为硬件和软件制造商创建一套图像认证的技术标准。这样就不用大费周章地使用专用应用。该联盟希望这能让元数据捕获、哈希计算和数据到存储库的传输都在幕后完成，并且不需要使用费。

如果C2PA的标准被广泛采用，即使网络浏览器也能检查在线的哈希值存储库，并对不一致的图像发出提醒。最终，哈希值可能会自动分布到区块链分类账上。位于斯坦福大学的Starling Lab正在对一个这样的系统进行试验。

然而障碍依然存在。Starling Lab的创始主管乔纳森·多坦（Jonathan Dotan）特别指出了一点。这项技术可能会让威权政府得以识别那些拍摄了对自己不利的照片的设备，进而追查到拍摄者。他指出，研究人员必须首先找到一种方法，让这样的追踪无法进行。有透明度固然是好事，但即使好人也承认，有时候，透明度太高未必是好事。■



Authenticating images

Proving a photo is fake is one thing. Proving it isn't is another

But, for the reporting of war crimes, it matters

THAT TRUTH is the first casualty of war is an old aphorism. One recent instance is the proliferation of images and videos of things that did not happen, in wars such as those currently going on in Ukraine and Syria. Some of these are outright fakes. Others are manipulated versions of honestly recorded material. Last year a doctored video appeared of Ukraine's president, Volodymyr Zelensky, apparently telling Ukrainian soldiers to surrender.

The proliferation of such fakes has, though, led to a second, more subtle approach to lying with images. This is to use their ubiquity to cast doubt on the veracity of inconvenient pictures that are real.

Shortly after Russia invaded Ukraine last year, for example, the Associated Press released a video of doctors failing to revive a young girl who had been hit in the shelling of Mariupol. The footage soon appeared on Russian television with the word "fake" stamped on it. Since it is hard to prove a negative (ie, that material has not been doctored), such evidence may thus be challenged, possibly even in court, and allegations of crimes based on that evidence may, as a result, not stick.

Ways to establish the authenticity of digital imagery would therefore be valuable. And one is now available. "Glass-to-glass" warning systems create special software "ecosystems" within which pictures and video can be taken, stored and transmitted in a way that alerts viewers to alterations, no matter when and where those changes are introduced in an image's journey from lens to screen.

One such system has been developed by eyeWitness to Atrocities, a charity based in London. The app at its core does two things. First, when a photo or video is taken by a phone fitted with that app, it records the time and location of the event, as reported by hard-to-denial electronic witnesses such as GPS satellites and nearby mobile-phone towers and Wi-Fi networks. This is known as the controlled capture of metadata, and is more secure than collecting such metadata from the phone itself, because a phone's time and location settings can be changed.

Second, the app reads the image's entire digital sequence (the zeros and ones which represent it) and uses a standard mathematical formula to calculate an alphanumeric value, known as a hash, unique to that picture. All this done, it then puts the metadata and the hash into a file called a proof bundle that is separate from the image and sends an encrypted copy of the image and its proof bundle to a special server.

Wendy Betts, director of eyeWitness to Atrocities, describes this server as a digital evidence locker. If an image's authenticity needs to be verified, it suffices to rescan its digital sequence, recalculate its hash, and then ask the repository whether or not it contains an identical hash. If even a single pixel of the image has been altered, the recalculated hash will not match the original. If it does match, then the image has not been retouched.

As an additional service, roughly 80 lawyers, each working for the charity without pay for a few hours a week, review the incoming images. They package those which seem to record abuses into dossiers that are then sent to prosecuting authorities including Europol (a law-enforcement agency of the European Union), the International Criminal Court and Ukraine's Office of the Prosecutor-General.

Andriy Kostin, the prosecutor-general himself, is a fan of the eyeWitness system—and not just because it provides the security of authenticity that

courts require. He also likes the fact that it helps overcome a second obstacle to his efforts: witnesses' fear of being found out.

In areas of Ukraine that are occupied by Russia, this is a serious risk. Were soldiers manning a checkpoint, for example, to discover on someone's phone video evidence collected by that person of war crimes, the consequences could be severe. To make this less likely to happen, the app's icon does not reveal its purpose. Moreover, if it is then tapped by a probing official and an incorrect passcode entered, that opens the phone's normal photo gallery. Maryna Slobodianuk, lead investigator at Truth Hounds, a human-rights group in Kyiv, says of the evidence of attacks she has collected using eyeWitness: "Even if I will be captured...no one will reach it."

The first version of eyeWitness's system, available gratis, was released in 2015, so most of the bugs have been dealt with. Uptake in Ukraine has soared over the past year. Ms Betts says that of the 40,000 submissions received in 2022 which her team considers relevant for investigations, more than 27,000 were sent from Ukraine.

Police officers and journalists are particularly eager users. So are analysts at the Ukrainian Healthcare Centre, a think-tank in Kyiv that employs the app to gather evidence of attacks on medical facilities.

Nor is eyeWitness the only provider of glass-to-glass services. The Guardian Project, in Valhalla, New York, has released a smartphone app called ProofMode. Like eyeWitness, ProofMode combines controlled-capture metadata and the image's hash into a proof bundle. Instead of operating the receiving server itself, though, ProofMode uses repositories run by other firms, such as Google, which log them in the fashion of a notary. Viewers of an image taken with ProofMode can upload it to a Guardian Project website that recalculates its hash and checks the repositories for a match. If it fails to find one, the image is declared altered.

Soon, the Guardian Project will add a new feature, Synchrony. This will link an image's location and time-of-capture to OpenStreetMap, an online cartography of the world, and also to a detailed geographical record of the world's weather over the past few years (which one, has yet to be decided). That will make it easy to check for inconsistencies between the place and time someone claims a picture was taken, and the local landscape and the weather conditions on that day. The idea, says Nathan Freitas, the Guardian Project's founder, is to "sync images to the real world as it was". He hopes to link to other databases, as well—including those that record when and where street protests have happened.

A third operator, Truepic, of La Jolla, California, is taking a more commercial approach. Charities pay nothing to use its software, but companies that employ it to keep an eye on things like supply chains, progress at construction sites, compliance with loan terms, and the whereabouts and condition of expensive kit, must stump up.

Truepic provides two services. One scans smartphones for malware designed to facilitate the falsification of metadata. The other spots so-called rebroadcasting attacks, in which a doctored image is photographed to create a new picture, which thereby lacks traces of tampering in its code. Mounir Ibrahim, once a member of America's diplomatic corps (he served, *inter alia*, in Damascus, a hotbed of photographic deception), and now head of public affairs at Truepic, is cagey about how this is done. But the trick, he notes, is to look for clues that all of an image's pixels have recorded a uniformly flat surface.

In 2021 Truepic joined forces with Adobe, ARM, the BBC, Intel and Microsoft to form the Coalition for Content Provenance and Authenticity (C2PA). This is trying to create a set of image-authentication technological standards for makers of hardware and software. The aim is to eliminate the need to fuss with special apps. Instead, the coalition wants metadata capture, hashing

and the transmission of data to repositories to take place behind the scenes and without royalties.

If C2PA's standards were widely adopted, even web browsers would be able to check an online repository of hashes and put a warning on images with no match. Eventually, hashes might be distributed automatically across blockchain ledgers. The Starling Lab, based at Stanford University, is running trials of such a system.

Hurdles, however, remain. Jonathan Dotan, the Starling Lab's founding director, points to one in particular. The technology could potentially allow authoritarian regimes to identify devices, and thus people, who have taken damning pictures. Researchers, he says, must first find a way to make such tracing impossible. Transparency is all very well, but even the good guys recognise that, sometimes, too much of it can be too much of a good thing.





自由交流

历史留给产业政策新时代的警示

危险不在于美国的“回流”措施失败——而在于它成功

“自由贸易几乎已死。”去年12月，在台积电位于亚利桑那州的新圆晶厂举行的一场建设里程碑庆典中，创始人张忠谋泼了大家一盆冷水。他说这话倒也不奇怪。7月，他曾说美国把芯片制造带回家的努力是“徒劳”。还在不久前，富裕国家的政府大多持同样的看法。但在一个焦虑不安的世界中，对供应链安全的担忧促使人们实验一回。历史给出了一些乐观的理由——还有许多忧虑的理由。

产业政策差不多和产业本身一样古老。英国工业革命伊始，美国第一任财政部长亚历山大·汉密尔顿就主张保护本国工业，宣称亚当·斯密支持自由贸易的论点“虽在‘几何学上正确’但‘实践上错误’”。美国、法国和德国在关税壁垒下实现了工业化。二战后，许多政府都试图推动工业化进程，在日本和韩国等地似乎取得了成功，但在其他地方却出现了相当不同的结果。今天的政策是另一类：由已经处于技术前沿的国家在一个充满了复杂全球供应链的世界中奉行。但过去的研究仍提供了宝贵的经验教训。

近年的政府干预主要基于“婴儿产业”论点。其想法是，如果国家纠正某种市场失灵，特定的行业有可能在一个它才刚刚冒头或尚不存在的经济体中实现独立发展。本地公司可能需要投资于专有技术或设备以提高竞争力，而不完善的资本市场无法为其提供所需的资金。或者，生产可能需要有一个供应商和制造商的网络，但企业彼此之间难以协调。或者可能存在信息问题。一个经济体可能具有尚未被发掘的潜力，但探寻这种潜力的企业家有可能把它暴露给竞争对手，从而使自己失去了从这种发现中获利的机会。在上述每一种情况下，政府支持或针对外国竞争的短暂保护（或两者兼而有之）都可能创造行业走向成熟所需的空间。

要弄清楚这些理论在实践中是否也成立还是只在几何中成立并非易事。产

业政策从来都不是孤立实施的，这意味着往往难以分离出其影响。尽管如此，细致的研究表明，婴儿产业政策在现实世界中是可行的。例如，上世纪70年代，美国是计算机芯片的主导出口国。日本政府大力投资于半导体研发，有可能帮助了消费芯片的日本公司协调以从羽翼未丰的日本生产商那里获得大部分供应（实际结果就是把美国公司拒之门外）。日内瓦高等学院（Graduate Institute in Geneva）的理查德·鲍德温（Richard Baldwin）和纽约城市大学的保罗·克鲁格曼（Paul Krugman）的研究得出结论称，这些政策支持了专业知识的积累，没有这一点，日本公司永远不可能在出口市场取得成功。

更近些时候，哈佛大学的米尔托·卡洛佩克奇迪（Myrto Kalouptsidi）的研究揭示，2006年至2012年间，中国的造船厂补贴使成本降低了20%之多。她认为这些补贴促成了造船业的一次重大洗牌，而日本是最大的输家。其他研究发现了更多干预措施帮助行业在市场中立足并对全球生产分布产生重大影响的案例。至少有些时候，比较优势是可以被策划构建出来的。

但历史也给出了大量警示。干预往往会增加成本，从而伤害消费者。鲍德温和克鲁格曼判断，打造芯片出口产业的努力最终让日本人遭受了损失。由于一个行业的输出通常是另一个行业的输入，对上游生产商的帮助可能使得疼痛在供应链上蔓延。俄勒冈大学的布鲁斯·布洛尼根（Bruce Blonigen）回顾了21个国家为发展钢铁产业所做的努力，发现此类干预措施大幅削弱了下游行业的出口竞争力。

就政府而言，它们必须愿意切断助力，让赢家独立成长并让输家出局。否则僵尸企业将占用资本和劳动力，拖累增长。本地条件很重要。华威大学的萨沙·贝克（Sascha Becker）和苏黎世联邦理工学院的彼得·埃格（Peter Egger）和马克西米利安·冯埃利克（Maximilian von Ehrlich）对欧盟向较贫困地区提供的投资基金的研究发现，现金转化为了投资和收入的加速增长——但仅限于那些拥有强有力的制度和受过教育的工人的地区。

而且，正如世界正在又一次见证的那样，疏忽鲁莽的政策会招致报复，最

终让所有人的境况都变得更糟。当复杂商品由跨境的供应链生产时，这尤其可能成为一个问题。如果友好国家彼此未能协调行动，它们最终可能会资助重复性的工厂（这不可能都符合经济效益），或者资助了那些无法获得竞争所需的外国组件的孤儿产业。

那些能填补制度空白的政策会更安全。达特茅斯学院的道格拉斯·欧文（Douglas Irwin）指出，美国在19世纪实施的关税似乎并不是促成其崛起为工业主导国的决定性因素。促进了储蓄和投资的银行法更为重要。加州大学伯克利分校的安·哈里森（Ann Harrison）和安德烈斯·罗德里格斯-克莱尔（Andrés Rodríguez-Clare）的调查质疑扭曲市场价格的“硬”干预措施对解决协调失灵真的有用，但发现企业和国家间的“软”合作扮演了重要角色。

这并不意味着美国政策组合中“较硬”的部分会毁掉其回流事业。张忠谋在12月坚称，他发表那些讲话时“满怀期待我们将取得成功”。的确，最紧迫的担忧可能不是美国的策略会失败，而是它会成功提振本国工业——并让一个支离破碎的世界境况更糟。 ■



Free exchange

Warnings from history for a new era of industrial policy

The danger is not that America's reshoring push fails—but that it succeeds

"FREE TRADE is almost dead," declared Morris Chang, the founder of TSMC, dampening the mood at an event in December to celebrate a milestone in the building of the Taiwanese chipmaker's new fab in Arizona. The remark was not out of character. In July he called America's effort to bring chipmaking home an "exercise in futility". Until recently, rich-world governments mostly shared his judgment. But worries about supply-chain security in a fraught world are prompting experimentation. History provides some reasons for optimism—as well as many for concern.

Industrial policy is just about as old as industry itself. Scarcely had Britain's Industrial Revolution got going when Alexander Hamilton, America's first Treasury secretary, argued for protection of his country's industry, declaring that Adam Smith's arguments in favour of free trade "though 'geometrically true' are 'practically false'". America, France and Germany industrialised behind tariff barriers. After the second world war scores of governments tried to help industrialisation along, with seeming success in places like Japan and South Korea, and rather different results elsewhere. Policy today is of a different sort: pursued by countries already at the technological frontier, in a world of complex global supply chains. Yet past research still holds valuable lessons.

Recent interventions are mostly based on "infant-industry" arguments. The idea is that, if the state corrects a market failure, a particular industry might thrive on its own in an economy where it is nascent or absent. Local firms might need investment in know-how or equipment to be competitive, which imperfect capital markets cannot finance. Alternatively, production

might require a network of suppliers and manufacturers, but firms struggle to co-ordinate. Or there may be information problems. An economy might have undiscovered potential, but an entrepreneur who seeks it out risks revealing it to competitors, which costs him the opportunity to profit from his discovery. In each case, government support or a brief spell of protection from foreign competition (or both) might create the space the industry needs to mature.

Working out if these theories are practically or merely geometrically true is no simple task. Industrial policy is never conducted in isolation, meaning it is often challenging to isolate its effects. Still, careful work suggests that infant-industry policy can work in the real world. In the 1970s, for instance, America was the dominant exporter of computer chips. The Japanese government invested heavily in semiconductor research, and may have helped chip-consuming Japanese firms co-ordinate to obtain most of their supply from fledgling Japanese producers (in effect shutting American firms out of the market). Work by Richard Baldwin of the Graduate Institute in Geneva and Paul Krugman of the City University of New York concluded that these policies supported the accumulation of expertise, without which Japanese firms could never have succeeded in export markets.

More recent work by Myrto Kalouptsidi of Harvard University revealed that Chinese shipyard subsidies between 2006 and 2012 reduced costs by as much as 20%. These subsidies, she reckons, helped account for a major reallocation of shipbuilding, with Japan the big loser. Other research turns up more cases when interventions have helped industries secure a market foothold, and meaningfully influenced the global distribution of production. At least sometimes, comparative advantage can be engineered.

Yet an abundance of caution is in order. Interventions often raise costs and thus hurt consumers. Messrs Baldwin and Krugman judged the Japanese were made worse off, on net, by the effort to build a chip-exporting industry.

Because the output of one industry is often the input for another, help for upstream producers can inflict pain further along the supply chain. Reviewing efforts to boost steel industries across 21 countries, Bruce Blonigen of the University of Oregon found such interventions sharply cut the export competitiveness of downstream industries.

Governments, for their part, must be willing to cut off help, so that winners eventually swim while losers sink. Otherwise zombie firms will tie up capital and labour, and drag down growth. Local conditions matter. A study of EU investment funds provided to poorer regions, by Sascha Becker of the University of Warwick and Peter Egger and Maximilian von Ehrlich of ETH Zurich, found that the cash translated into faster growth in investment and income—but only in places with strong institutions and educated workers.

And as the world is rediscovering, careless policy can provoke retaliation, leaving everyone worse off. This may prove to be a particular problem at a time when sophisticated goods are produced along cross-border supply chains. If friendly countries fail to co-ordinate, they may end up funding duplicative plants, which cannot all be economical, or orphan industries without access to the foreign components they need to compete.

Policies which fill institutional gaps are safer. Douglas Irwin of Dartmouth College notes that America's tariffs in the 19th century do not seem to have been decisive in promoting its rise to industrial dominance. Banking laws that facilitated saving and investment were more important. In their survey, Ann Harrison and Andrés Rodríguez-Clare of the University of California, Berkeley, doubt that “hard” interventions which distort market prices are of use, but find an important role for “soft” collaborations between firms and the state, to solve co-ordination failures.

This does not mean that the “harder” parts of America’s policy mix will doom its reshoring enterprise. Mr Chang, for his part, insisted in December

that he gave his remarks “in the full expectation that we are going to have success”. Indeed, the most pressing concern may be less that America’s gambit will fail, than that it will succeed in boosting domestic industry—and leave a fractured world worse off for it. ■



梧桐

美元可能会让投资者吓一大跳

几乎人人都认为美元会走弱

货币是我们的，麻烦是你们的。美国前财长约翰·康纳利（John Connally）在1971年向欧洲领导人如此描述美元。这话很贴切。他的老板理查德·尼克松停止了美元兑付黄金，并要求改变1944年在布雷顿森林建立的汇率体系。其他国家被告知要让自己的货币走强，不然就要面对美国的贸易限制。各国很快就予以配合。到那年年底，《史密森协定》（Smithsonian Agreement）让美元兑其他主要货币的汇率贬值了约十分之一。

今天的汇率大多是浮动的，由市场而非紧急会谈决定。不过走弱的美元再一次让人们松了口气。去年9月，衡量美元兑其他货币强弱的美元指数（DXY）达到了20年来的最高点（见图表）。日元一路下跌；英镑一度看起来要落到与美元平价的水平；欧元则几次短暂地低于美元。自那以后，美元开始走弱：按美元指数衡量，它现在比此前高点低10%。

强势的美元会造成无尽的麻烦。贫穷国家通常以美元借债。当美元走强，这些债务就会变得更加沉重。即使是在政府通常以本国货币发债的富裕国家，强势的美元也会让公司借款人捉襟见肘。经济学家马泰奥·马吉奥利（Matteo Maggiori）、布伦特·内曼（Brent Neiman）和杰西·施雷格（Jesse Schreger）在2020年所做的分析显示，在澳大利亚、加拿大和新西兰，超过90%由外国人持有的公司债券都是以外币计价的，主要是美元。

遭遇麻烦的不只有债务人。大宗商品以美元报价，当美元走强，价格就变得更贵。美国出口商的竞争力减弱，因为他们的产品对外国人来说更贵了。持有海外资产的美国投资者的回报缩水。这就有充分的理由为美元的回撤欢呼了。

不幸的是，人们也许只能暂时松一口气。要知道原因，想想美元近期强势

的由来。一是货币政策。整个2022年，美联储的加息幅度和速度都高于其他央行。这让美元成了“套利交易”的极好目标：卖出低收益货币，买入高收益货币，把利差收入囊中。第二个源头是恐慌。俄罗斯入侵乌克兰、中国不可持续的“清零”政策，还有世界经济濒临衰退，都推高了市场的焦虑情绪。在焦虑不安的时期，投资者往往会追捧他们认为安全的美国资产。第三个源头是美国经济。能源价格高企而美国又是能源出口国，这在一定程度上让美国的经济形势看起来强于大多数其他国家。

确实，美联储的紧缩政策在放缓，美联储官员预计利率会在今年见顶。但是，他们预计顶部在5%以上，高于投资者的预期，而且将在顶部停留较人们预期更长的时间才会被降下来。如果市场接受了美联储的展望，套利交易可能还会持续下去。恐慌交易可能也是如此，它取决于难以预测的战争走势。

即便是美国陷入衰退可能也不会削弱美元。美元在美国经济向上攀升和走下坡时往往都会保持强势，货币交易员管这种现象叫“美元微笑”。如果美国增长乏力，全球经济很可能也境况不佳，从而增强美元作为避险资产的吸引力。

不过美元将会走强的最佳论据是投资者坚信它不会走强。在美国银行（Bank of America）最近对基金经理的调查中，认为美元会走弱的比例接近历史最高点。在数据供应商彭博调查的预测机构中，对美元的中位预测认为它今年兑其他所有主要货币都会走软，之后会继续下跌。

每天有约6.6万亿美元与其他货币交易，很难想象当中至少还有一部分赌注尚未押下。押下的赌注越多，美元上涨的潜力就越大。就在《史密森协议》达成不久，投机者迫使美元进一步贬值，让货币市场重新陷入混乱，最终让布雷顿森林体系完全崩溃。如今，如果美元被推向另一个方向，最大的痛楚将来袭。投资者可能要大吃一惊。 ■



Buttonwood

The dollar could bring investors a nasty surprise

Virtually everyone thinks the greenback will weaken

OUR CURRENCY, your problem. That is how John Connally, America's Treasury secretary, described the dollar to European leaders in 1971. The phrasing was apt. His boss, Richard Nixon, had suspended the convertibility of the dollar into gold and demanded a change to the exchange-rate system established at Bretton Woods in 1944. Other countries were told to strengthen their currencies, or America would subject them to trade restrictions. Compliance followed in short order. By the end of the year, the Smithsonian Agreement had devalued the dollar by around a tenth against key foreign currencies.

Today's exchange rates are mostly floating, set by the market rather than at crunch talks. Yet once again a weaker dollar is prompting sighs of relief. Last September the DXY, a gauge of the dollar's strength against other currencies, was at its highest in 20 years (see chart). The yen had tumbled; the pound at one point looked like it was racing towards parity with the dollar; the euro spent a few brief spells below it. Since then, the greenback has weakened: measured by the DXY, it is now 10% below its recent peak.

A mighty dollar causes no end of problems. Poorer countries tend to borrow in the currency. When it strengthens, these debts become heftier. Even in rich countries, where governments mostly issue debt in their own currency, a stronger dollar squeezes corporate borrowers. Analysis in 2020 by Matteo Maggiori, Brent Neiman and Jesse Schreger, three economists, showed that in Australia, Canada and New Zealand more than 90% of corporate bonds held by foreigners were denominated in outside currencies, typically dollars.

It is not only debtors that suffer. Commodity prices are quoted in dollars; when the currency strengthens they get dearer. American exporters become less competitive, as their products are more expensive for foreigners. American investors with overseas assets have their returns eaten away. Good reason, then, for the cheering at the greenback's retreat.

Unfortunately, the relief may be temporary. To see why, consider the sources of the dollar's recent strength. One is monetary policy. Throughout 2022, America's Federal Reserve raised rates higher and faster than other central banks. This made the dollar a good target for a "carry trade": selling a low-yielding currency to buy a high-yielding one and pocketing the difference. A second source is fear. Russia's invasion of Ukraine, China's unsustainable "zero-covid" policy and the teetering of the global economy towards recession all ratcheted up markets' anxiety levels. In anxious times investors tend to reach for the perceived safety of American assets. A final source is America's economy. In part because of higher energy prices and the country's status as an energy exporter, it seems in better shape than much of the rest of the world's.

True, the pace of the Fed's tightening is slowing, and its governors expect rates to peak this year. But they expect that peak to be higher than investors do, at above 5%, and that it will be maintained longer before being cut. Were the market to accept the central bank's view, the carry trade might yet have another leg. So may the fear trade, which is dependent on the progress of an unpredictable war.

Even an American recession may not dent the dollar. The greenback tends to do well both when America's economy is motoring ahead and when it falls into a downturn, a phenomenon currency traders call the "dollar smile". If American growth is sputtering, the global economy is likely to be in jeopardy as well, enhancing the appeal of dollar assets as havens.

Yet the best argument that the dollar will strengthen is investors' conviction that it won't. In Bank of America's recent survey of fund managers, a near-record proportion thought that the greenback would weaken. Among forecasters surveyed by Bloomberg, a data provider, the median projection is for the dollar to fall against every other major currency this year, and to continue to drop after that.

With some \$6.6trn traded against other currencies every day, it is difficult to imagine that at least some of these bets have not already been placed. The more that have, the greater the potential for a rise. Shortly after the Smithsonian Agreement was struck, speculators threw currency markets back into chaos by forcing the dollar to devalue further, eventually breaking the Bretton Woods system altogether. Nowadays, the greatest pain would come if the dollar were driven in the opposite direction. Investors could be in for a shock. ■



高性能汽车

顶级豪车走俏

劳斯莱斯和法拉利开足了马力

豪华汽车不管在纸面上还是路面上都很亮眼。对它们的制造商来说，它们也往往还能让自己的损益表很亮眼。2022年全球汽车销量大约为7900万辆，低于十年前的水平。然而据券商盛博的数据，在同一时期内，对售价十万欧元（107,000美元）以上的豪华座驾的需求却以每年约6.5%的速度增长。

去年，对顶级豪车的需求尤其火爆。据咨询机构标普全球（S&P Global）的数据，虽然2022年汽车销量同比下降了1.3%，劳斯莱斯却在1月9日宣布它那些象征社会地位的超豪华汽车销量增加了8%。为富人制造大玩具的意大利制造商法拉利（其最大股东Exor集团持有本刊母公司的股份）的业绩可能还要更好。去年1月到9月，法拉利的销量同比增长了20%。

这两家公司主导着一个规模很小但利润丰厚的利基市场。劳斯莱斯为德国宝马公司所有，去年售出了6000多辆汽车，创下纪录。盛博估计，2021年全球售出的价格超过25万欧元的汽车中，有大半出自劳斯莱斯。法拉利所占份额超过三分之一。其余大多出自大众旗下的意大利跑车公司兰博基尼。这两家意大利车厂在15万至25万欧元价位的细分市场上表现不俗，这个市场由保时捷主导（保时捷去年从大众剥离出来，成为全球价值最高的汽车公司之一）。1月10日，大众旗下同是这个价位（略微）低些的市场上的大户宾利表示，它在2022年首次销量突破15,000辆，比2021年增长了4%。

劳斯莱斯可不会纡尊降贵考虑这等不够档次的需求。定制元素——精美彩绘、奢华真皮和实木内饰，还有配套的香槟柜——让劳斯莱斯的平均售价超过了50万欧元。每一辆车都带来了丰厚利润。该公司秉持其客户所看重的审慎态度，不肯透露利润有多高，不过它可能比号称营业利润率约为

25%的法拉利赚得更多。相比之下，保时捷约15%的利润率都显得寒酸，更别提豪华汽车公司总体上10%左右的水平了。

法拉利430亿美元的市值让它成为世界第11大上市汽车公司。若按摊在每辆已售汽车上的市值来算，法拉利遥遥领先（见图表）。假如劳斯莱斯是一家独立公司，它也会一骑绝尘。两家公司都得心应手地操控着这一奢侈品市场，控制供应量并保持高价。

现在，两家公司都必须应对汽车业的电动化进程。它们面临的挑战各不相同。即使最普通的电动车也快如闪电，令法拉利的魅力略为失色；它们还能提供顺滑安静的乘坐体验，正是这一点让劳斯莱斯的引擎在汽油时代卓尔不群。劳斯莱斯将在今年底交付它的首款电动车Spectre，安静的电动引擎至少符合它的品牌调性。低沉的引擎轰鸣则是法拉利的卖点之一，它面对的任务更为棘手。法拉利的工程师无疑正努力工作，确保预计于2025年推出的法拉利首款纯电动车操控起来像台跑车，尽管它装着一块沉重的电池。 ■



High-performance motoring

The priciest cars are selling fast

Rolls-Royce and Ferrari are at full throttle

PRICEY AUTOMOBILES are impressive on paper and on the road. For their makers, they also often leave a good impression on the income statement. Global car sales in 2022, at around 79m vehicles, are below the level of a decade ago. Yet demand for fancier sets of wheels costing more than €100,000 (\$107,000) grew by around 6.5% a year over the same period, according to Bernstein, a broker.

Last year the surge was particularly pronounced for the most exclusive motors. Whereas 1.3% fewer cars were sold in 2022 than the year before, according to S&P Global, a consultancy, on January 9th Rolls-Royce said that it had sold 8% more of its ultimate automotive status symbols last year. Ferrari, the Italian manufacturer of rich persons' playthings (whose biggest shareholder, Exor, also part-owns The Economist's parent company), may do even better. Between January and September Ferrari sold 20% more cars than in the same period the year before.

The pair dominate a tiny but profitable niche. Rolls, owned by Germany's BMW, sold more than 6,000 cars last year—a record. In 2021 it supplied well over half the world's cars costing over €250,000, reckons Bernstein. Ferrari's share was more than a third. Lamborghini, an Italian sportscar firm owned by Volkswagen (VW), accounted for most of the rest. The two Italian marques are going strong in the €150,000-250,000 bracket, which is dominated by Porsche (spun off from VW last year to become one of the world's most valuable carmakers). On January 10th Bentley, a VW-owned powerhouse in that (slightly) less ostentatious segment, said it had sold more than 15,000 vehicles for the first time in 2022, 4% more than in 2021.

Rolls does not dirty its hands with such proletarian rides. Bespoke elements—extravagant paint jobs, sumptuous leather-and-wood interiors, champagne chests to match—have pushed the average selling price of a Roller above €500,000. Each generates vast profits. True to the discretion prized by its customers, the firm won't say how much profit; it may be more lucrative than Ferrari, which boasts a rich operating margin of around 25%. Even Porsche's 15% or so, let alone around 10% for all premium carmakers, looks skinny by comparison.

Ferrari's market capitalisation of \$43bn makes it the world's 11th-most-valuable listed car firm. In terms of market value per car sold, it is miles ahead of the pack (see chart). Rolls would be, too, were it an independent company. Both have skilfully manoeuvred the luxury-goods market, keeping supply in check and prices high.

Now both companies must navigate the industry's progressing electrification. This poses different challenges to each. Even run-of-the-mill EVs are lightning-fast, dulling part of Ferrari's appeal, and offer a smooth and silent ride, which distinguished Rolls's engines in the petrol era. For Rolls, which will start shipping its first EV, the Spectre, in late 2023, quiet electric motors are at least on-brand. Ferrari, whose throaty roar is part of the attraction, faces a more delicate task. Its engineers are doubtless hard at work ensuring that its debut full EV, expected by 2025, handles like a racing car despite a heavy battery. ■



航运业预测

从港口投资看全球商贸的未来

它会变得高科技，也更倾向亚洲

在位于新加坡西端大片填海土地上的大士港（Tuas Mega Port），自动驾驶车辆快速驶过五个新泊位。无人起重机高高耸立，装有摄像头的无人机在四周环绕。这些泊位是预计在2027年建成的21个泊位中的第一批。等到2040年大士港建设全面完工时，整个综合体将成为全球最大的集装箱港口，作为业主的新加坡国际港务集（PSA International，以下简称PSA）宣称。

大士港从两个方面显示了未来的走向。它展示了在面对土地紧缺、环境关切等扩建新设施的障碍时，全球的港口运营商如何部署智能技术来满足市场对港口服务的需求。更根本的是，新加坡这个城市国家的这项投资（估计造价达150亿美元）是整个物流业在重要性日渐上升的亚洲的巨额投资潮的一部分，尤其是东南亚。国际货币基金组织预计，2022年至2027年期间，该地区五个最大经济体——印尼、马来西亚、新加坡、菲律宾和泰国——将成为全球贸易量增长最快的集团。其结果是全球商业版图和关键节点蓝图正在被同时重绘。

在全球各地，要扩建港口变得越来越难，美国长岛的霍夫斯特拉大学（Hofstra University）的运输地理学教授让-保罗·罗德里格（Jean-Paul Rodrigue）指出。位置适当的地方土地稀缺，却不缺反对开发的人，尤其是环保人士。去年，希腊比雷埃夫斯（Piraeus）的一个大型港口扩建项目因未能提供合理的环评报告而被法院叫停。墨西哥韦拉克鲁斯（Veracruz）的一个同类项目也因环境问题被阻止。

一个解决方案是让现有物流网络变得更高效，而非仅仅扩大规模。4月，PSA完成了对百运达国际货运（BDP International）的收购，这家美国货运代理公司专事供应链管理。交易所涉金额未披露，不过据称持有该公司

的私募股权曾开价15亿美元。过去两年，阿联酋港口运营商迪拜环球港务集团（DP World，以下简称迪拜环球）已经收购了两家供应链公司：以8.9亿美元收购南非的盈佩瑞（Imperial Logistics），以12亿美元收购美国公司时锐（Syncreon）。

然而，优化供应链的作用始终有限。到了某个节点，还是需要扩大规模。一个方法是填海造地。这需要大兴土木，而且成本高昂。新加坡海事及港务管理局（Maritime and Port Authority）为大士港项目的第一阶段填海工程出资约18亿美元。鹿特丹庞大的马斯平原（Maasvlakte）港区扩建工程（第二期于2015年启用）迄今已令鹿特丹港务局（Port of Rotterdam，由荷兰政府与鹿特丹市政府共同拥有）耗资约29亿欧元（31亿美元）。

许多港口是深水港，填海造地并不可行，因而产生了向上扩建的想法。按传统的港口堆场设计，叠放集装箱超过六层是行不通的，要不断移动堆起来的集装箱才能搬走想要提走的箱子。这个腾挪其他箱子的过程花费的时间可能比在港口和船上搬运集装箱更多，迪拜环球与西马克工程集团（SMS Group）的合资企业Boxbay的首席执行官马蒂亚斯·多布纳（Mathias Dobner）表示。在BoxBay的“高架”存储系统中，每个集装箱都存放在一个单独的架子上，自动起重机可以把它们单独吊运出来。在迪拜环球运营的杰贝阿里港（Jebel Ali Port），这套系统能让集装箱堆放至11层高。

假如横向或垂直扩建都行不通，还有一个选择是异地扩建。这就是为什么建在内陆的“陆港”越来越受欢迎。在那里，货物被提前装入集装箱，等货船到达码头时可以马上装船，无需在港口存放多日。这也减轻了码头的道路拥堵。在距离加州海岸约150公里的莫哈维沙漠（Mojave Desert），投资公司Pioneer Partners已购入地块并获许可建造这样的设施，以缓解洛杉矶和长滩那些低效到无可救药的港口的拥堵问题。

2016年，PSA与中国国有铁路运营商成立了一家合资企业，在中国经营一个陆港网络。制造商在13个内陆火车站之一把货物装上火车，运往沿海地区。网络中的一些火车站离任何海岸线都相当远。其中一个位于新疆乌鲁

木齐，这里比全球任何其他城市都更远离海洋，距孟加拉湾约2400公里。2022年，世界银行的私营部门支持机构国际金融公司（International Finance Corporation）与新加坡另一家物流公司叶水福集团（YCH Group）及越南企业集团T&T Group签署了一项协议，将在越南北部的永福省（Vinh Phuc）开发建设一个价值三亿美元的内陆集装箱场站。这个名为“越南超级港口”（Vietnam SuperPort）的项目将于2024年开始运营，为这个出口增速远超内陆物流投资的国家带来一些可喜的缓解。

所有这些亚洲的陆港建设都指向重塑港口业的第二股力量：重心东移。几十年来，亚洲贸易往往是单向的。集装箱满载着由亚洲的廉价劳动力制造的货物运往发达经济体，而运回的基本是空箱。在上世纪90年代末，按价值计算，超过70%的亚洲出口产品流向了世界其他地区。25年后，一定程度上由于这些贸易流动以及更加复杂的供应链，亚洲经济体已变成大型市场。如今，亚洲近60%的出口在本区域内流动。

正如PSA投资兴建大士港，物流业正长线押注这个比例还将增长。在疫情期间的电商热潮中，各地的物流投资都有所增长，在亚洲更是急剧膨胀。据房地产咨询公司世邦魏理仕（CBRE）预测，在2021年至2026年的全球网购增长中，亚洲（包括中国）将占到90%。这将需要新建高达1.3亿平方米的物流地产。

在亚洲，一股投资存储仓库和配送中心的热潮已经开启。去年，新加坡物流地产专业投资公司普洛斯（GLP）宣布设立一个价值11亿美元的专注越南的基金以及一个37亿美元的专注日本的基金。其价值10亿美元的第六支中国基金已于11月初完成募集。由于全球制造商希望把生产从中国转移到其他地方，印度可能会获得提振。印度首富高塔姆·阿达尼（Gautam Adani）经营的港口业务包含位于古吉拉特邦（Gujarat）的印度最大港口蒙德拉港（Mundra Port），以及分布在该国七个邦的另外12个港口和码头。这些港口的合计年货运量已从三年前的两亿吨飙升至到2022年的三亿吨。阿达尼的目标是到2025年达到五亿吨。

海运巨头们的投资也同样指向东方。去年10月，当全球海运费用因疫情瓶

颈缓解而急跌之际，总运力全球第一的地中海航运公司（Mediterranean Shipping Company，以下简称MSC）宣布开辟五条新的亚洲内部航线。此前在7月，MSC宣布与胡志明市政府建立一家价值60亿美元的合资企业，将在当地建设港口并于2027年前投用。该港口建成后将成为越南最大的港口。8月，MSC的头号竞争对手A.P.穆勒-马士基集团（A.P. Moller-Maersk）完成了对利丰物流（一家专注亚洲内部贸易的香港公司）36亿美元的收购。利丰物流在亚洲的223个仓库和一万名员工就此纳入这家明显瞄准亚洲消费者的丹麦海运巨头旗下。

上世纪海运贸易蓬勃发展之时，物流投资反映了全球生产和消费模式的转变。这样的转变如今再次上演，而这次，未来看来会更高效、更智能——也更东方。 ■



Shipping forecast

Investments in ports foretell the future of global commerce

It will be more high-tech—and more Asian

DRIVERLESS VEHICLES whizz across five new berths at Tuas Mega Port, which sits on a swathe of largely reclaimed land at the western tip of Singapore. Unmanned cranes loom overhead, circled by camera-fitted drones. The berths are the first of 21 due by 2027. When it is completed in 2040, the complex will be the largest container port on Earth, boasts PSA International, its Singaporean owner.

Tuas is a vision of the future on two fronts. It illustrates how port operators the world over are deploying clever technologies to meet the demand for their services in the face of obstacles to the development of new facilities, from lack of space to environmental concerns. More fundamentally, the city-state's investment, with construction costs estimated at \$15bn, is part of a wave of huge bets by the broader logistics industry on the rising importance of Asia, and South-East Asia in particular. The IMF expects the region's five largest economies—Indonesia, Malaysia, Singapore, the Philippines and Thailand—to be the fastest-growing bloc in the world by trade volumes between 2022 and 2027. The result is that the map of global commerce and the blueprints for its critical nodes are being simultaneously redrawn.

Across the planet, the expansion of seaports is becoming tougher, notes Jean-Paul Rodrigue, a professor of transport geography at Hofstra University in Long Island. Space in the right locations is scarce. Critics of development, especially among environmentalists, are not. Last year a big port expansion in Piraeus, Greece, was blocked by courts for failing to provide the right assessment of its environmental impact. One in Veracruz, Mexico, was also

stopped on environmental grounds.

One solution is to make existing logistics networks more efficient rather than merely larger. In April PSA finalised its purchase of BDP International, an American freight-forwarder specialising in supply-chain management, for an undisclosed sum (its previous private-equity owner had reportedly been looking for \$1.5bn). Over the past two years DP World, an Emirati port operator, has bought two supply-chain specialists: Imperial Logistics, a South African firm, for \$890m and Syncron, an American one, for \$1.2bn.

Streamlining supply chains only gets you so far, however. At some point, new capacity will be needed. One way to achieve it is by reclaiming land from the sea. This requires feats of civil engineering—and is expensive. Singapore's Maritime and Port Authority spent around \$1.8bn on filling in the sea with earth for the first stage of the new Tuas facility. The massive Maasvlakte expansion, the second leg of which opened in 2015, has so far cost the Port of Rotterdam, an enterprise jointly owned by the Dutch state and the city government, around €2.9bn (\$3.1bn).

Many ports are too deep for land reclamation to be viable. Some are therefore deciding to build upwards. In conventional set-ups, it is impractical to stack more than six containers on top of each other, and even then tall stacks require boxes to be shuffled around constantly to get hold of the right one. The shuffling can take more time than actually moving containers around the port and onto vessels, says Mathias Dobner, chief executive of BoxBay, a joint venture between DP World and SMS Group, an engineering firm. In BoxBay's "high-bay" storage system each container sits in an individual rack, where automated cranes can pluck them out individually. In Dubai's Jebel Ali Port, run by DP World, this allows containers to be stacked 11 high.

If you cannot build out or up, another option is to build elsewhere. That

explains the rising popularity of inland “dry ports”, where goods are put in containers ahead of time, ready to be loaded onto ships as they arrive at the pier without needing to be stored for days at the port itself. This also lightens road congestion at the terminals. Around 150km (90 miles) from California’s coast, in the Mojave Desert, Pioneer Partners, an investment firm, has secured land and permits for such a facility, to ease traffic at the hopelessly inefficient ports of Los Angeles and Long Beach.

In 2016 PSA entered a joint venture with Chinese state-owned rail operators to run a network of dry ports in China. Manufacturers load goods onto trains at one of 13 inland rail terminals for transport to the coast. Some of these terminals are rather a long way from any shoreline. Urumqi in Xinjiang province, home to one of them, is farther from the sea than any other city in the world, around 2,400km from the Bay of Bengal. In 2022 the International Finance Corporation, the private-sector arm of the World Bank, signed an agreement with another Singaporean logistics firm, YCH Group, and T&T Group, a Vietnamese conglomerate, to develop a \$300m inland container depot in Vinh Phuc, in northern Vietnam. The project, known as Vietnam SuperPort, will begin operations in 2024, providing some welcome relief in a country where exports have risen far more rapidly than inland logistical investments.

All the dry-port development in Asia points to the second force reshaping the ports business: the shift of its centre of gravity eastwards. For decades Asian trade has tended to be one-way. Containers loaded with goods manufactured by the continent’s cheap labour sailed to advanced economies and came back largely empty. In the late 1990s more than 70% of Asian exports by value went to other parts of the world. A quarter of a century on, thanks in part to those trade flows and more complex supply chains, Asian economies have become big markets. Today nearly 60% of Asia’s exports flow within the region.

The logistics industry is, like PSA with Tuas, making a long-term wager that this share will grow. Logistics investments grew everywhere amid the pandemic surge in e-commerce. In Asia they ballooned. CBRE, a property consultancy, forecasts that Asia (including China) will account for 90% of the growth in global online shopping between 2021 and 2026. That will require up to 130m square metres of new logistics real estate.

A boom in investment in warehouses for storage and hubs for distribution and fulfilment in the region is already under way. Last year GLP, a Singaporean investment firm specialising in logistics real estate, announced a \$1.1bn fund focusing on Vietnam and a \$3.7bn one focused on Japan. Its sixth China fund, worth \$1bn, closed in early November. India is likely to get a boost as global manufacturers look to diversify their production away from China. The ports business of India's richest tycoon, Gautam Adani, operates Mundra Port in Gujarat, the country's largest, and 12 other ports and terminals across seven Indian states. Their combined annual cargo volumes have surged from 200m tonnes three years ago to 300m in 2022. Mr Adani is aiming for 500m tonnes by 2025.

Investments by shipping giants are pointing in the same eastward direction. In October, while global shipping rates were plunging as the effects of pandemic-era bottlenecks eased, Mediterranean Shipping Company (MSC), the world's biggest by total capacity, announced five new intra-Asian services. Three months earlier MSC had announced a \$6bn joint venture with the government of Ho Chi Minh City to build a port there by 2027. It will be Vietnam's largest port on completion. In August A.P. Moller-Maersk, MSC's biggest rival, completed the \$3.6bn purchase of LF Logistics, a Hong Kong-based firm focusing on intra-Asian trade. The deal brought 223 warehouses and 10,000 employees across the continent under the Danish shipping giant's banner, with an explicit focus on Asian consumers.

When seaborne trade boomed last century, investments in logistics

reflected shifts in the global patterns of production and consumption. They are doing so again. And this time the future looks leaner, smarter—and more eastern. ■



零和

威胁全球化的破坏性新逻辑

美国正在引领全球走向补贴、出口管制和保护主义的危险滑坡

自1945年以来，世界经济一直按照美国承诺支持的规则和规范体系运行。这带来了前所未有的经济一体化，促进了增长，使数亿人摆脱了贫困，并帮助西方在冷战中战胜了苏联。如今这个体系岌岌可危。各国竞相补贴绿色产业，把制造业从无论盟友还是敌人那里吸走，还限制商品和资本的流动。互利已经过时，国家收益至上。一个零和思维的时代已经开启。

旧体系承压已久，因为在2007至2009年的全球金融危机过后，美国维护它的兴趣减弱了。但拜登总统放弃自由市场规则而采取激进的产业政策又给它当头一棒。美国为绿色能源、电动汽车和半导体提供了高达4650亿美元的巨额补贴，都搭配着在本地生产的要求。负责审查对内投资以防止外国对经济产生不当影响的官僚如今能够左右占股市市值60%的行业。官员们正在禁止越来越多的出口——尤其是高端芯片和芯片制造设备流向中国。

对于华盛顿的许多人来说，强硬的产业政策十分诱人。它可能有助于巩固美国对中国的技术优势，而中国长期以来一直通过国家干预在重要领域寻求自给自足。由于碳定价在政治上不可行，这种政策可能会促进脱碳。它也反映了一种希望，即政府干预可能会在私营企业失败的地方取得成功，并使美国的中心地带实现再工业化。

然而，其直接后果是在全球范围内引发了危险的保护主义漩涡。在印度建一个芯片制造厂，政府将承担一半的费用；在韩国建一个，你可以享受慷慨的税收减免。自2020年以来已有其他七个市场经济体宣布了“战略”行业政策，如果它们的支出等同于美国这方面支出占GDP的比例，则总支出将达到1.1万亿美元。去年，引起欧洲官员注意的跨境商业交易中有近三分之一受到了详细审查。拥有制造电池所需原材料的国家正在关注出口管制。

印度尼西亚已禁止镍出口；阿根廷、玻利维亚和智利可能很快就会以类似欧佩克的方式协调锂矿产量。

与中国的经济冲突看起来越来越不可避免。随着中国在进入本世纪后更深入地融入全球经济，许多西方人预测中国会变得更加民主。这种希望的破灭——加上数以百万计的制造业工作岗位转移到了中国工厂——导致美国不再热爱全球化。今天，拜登政府担心依赖中国提供电池的危险，就像欧洲在乌克兰被入侵之前依赖俄罗斯提供天然气那样。无论民主党人还是共和党人，都担心美国在先进芯片制造中的领先地位若被台湾抢占会削弱自己发展人工智能的能力——他们预测，未来的军队将依赖人工智能来制定战略和引导导弹。

有些人只是想阻止中国变得过于富裕——就好像让14亿人陷入贫困是道德的或可能确保和平一样。其他人则更明智地专注于增强美国的经济韧性并保持其军事优势。他们认为，中心地带的再工业化将重新点燃对市场资本主义的支持。与此同时，作为全球霸主，美国经得起其他国家的抱怨。

这种想法是错误的。如果零和政策被视为成功，放弃它们只会变得更难。事实上，即使它们真的重塑了美国工业，其整体影响也更有可能是造成危害——破坏全球安全、阻碍增长和提高绿色转型的成本。

一个问题是额外的经济成本。本刊估计，复制对全球技术硬件、绿色能源和电池等行业里的公司的累计投资将花费3.1万亿至4.6万亿美元（占全球GDP的3.2%至4.8%）。再工业化将提高价格，对穷人的伤害最大。复制绿色供应链将使美国以及全世界摆脱碳排放的成本更高。历史表明，大量公共资金可能会被浪费。

另一个问题是朋友和潜在盟友的愤怒。第二次世界大战后美国的天才之处在于意识到其利益在于支持全球商业的开放。因此它追求全球化，尽管到1960年它已占到全球美元GDP的近40%。

如今，它的产出份额已降至25%，美国比以往任何时候都更需要朋友。只有在荷兰公司阿斯麦（ASML）和日本的东京电子（Tokyo Electron）也拒

绝向中国供应设备的情况下，它对中国芯片制造商的出口禁令才会奏效。如果民主世界作为一个集团运作，电池供应链同样会更加安全。然而，美国的保护主义正在激怒欧洲和亚洲的盟友。

美国还必须拉拢新兴大国。银行高盛预计，到2050年，印度和印度尼西亚将成为世界第三和第四大经济体。两者都是民主国家，但都不是美国的亲密朋友。到2075年，尼日利亚和巴基斯坦也将获得经济影响力。如果美国要求其他国家将中国拒之门外而不向它们提供足够的进入美国市场的机会，那么它将被崛起的大国唾弃。

最后一个担忧是，经济冲突扩散得越多，要解决需要全球合作的问题就越难。尽管各国竞相争取绿色技术，但仍在争论如何帮助贫穷世界脱碳。由于中国这个大债权国的阻挠，斯里兰卡等陷入债务困境的国家很难得到救助。如果各国不能合作对付一些问题，这些问题将无法解决，世界将因此受损。

没有人期望美国会回到1990年代。它寻求保持军事优势并避免在关键经济原料方面危险地依赖中国是正确的。然而，这使得其他形式的全球一体化变得更加重要了。鉴于各国各自的价值观，它应该在可能的情况下寻求各国之间最深入的合作。今天，这可能需要一些重叠的论坛和临时协议。例如，美国应该加入《跨太平洋伙伴关系全面进步协定》，这是一项亚洲贸易协定，是基于美国帮助起草但后来放弃的一项早期协议达成的。

鉴于美国政治的保护主义转向，拯救全球化看起来似乎希望渺茫。但国会为乌克兰的援助表明选民并非只关心本国。调查显示，自由贸易的受欢迎程度正在恢复。有迹象表明，拜登政府正在回应盟友对其补贴政策的担忧。

然而，拯救全球秩序需要更大胆的美国领导层来再次拒绝零和思维的虚假承诺。在系统彻底崩溃、损害无数生计并危及自由民主和市场资本主义的事业之前，仍有时间来扭转局面。任务艰巨而紧迫，而它再重要不过了。时钟在滴答作响。 ■



Zero-sum

The destructive new logic that threatens globalisation

America is leading a dangerous global slide towards subsidies, export controls and protectionism

SINCE 1945 the world economy has run according to a system of rules and norms underwritten by America. This brought about unprecedented economic integration that boosted growth, lifted hundreds of millions of people out of poverty and helped the West prevail over Soviet Russia in the cold war. Today the system is in peril. Countries are racing to subsidise green industry, lure manufacturing away from friend and foe alike and restrict the flow of goods and capital. Mutual benefit is out and national gain is in. An era of zero-sum thinking has begun.

The old system was already under strain, as America's interest in maintaining it waned after the global financial crisis of 2007-09. But President Joe Biden's abandonment of free-market rules for an aggressive industrial policy has dealt it a fresh blow. America has unleashed vast subsidies, amounting to \$465bn, for green energy, electric cars and semiconductors. These are laced with requirements that production should be local. Bureaucrats tasked with scrutinising inward investments to prevent undue foreign influence over the economy now themselves hold sway over sectors making up 60% of the stockmarket. And officials are banning the flow of ever more exports—notably of high-end chips and chipmaking equipment to China.

For many in Washington, muscular industrial policy holds a seductive appeal. It could help seal America's technological ascendancy over China, which has long pursued self-sufficiency in vital areas using state intervention. As carbon pricing is politically unfeasible, it could foster

decarbonisation. And it reflects a hope that government intervention might succeed where private enterprise failed, and reindustrialise America's heartlands.

The immediate consequence, however, has been to set off a dangerous spiral into protectionism worldwide. Build a chipmaking plant in India and the government will stump up half the cost; build one in South Korea and you can avail yourself of generous tax breaks. Should seven other market economies that have announced policies for "strategic" sectors since 2020 match America's spending as a share of GDP, total outlays would reach \$1.1trn. Last year nearly a third of the cross-border business deals that came to the attention of European officials received detailed scrutiny. Countries with the raw materials needed to make batteries are eyeing export controls. Indonesia has banned nickel exports; Argentina, Bolivia and Chile may soon collaborate, OPEC-style, on the output of their lithium mines.

Economic conflict with China looks increasingly inevitable. As China became more deeply integrated into the global economy at the turn of this century, many in the West predicted that it would become more democratic. The death of that hope—combined with the migration of a million manufacturing jobs to Chinese factories—caused America to fall out of love with globalisation. Today Mr Biden's administration frets about the danger of depending on China for batteries the way Europe relied on Russia for gas before the invasion of Ukraine. Democrats and Republicans alike worry that the loss of America's lead in advanced chipmaking to Taiwan will undermine its ability to develop artificial intelligence—on which, they predict, armies of the future will rely to plan strategy and guide missiles.

Some simply want to stop China becoming too rich—as if impoverishing 1.4bn people were either moral or likely to ensure peace. Others, more wisely, focus on increasing America's economic resilience and maintaining its military edge. A reindustrialisation of the heartland, they argue, will

rekindle support for market capitalism. In the meantime, as the global hegemon, America can weather other countries' complaints.

This thinking is misguided. If zero-sum policies were seen as a success, abandoning them would only become harder. In reality, even if they do remake American industry, their overall effect is more likely to cause harm by corroding global security, holding back growth and raising the cost of the green transition.

One problem is their extra economic costs. The Economist estimates that replicating the cumulative investments of firms in the global tech-hardware, green-energy and battery industries would cost \$3.1trn-4.6trn (3.2-4.8% of global GDP). Reindustrialisation will raise prices, hurting the poor most. Duplicating green supply chains will make it costlier for America and the world to wean themselves off carbon. History suggests that vast amounts of public money could go to waste.

Another problem is the fury of friends and potential allies. America's genius after the second world war was to realise that its interests lay in supporting openness in global commerce. As a result it pursued globalisation despite, by 1960, making up nearly 40% of global dollar GDP.

Today its share of output has fallen to 25% and America needs friends more than ever. Its ban on exports to China's chipmakers will work only if the Dutch firm ASML and Japan's Tokyo Electron also refuse to supply them with equipment. Battery supply chains will likewise be more secure if the democratic world operates as one bloc. Yet America's protectionism is irking allies in Europe and Asia.

America must also woo emerging powers. By 2050 India and Indonesia will be the world's third- and fourth-largest economies, projects Goldman Sachs, a bank. Both are democracies but not close friends of America. By

2075 Nigeria and Pakistan will have gained economic clout, too. If America demands that other countries freeze out China without offering sufficient access to its own markets then it will be spurned by rising powers.

A final worry is that the more economic conflict proliferates, the harder it becomes to solve problems that demand global collaboration. Despite racing to secure green technology, countries are squabbling over how to help the poor world decarbonise. It is proving hard to rescue countries in debt distress, such as Sri Lanka, because of obstruction by China, a big creditor. If countries cannot co-operate to tackle some problems, these will become impossible to fix and the world will suffer accordingly.

Nobody expects America to go back to the 1990s. It is right to seek to preserve its military pre-eminence and to avoid a dangerous dependence on China for crucial economic inputs. Yet this makes other forms of global integration all the more essential. It should seek the deepest co-operation between countries that is possible, given their respective values. Today this probably requires a number of overlapping forums and ad hoc deals. America should, for instance, join the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, an Asian trade pact based on an earlier deal it helped write but then abandoned.

Saving globalisation may seem impossible, given the protectionist turn in American politics. But Congress's aid to Ukraine shows that voters are not insular. Surveys suggest the popularity of free trade is recovering. There are signs that the Biden administration is responding to allies' concerns about its subsidies.

Yet rescuing the global order will require bolder American leadership that once again rejects the false promise of zero-sum thinking. There is still time for that to happen before the system collapses completely, damaging countless livelihoods and imperilling the causes of liberal democracy and

market capitalism. The task is enormous and urgent; it could hardly be more important. The clock is ticking. ■



经济学人视频

商业界如何应用元宇宙？（预告）

如果你认为元宇宙只是关于游戏、娱乐和线上会议，不妨再想想。



The Economist Film

How will business use the metaverse? - Trailer

If you thought the metaverse was all about gaming, gigs and virtual meetings, think again.



健康即财富

《救命求财》记录了一场畅销药研发竞赛

内森·瓦尔迪的新书再现了两家制药公司的一场争战【《救命求财》书评】

《救命求财》，内森·瓦尔迪著。W.W.诺顿出版社出版，288页，30美元。

没有什么科研工作能比研发一款畅销的药物或疫苗更能赚大钱了。辉瑞的降胆固醇药物立普妥（Lipitor）据说已为该公司赚了1600多亿美元。葛兰素史克（GSK，原为GlaxoSmithKline）也凭借哮喘药舒利迭（Advair）赚了数百亿。在新冠疫情之前鲜为人知的BioNTech公司也靠它研发的mRNA疫苗赚进数十亿。

理所当然，制药公司（如今还要加上风险资本家和对冲基金）总是在探寻下一款神奇新药。内森·瓦尔迪（Nathan Vardi）的新书引人入胜地讲述了制药公司争相研发一种只攻击癌细胞而不损害健康细胞的血癌新药的历程。

《救命求财》（For Blood and Money）追踪了美国加州两家小型生物技术公司Pharmacyclics和Acerta Pharma抢占慢性淋巴细胞白血病（一种血液和骨髓的癌症）药物市场的历程。所用的疗法涉及抑制布鲁顿酪氨酸激酶（BTK）的活动，这种酶调节着部分白血球内部的化学信号。瓦尔迪解释了BTK抑制剂背后的科学原理以及它们如何成为诱人的癌症治疗工具。

这场药企斗法的好戏始于Pharmacyclics。作者介绍了投资该公司的成功企业家鲍勃·杜根（Bob Duggan），讲述了他如何很快从Pharmacyclics创始人手中夺权并成为了CEO。杜根解雇了几名关键员工，而这些人后来投身另一家生物技术创业公司，也就是Acerta。在那里，他们试图研发一种同样基于BTK抑制剂的竞争药物。竞赛启动了。

这场好戏有着五彩缤纷的演出阵容：医学研究人员、医生、科学教徒和纽约的金融家。瓦尔迪让读者慢慢了解到这些人物各自的野心、自负和怪

癖，以及他们在争斗中的密谋与钩心斗角。瓦尔迪还展现了在食品药品管理局（FDA）的监督之下，美国漫长而复杂的药物审批过程，以及大型制药公司在评估是否投资新产品时的冷酷算计。舞台的中央是病人，往往是老年人、求药若渴的人。

作为一名财经记者，瓦尔迪非常了解风险投资圈，描述各种交易和协定的金融环节时最是信手拈来。他深入调查人物的背景，细致再现会议和事件，让Pharmacyclics和Acerta的斗法跃然纸上。他努力把这个故事呈现为一部现实惊悚剧，尽管手法有时显得程式化，但读起来仍酣畅淋漓。

这个故事以喜剧结尾。竞赛最终不是诞生了一种抗癌药物，而是两种：Pharmacyclics推出了伊布替尼（Imbruvica），Acerta拿出了阿卡替尼（Calquence）。两种药都相当有效，都成为了畅销药。虽然药价之高令人却步，但仍有成千上万的病人因而受惠。

两种药背后的金主也获得了极丰厚的回报。瓦尔迪称，杜根个人对Pharmacyclics总共投资了5000万美元，收回35亿美元。（该公司于2015年被艾伯维[AbbVie]收购。）Pharmacyclics联合强生公司率先推向市场的伊布替尼仅在2021年就取得了超过50亿美元的收入。阿斯利康在2016年购入Acerta的多数股权，它们的阿卡替尼在2021年也带来了超过10亿美元的收入。

这种寻找癌症新药的高风险手段显然是奏效了。但读者最后还是会纠结一个问题。这种争强斗胜、利润驱动的过程真的是研发救命药物的最优路径吗？ ■



Health is wealth

“For Blood and Money” charts a race to develop a blockbuster drug

Nathan Vardi’s book brings to life a contest between two pharmaceutical firms

For Blood and Money. By Nathan Vardi. W.W. Norton; 288 pages; \$30

FEW SCIENTIFIC endeavours are more lucrative than developing a blockbuster drug—or a blockbuster vaccine. Lipitor, Pfizer’s cholesterol-lowering medication, is reputed to have made the company more than \$160bn. Advair, an asthma drug, has earned tens of billions of dollars for GSK (formerly GlaxoSmithKline). And BioNTech, a firm few people had heard of before the covid-19 pandemic, has made billions from its mRNA vaccine.

Naturally, pharmaceutical companies—and, these days, venture capitalists and hedge funds—are always searching for the next wonder drug. Nathan Vardi’s new book is a fascinating look at the quest to develop a new drug for blood cancer that targets only cancerous cells and not the healthy kind.

“For Blood and Money” follows two small biotech firms in California, Pharmacyclics and Acerta Pharma, as they try to capture the market for a drug to treat chronic lymphocytic leukaemia, a cancer of the blood and bone marrow. The technique involves inhibiting the activity of Bruton tyrosine kinase (BTK), an enzyme that regulates chemical signals inside some white blood cells. Mr Vardi explains the science behind BTK inhibitors and shows how they became an attractive tool for cancer treatment.

The corporate drama begins with Pharmacyclics. The author introduces Bob Duggan, a successful entrepreneur who invests in the company, quickly wrests control from its founder and becomes CEO. Mr Duggan sacks a couple of key employees, who wind up at another biotech startup, Acerta. There

they try to develop a rival drug that is also based on a BTK inhibitor. The race is on.

The technicolour cast of characters includes medical researchers, doctors, scientologists and New York financiers. Readers become acquainted with their personal ambitions, egos and quirks, and the intrigue and politics of their rivalries. Mr Vardi also lays out the slow, complicated process for the approval of drugs in America, overseen by the Food and Drug Administration, and the cold calculations of big pharmaceutical firms as they assess whether to invest in a new product. In the middle of it all are the patients, often elderly and desperate for a cure.

A financial journalist, Mr Vardi knows the world of venture capital intimately, and is at his strongest when writing about the financial aspects of deals. He delves into his characters' backgrounds and recreates meetings and events in detail; the contest between Pharmacyclics and Acerta comes alive. His efforts to present the story as a real-life thriller generate pace, even if the approach sometimes feels formulaic.

The story has a happy ending. The race ends up producing not one but two cancer drugs, Imbruvica from Pharmacyclics and Calquence from Acerta. Both are effective and become blockbusters. The prices are dauntingly steep, but tens of thousands of patients benefit.

As, royally, do the backers of the two drugs. Mr Duggan's own total investment of \$50m in Pharmacyclics yields \$3.5bn, Mr Vardi reports. (The firm was bought by AbbVie in 2015.) Imbruvica, which became available first—marketed jointly with Johnson & Johnson—generated over \$5bn in revenues in 2021 alone. AstraZeneca took a majority stake in Acerta in 2016; their drug Calquence brought in more than a billion dollars in 2021 too.

This high-risk method for finding a new cancer treatment certainly works.

Yet the reader is left with a nagging question. Is this testosterone-fuelled, profit-driven process really the best way to develop life-saving drugs? ■



梧桐

2023会是投资者的又一个噩梦年吗?

很多人持乐观态度，但缺乏依据

在经历了噩梦般的2022年后，惊魂未定的投资者需要弥补损失，也需要思考很多事情。他们要做资产类别配置，要选择或避开一些行业，要预测世间的各种经济变量。职业理财经理们还有一件格外伤脑筋的事情，那就是如何不让惶恐不安的客户慌忙离场。但有一个棘手的问题压过了一切，它在每次崩盘时都会赫然浮现。那就是：最糟糕的时期过去了吗？

从宏观经济看，答案很明确：今年将是严酷的一年。国际货币基金组织总裁克里斯塔利娜·格奥尔基耶娃（Kristalina Georgieva）1月1日警告称，全球经济的三分之一很可能会在2023年陷入衰退。在欧元区和英国，衰退期可能已经开始。根据芝加哥大学和《金融时报》前不久对经济学家的一项调查，85%的受访者认为美国将在今年年底前跟上。

这并不是说经济一定还会再惨遭一次“血洗”——它甚至可能意味着相反的情境。理论上说，市场具有前瞻性，在2022年的大部分时间里，世界一直被经济衰退的担忧所笼罩。这样一种广泛共识应该已经体现在今天的价格中，这意味着即使前景稍有好转也会提振价格。事实上，摩根资产管理（JPMorgan Asset Management）的分析师就是根据人们一致强烈看衰经济而认为2023年年底的股价实际上将高于年初。并非只有他们持乐观态度。高盛的研究人员认为，股价将在短期内下跌，但在年底前会回升。德意志银行的乐观派认为，代表美国大型公司的标准普尔500指数在年底将比目前高出17%。

如果今年和2022年一样出现股债双杀，那将是罕见的情况。股票价格多半会上涨。它们很少连续两年下降。标普500指数上一次出现这种情况是在20年前互联网泡沫破裂的时候。去年债券市场之所以暴跌，是因为美联储以自上世纪80年代以来最快的速度加息，而这种加息速度不太可能重演。

即便如此，仍有理由相信前方还会有更多痛楚。首先，以历史标准衡量，股价相对于其潜在收益仍然很高。尽管去年出现暴跌，但“成长型”股票（未来有望获得高额利润的公司的股票）的市盈率仅回落到2019年的水平。这是自2007至2009年全球金融危机以来的最高水平，并且是经过长达十年的牛市才达到的。的确，“价值型”股票（与公司账面资产相比价格较低的股票）看起来更有吸引力。但随着经济衰退的到来，这两种类型的股票都容易受到盈利评级下调的影响，而这种下调大多都还没有发生。

此外，今天的高估值形成于一个非同寻常的时期：各国央行通过量化宽松（QE）源源不断地向市场注入流动性。通过用新发行的货币购买政府债券，美联储和其他国家的央行压低了债券收益率，这促使投资者在股票等风险较高的资产中寻求回报。如今，这些量化宽松措施正在发生逆转。一个后果是各国政府会明显更加依赖私人投资者来持有其债务。在2022至2023财年，美国财政部可能需要从投资者那里借入的资金金额是新冠疫情前两年平均水平的近两倍，或者是疫情前五年平均水平的四倍。即使各国央行不提高短期利率，这种供过于求也可能导致债券价格下跌、收益率上升。就像2022年一样，相比之下，股票就会显得没那么有吸引力。

之所以悲观的最后一个原因是经济学家和投资者之间的意见分歧。尽管学者们预计经济会衰退，但许多投资者仍然希望衰退能被避免。市场预期美联储的基准利率将在今年上半年达到近5%的峰值，然后下降。但各国央行行长对此并不认同。他们预计到年底利率会超过5%。

因此，投资者赌的是，要么通胀会以快于美联储预期的速度下降到目标水平，要么作为“货币守护者”的央行没法狠下心来施加为了降通胀而需引致的痛苦。当然，事实有可能会证明他们是对的。但在2022年的大部分时间里，市场都低估了美联储的鹰派作风，结果在一次接一次的加息会议上被美联储主席鲍威尔戳破幻想。如果这种情形重演，那2023年又会是投资者日子难过的一年。 ■



Buttonwood

Will investors have another awful year in 2023?

There is a lot of unfounded optimism about

AFTER A NIGHTMARISH 2022, shell-shocked investors have losses to recoup and plenty to ponder. There are asset-class allocations to be made, industries to favour or shun and every economic variable under the sun to forecast. Professional money managers have the extra headache of working out how to stop nervous clients racing for the exits. But one question dominates the rest, and it is the impossible one that looms over every crash. Is the worst over?

Economically, there is a clear answer: this year will be grim. Kristalina Georgieva, head of the IMF, warned on January 1st that a third of the global economy is likely to fall into recession in 2023. Downturns have probably already begun in the euro zone and Britain. In a recent poll of economists carried out by the University of Chicago and the Financial Times, 85% thought America would follow before the year is out.

This does not guarantee another bloodbath—it could even mean the opposite. In theory, markets are forward-looking, and fears of recession stalked the world for much of 2022. Such a widely held consensus should be baked into today's prices, meaning even a marginally better outlook would buoy prices. Indeed, analysts at JPMorgan Asset Management use the strength of agreement that there will be a recession to argue that stock prices will in fact end 2023 higher than they started. They are not alone in their optimism. Goldman Sachs's researchers think share prices will fall in the near term, but recover by the end of the year. Deutsche Bank's bullish lot reckon the S&P 500 index of large American firms will end the year 17% higher than it now stands.

If this year offers a repeat of 2022, with heavy losses for both stocks and bonds, it will be an unusual one. Stock prices mostly go up. They rarely decline two years in a row. The S&P 500 last did so two decades ago during the bursting of the dotcom bubble. Last year's bond rout was on account of the Federal Reserve raising rates at its fastest pace since the 1980s, which is unlikely to be repeated.

Even so, there are reasons to believe more pain lies ahead. The first is that shares, relative to their underlying earnings, remain expensive by historical standards. Despite last year's plunge, the price-to-earnings ratio for "growth" stocks, those of companies promising big future profits, has fallen back only to where it was in 2019. This was its highest since the global financial crisis of 2007-09, a level which was reached after a decade-long bull market. True, "value" stocks, those with a low price compared with the firm's book assets, look more attractive. But as recession sets in, both types are vulnerable to earnings downgrades that are, for the most part, yet to materialise.

Moreover, today's valuations were reached during an unusual period: one in which central banks pumped endless liquidity into the market via quantitative easing (QE). By buying government bonds with newly created money, the Fed and others depressed yields and nudged investors to seek returns in riskier assets, like stocks. Now these QE programmes are being kicked into reverse. One consequence is that governments will rely much more on private investors to hold their debt. In the fiscal year of 2022-23, America's Treasury may need to borrow almost twice as much from investors as it did during each of the two years preceding the covid-19 pandemic, and four times the average in the five years before that. Even without central banks raising short-term interest rates, this glut could drive bond prices down and yields up. Just as in 2022, stocks would therefore be left looking less attractive by comparison.

The final reason for gloom is a divergence between economists and investors. Although wonks are betting on a recession, many punters still hope one can be avoided. Markets expect the Fed's benchmark rate to hit a peak of below 5% in the first half of this year, before declining. The central bank's governors disagree. They project that the interest rate will end the year above 5%.

Thus investors are betting either that inflation will fall to target more quickly than the Fed expects, or that the monetary guardians do not have the heart to inflict the pain it would take to get it down. There is, of course, a chance they will be proved right. But markets spent much of 2022 underestimating the Fed's hawkishness, only to be put in their place by Jerome Powell, the central bank's governor, at meeting after meeting. If the pattern repeats, 2023 will be another miserable year for investors. ■



犯罪动机？

萨姆·班克曼-弗里德拒不认罪

尽管有关他的加密王国爆雷的信息铺天盖地，但仍遗留一大疑问

从某些方面来说，约瑟夫·班克曼（Joseph Bankman）和芭芭拉·弗里德（Barbara Fried）家的假日季和很多人家差不多。离巢的成年子女通常会在节假日回到家里来。他们的儿子——已破产的加密货币交易所FTX的创办人萨姆·班克曼-弗里德（Sam Bankman-Fried）也是这样。12月22日他飞往加州的帕洛阿尔托（Palo Alto），并在元旦后不久离开。

不过，他这次回家还是与大多数人稍有不同。去年11月，班克曼-弗里德的商业帝国崩溃，之后他在巴哈马被捕并被引渡到纽约，面临欺诈和洗钱的指控。在纽约南区法院的法官同意以2.5亿美元的“出庭保证金”释放他之后，他才得以于12月22日飞往加州，担保人是他的父母和另外两人。他被要求出庭、在脚踝上佩戴监视器，并与父母住在一起。如果他不遵守这些条款，担保人就要支付保证金。1月3日，他回到纽约——这次是对面临的各项指控做无罪辩护。

庭审日期暂定在10月2日。但班克曼-弗里德可能会达成认罪协议，尽管他继续声称自己没有故意欺骗任何人。如果开庭审判，他的两位前同事——卡罗琳·埃里森（Caroline Ellison）和加里·王（Gary Wang）会出庭作证：前者是班克曼-弗里德创立并拥有大部分所有权的对冲基金阿拉米达（Alameda）的负责人；后者是FTX的联合创始人。他俩目前都在配合当局调查。12月21日，埃里森就电信欺诈和合谋洗钱等七项指控认罪，这可能让她面临最高110年的监禁。与此同时，加里·王承认了欺诈的指控，最高可能被判入狱50年。

他们二人提供给检察官的证据有助于支持对班克曼-弗里德的刑事和民事指控，民事部分由美国证券交易委员会（SEC）和商品期货交易委员会（CFTC）两家监管机构提起。两人提交的证词表明，自2019年FTX成立以

来，班克曼-弗里德就将客户存款非法转移到阿拉米达。他们还指出，班克曼-弗里德指示加里·王让阿拉米达不受FTX重要规程的约束。根据FTX的规则，如果交易对客户不利，向客户借钱建立的交易头寸便会被强制平仓。而不受约束就可以让阿拉米达在该交易所的余额为负数；换句话说，它让阿拉米达可以挪用客户的资产。

此外，针对埃里森的指控表明，班克曼-弗里德指示他的这位商业伙伴（也是前女友）抬高FTT代币的价格。班克曼-弗里德把自己创造的FTT加密货币免费交给阿拉米达，这样阿拉米达就可以利用它从其他加密货币机构借入更多资金。根据SEC的说法，班克曼-弗里德在建立起几种让阿拉米达能尽可能多地借钱的途径后，就把阿拉米达当成了自己的“提款机”，用来支付捐款、购买房产和投资。

鉴于FTX倒闭后已披露出大量信息，关于FTX和班克曼-弗里德帝国的灭亡，最引人关注的问题已经不再是发生了什么。很显然，数十亿美元的客户资产最终都进入了阿拉米达，要么是被直接转入，要么是通过阿拉米达享受的特殊待遇。更大的问题是，班克曼-弗里德及其同事究竟为什么要这样做，而这个问题仍然没有答案。

班克曼-弗里德的无罪抗辩为可能到来的庭审做了铺垫。如果开庭审判，可能会让观察人士离答案更近一步。又或许，真相会以另一种路径浮出水面。班克曼-弗里德家的这个假日季另有一个特别之处，据称迈克尔·刘易斯（Michael Lewis）拜访了班克曼-弗里德及其父母。自去年年中以来，这位著名记者一直在为自己的新书追踪班克曼-弗里德。据说，他最近一次访问的目的是讨论这本书的电影版权。 ■



Whydunnit?

Sam Bankman-Fried pleads not guilty

Despite the avalanche of information about his crypto blow-up, one big question remains

IN ONE WAY the holiday season in Joseph Bankman and Barbara Fried's house was like many others. Adult children who have fled the nest often return home for the festive period. Their son, Sam Bankman-Fried, the founder of FTX, a now defunct crypto exchange, did the same. He flew to Palo Alto, California, on December 22nd and departed shortly after New Year's Day.

Yet he did so in slightly different circumstances from most. After the collapse of his empire in November, Mr Bankman-Fried was arrested in the Bahamas, before being extradited to New York to face fraud and money-laundering charges. He flew to California on December 22nd only after a judge in the South District court of New York agreed to release him on a \$250m "appearance bond", which his parents and two other people agreed to pay if he did not comply with the terms. These require him to appear in court, wear an ankle monitor and live with his parents. On January 3rd he returned to New York—this time to plead not guilty to the various charges he faces.

A provisional date of October 2nd was set for the trial. But it is possible that Mr Bankman-Fried, who continues to claim he did not intentionally defraud anyone, will strike a plea deal. If there is a trial he will face the testimony of his former colleagues: Caroline Ellison, who ran Alameda, the hedge fund Mr Bankman-Fried founded and majority-owned, and Gary Wang, a co-founder of FTX, both of whom are now co-operating with the authorities. On December 21st Ms Ellison pled guilty to seven charges which

could carry a maximum sentence of 110 years in prison, including wire fraud and conspiracy to commit money-laundering. Mr Wang, meanwhile, pled guilty to fraud charges which could carry a maximum of 50 years.

The evidence the two provided to prosecutors helped inform the criminal charges against Mr Bankman-Fried and the civil complaints from the Securities and Exchange Commission (SEC) and the Commodities and Futures Trading Commission (CFTC), two regulators. Their submissions suggest that since FTX was set up in 2019, Mr Bankman-Fried improperly channelled customer deposits to Alameda. They also suggest he directed Mr Wang to exempt the hedge fund from important FTX procedures. The rules were designed to ensure that trading positions customers had borrowed money to open were closed if trades moved against them. The exemption allowed Alameda to have a negative balance on the exchange; in other words, it let the firm borrow customers' assets.

In addition, the complaints against Ms Ellison suggest Mr Bankman-Fried instructed his business partner (and former romantic one) to prop up the price of the FTT token. Mr Bankman-Fried had created this cryptocurrency himself, and given it to Alameda for nothing, so that the hedge fund could use it to borrow even more money from other crypto institutions. Having set up ways for Alameda to borrow as much as possible, Mr Bankman-Fried then used the firm as his “piggy-bank”, according to the SEC—disbursing donations, buying property and making investments.

Given the amount of information revealed since FTX collapsed, the most interesting question about the demise of the firm and Mr Bankman-Fried’s empire is no longer what happened. It is clear that billions of dollars of customers’ assets ended up at Alameda, either because they were channelled there directly or because of the special treatment the firm enjoyed. The bigger question, which is still unanswered, is exactly why Mr Bankman-Fried and his colleagues did this.

Mr Bankman-Fried's not-guilty plea prepares the ground for a possible trial that may get observers closer to the answer. Or perhaps the truth will come out by a different route. Another peculiar feature of the holiday period at the Bankman-Fried home is that parents and son were reportedly visited by Michael Lewis. The celebrated journalist has been following Mr Bankman-Fried since the middle of last year for a book. The purpose of his latest visit was, apparently, to discuss the film rights. ■



特斯拉谜题

投资者判定特斯拉是家汽车公司，不是科技公司

股价暴跌表明他们不再认为特斯拉会统领世界

特斯拉的市值在2020年夏天超过了当时世界上价值最高的汽车公司丰田，自那之后，它的拥趸和质疑者启用了一种新的度量单位。随着这家电动汽车领军公司的股价上涨，人们用排在它之后的几家汽车公司的市值之和来表示它的价值，先是之后两家之和，然后是五家，再是十家。一年前，特斯拉的市值超过1.2万亿美元，已经比其他大多数汽车公司的总和还要多。自那以来，它的市值已经蒸发了71%——这也超过了该行业中大部分公司的价值。它那反复无常的老板马斯克的财富因此缩水了2000多亿美元。

最近一次冲击发生在1月3日，特斯拉连续第三个季度交付量低于分析师预期，并报告产量和交付量之间的差距拉大，表明市场对其电动汽车的需求趋于疲软。一天之内，特斯拉损失了12%的市值——约500亿美元，相当于一个福特。即便是看涨的投资者现在也怀疑马斯克能否兑现到2030年年产2000万辆汽车的承诺，以及特斯拉的Autopilot能否很快成为改变世界的全自动驾驶系统。不过，市场对特斯拉前景重新校准的主要原因是人们逐渐认识到这家公司主要还是一家汽车制造商，而它的老板也不是超人。

马斯克一直认为特斯拉是一家科技公司，和Alphabet、苹果、Meta等数字巨头是同类，跟丰田或大众那样的旧经济时代的造车厂不是一路。市场一度也是这么认为，不论是在疫情时期所有数字产品销路大涨推动科技股飙升之际，还是去年科技股大跌之时——因为科技公司的增长开始放缓，而利率上升又让它们承诺的未来利润在今天看起来不再那么值钱。

但是在过去几个月里，特斯拉的股价经历了比大型科技公司更剧烈的回调。与此同时，特斯拉也经历了汽车公司常见的磨难。虽然它在疫情导致供应链断裂期间成功避免了最糟糕的境况，但还是没能逃过中国放弃清零政策时的混乱：它在上海的大型工厂因新冠导致停产而受创。在为汽车业

的电动转型设定了方向之后，它现在面临多方竞争，既来自老牌汽车公司，也来自一大批由它激发的新势力。在特斯拉公布令人失望的数据几天后，大众发布了ID.7，目标直指特斯拉的入门级轿车Model 3。

电动汽车买家越来越不愿像早期用户那样，忽视特斯拉的质量存疑和性价比超低的内饰。进步主义富人中那些自然而然拥抱了特斯拉的车主却不容易对马斯克处理推特时的自由意志主义操作视而不见（去年10月他收购了推特，并兴致勃勃地对它胡作非为），再者现在有很多能让他们良心好过些的其他电动汽车可选。

换句话说，特斯拉不再是唯一的选择——它也肯定不是科技巨头。不过，就电动汽车制造商而言，它的成绩依然骄人。在2022年，它交付了130万辆车，比前一年增长了40%，并启用了两座新装配工厂。它正在研发一款更小、更便宜的车型，今年还将开始交付人们期待已久的Cybertruck皮卡。它的市值仍约为3600亿美元，大约相当于排在它后面的三大汽车制造商的总和。 ■



The Tesla conundrum

Investors conclude that Tesla is a carmaker, not a tech firm

A share-price rout suggests they no longer think it will take over the world

AFTER TESLA'S market capitalisation swept past that of Toyota, then the world's most valuable car company, in the summer of 2020, devoted fans and incredulous sceptics deployed a new unit of measurement. As the electric-vehicle (EV) champion's share price rose, its worth was couched in terms of the combined value of the next two, then five, then ten biggest carmakers. A year ago Tesla's market value surpassed \$1.2trn, more than most other car companies put together. Since then it has lost 71% of that—a sum exceeding the value of most of the industry. The fortune of its mercurial boss, Elon Musk, has shrivelled by more than \$200bn as a result.

The latest blow came on January 3rd, after Tesla missed analysts' expectations for deliveries for the third quarter in a row and reported that the gap between production and deliveries had grown, suggesting softening demand for its EVs. It lost 12% of its value—roughly \$50bn, or one Ford Motor Company—in a day. Even bullish investors now doubt that Mr Musk will fulfil his promise of making 20m cars a year by 2030, or that Tesla's "Autopilot" is close to becoming a world-changing fully autonomous driving system. Yet the main reason for the market's recalibration of Tesla's prospects is a dawning realisation that the company is chiefly a carmaker—and that its boss is not superhuman.

Mr Musk has always regarded his company as a tech firm, a peer of digital giants like Alphabet, Apple or Meta, not of old-economy metal-bashers such as Toyota or Volkswagen. For a time, so did the market—first as tech shares soared amid the pandemic-era boom in all things digital, then as they slumped last year, after their growth began to slow and higher interest rates

made their promised future profits look less valuable today.

In the past few months, however, Tesla's share price has suffered a sharper correction than big tech. This has coincided with its more mundane tribulations as a car business. Having managed to avoid the worst of the pandemic supply-chain disruptions, Tesla has been caught up in China's chaotic retreat from the zero-covid policy; its big factory in Shanghai has been hit by virus-related shutdowns. And having set the course for the industry's EV transition, it now faces plenty of competition from established rivals and a host of newcomers it inspired. Days after Tesla reported the disappointing figures, Volkswagen unveiled its ID.7, a challenger to Tesla's entry-level Model 3 saloon.

EV-buyers, for their part, are becoming less willing than early adopters to overlook Tesla's questionable build quality and the interior of a much cheaper car. And the natural Tesla-owners among the wealthy progressive set are less prepared to overlook Mr Musk's libertarian antics at Twitter, which he bought in October and has mismanaged with gusto—especially now that they have plenty of conscience-salving EV alternatives to choose from.

Tesla is, in other words, no longer the only game in town—and certainly no tech behemoth. As EV-makers go, though, it still looks impressive. In 2022 it delivered 1.3m cars, 40% more than the year before, and opened two new assembly plants. It is working on a smaller, cheaper car and this year will start to deliver its long-awaited Cybertruck pick-up. And it is still worth some \$360bn—about as much as the next three biggest carmakers combined. ■



巴托比

如何度过一生中最富成效的工作日

新的一年，新的你

这是2023年第一个完整的工作周。你已经定下了两个新年决心。首先，把自己变成充满干劲的生产率机器。不再拖延，不再午睡。第二，最大程度地提升自己身心健康的感受。几天下来，你的日记将见证一个人的蜕变，你俨然已是高效自我管理的典范。

07:00，去健身房。把手机留在家里。高尚的灵魂寓于强健的身体。

08:00，让住家外教去叫醒孩子，别让他们出现在你面前。

08:15，在Spotify上听一小段鲸鱼的歌声。淋浴。更衣。

08:30，吃点带奇亚籽的东西。

08:40，清理牙齿上的奇亚籽。

08:58，进入家里的办公区。感觉非常健康。从来没有这么元气满满。

09:00，关闭手机飞行模式，启动笔记本电脑。手机开始疯响：未接来电、Slack信息、短信。又回到了2022年那些糟糕的日子里一天中开始急转直下的时刻。使用新的批处理大法：回复最早的五封邮件，其他一概无视。再次关闭通知。

09:30，列出今天需要完成的任务。根据优先级给它们标记颜色。把高优先级任务切分成独立的部分。综合运用时间盒法和番茄工作法，把它们填写进今天的日程表。

10:30，今天的日程表做好了。未来几小时将非常充实。起身在街区里散个步，避免肌肉骨骼问题。不时停下来遥望20码外，让眼睛保持健康。在

街上见见朋友。

11:30，回到办公桌前。决定找个“陪伴学习”视频，也就是别人伏案工作的录像，让自己面对一天的工作再多一点动力。这个办法非常有效，只要选对了内容。也可以选择有雨点打在窗户上的视频。或者一只熟睡的猫。又或者燃烧的木柴。

12:00，“陪伴学习”录像正在播放。选择了猫。这一天到了这会儿已经有点偏离轨道了。开始第一个25分钟的番茄工作时段。

12:25 这一段效果很棒。起身。伸展。

12:30，开始第二个番茄工作时段。激光都没有我聚焦。

12:40，无聊至极。想要登录Wordle玩猜词游戏，但笔记本上安装了拦截器，18:00之前都不能使用这个网站。唯一的解决方法是更改电脑时间。不确定该怎么做，但应该不会太难。

13:30，还是挺难的。但已经玩过Wordle了（四次就猜中了！）电脑时钟现在完全是错的，显示是2024年。把它改回来就好。

14:00，没时间做第二次邮件批处理了。午餐和养生时段晚了一小时开始。用黑麦面包，三文鱼和莳萝做个开放式三明治。采用叠加习惯的建议，同时做两种正念练习：一边听着蚱蜢叫声的录音，一边自我头部按摩。

15:00，进入闭关模式。放弃番茄工作法：至少要做两小时，然后才开始最后的邮件批处理。在浏览器上使用计时器标签页设置倒计时。

15:30，没什么实质进展。感觉自己有点差劲。打开电子邮件收件箱里的赞美文件夹，回味过去从同事那里收获的赞美。

15:45，开始感到一丝恐慌。孤注一掷，启用“不写就死”这个老程序，如果没有达到字数目标，它就会开始删除你已经写下的东西。这能帮你在页面

上尽量写下点什么。

16:15，见鬼了。孩子手上沾着什么毛茸茸的东西进来了（老鼠？还是谁的头发？）当我把她打发出去后，“不写就死”已经抹去了我写下的大部分东西。

17:00，用孩子的印字模版制作了一张非常专业的海报，上面写着“工作中，请勿进入”，准备把它贴在门上。不错，搞定了一件事。我需要提提神，去参加公司一直在营销的笑声疗法课程吧。

17:30，不知为何，调不出声音。笑疗里的所有人看起来都跟疯了一样。已经把问题报给IT部门。

17:45，第三个（好吧，第二个）邮件批处理时段开始了。重新打开通知，打开邮箱。消息洪流般涌入。老板打来过四通电话。很难说发生了啥事，但似乎人人都对我有意识地给工作排序很有意见。也不奇怪。

18:00，打给老板。我必须在明早9点前为一个新客户做完一些事。感觉好多了。要是每天都有人给我设定一个紧急的最后期限就好了。■



Bartleby

How to have the most productive working day of your life

New year, new you

IT'S THE first full working week of 2023. You have two new year's resolutions. First, to turn yourself into a humming machine of productivity. No more procrastinating, no more afternoon naps. Second, to maximise your own sense of well-being. A few days in, and your daily journal bears witness to a changed person, a model of self-caring efficiency.

07:00 Go to the gym. Leave phone at home. Mens sana in corpore sano.

08:00 Tell au pair to wake children, and to keep them out of your way.

08:15 Listen briefly to the call of a whale on Spotify. Shower. Dress.

08:30 Eat something with chia seeds.

08:40 Remove chia seeds from teeth.

08:58 Enter home office. Great sense of wellness. Never felt better.

09:00 Turn phone off aeroplane mode and fire up laptop. Phone goes mad: missed calls, Slack messages, texts. Precisely where the day went wrong in the bad old days of 2022. Use new batching technique: respond to the oldest five emails and ignore everything else. Turn notifications off again.

09:30 Make a list of tasks that need to be completed today. Colour-code those tasks according to priority. Chunk each of the high-priority tasks into discrete segments. Use combination of time-boxing and Pomodoro techniques to put them into the calendar for the day ahead.

10:30 Calendar for the day is now complete. Very full few hours ahead. Get up and go for a walk around the block to avoid musculoskeletal problems. Every so often stop and look 20 yards into the distance to maintain eye health. See friend on street.

11:30 Back at desk. Decide to find a “Study with Me” video, a recording of someone else working at their desk, as extra motivation for the day to come. Very effective technique, just need to choose the right recording. Might have one with rain pattering on the windows. Or a cat sleeping. Or logs on a fire.

12:00 “Study with Me” recording is now playing. Went with the cats. Day is slightly off-track now. Begin first 25-minute Pomodoro session.

12:25 Excellent session. Get up. Stretch.

12:30 Second Pomodoro session begins. Lasers are less focused than me.

12:40 Extremely bored. Try to get onto Wordle but have installed blocker on laptop that means I cannot use the site until 18:00. Only way around this is to change the time on the computer. Not sure how to do this but it cannot be that hard.

13:30 It is quite hard. But Wordle is done (in four tries!). Clock on computer is now totally wrong; saying it is 2024. Just need to change it back.

14:00 No time for second email-batching session. Lunch and well-being hour begins an hour late. Make open sandwich with rye bread, salmon, dill. Use stacked-habits advice to do two mindfulness exercises at once: self-administer head massage while listening to soundtrack of grasshopper noises.

15:00 Activating hermit mode. Ditch Pomodoro technique: need to get at least two hours done before final email-batching session. Use timer tab to

set countdown clock going on my browser.

15:30 Not made great progress. Feeling a bit worthless. Open the compliments folder in my email inbox to remind myself of praise I have received from colleagues in the past.

15:45 Starting to feel a bit panicky. As last resort use “Write or Die”, an old program that starts deleting your work if you have not met targets for word count. Helps just to get something on the page.

16:15 FFS. Child came in with something hairy (a rat? someone else’s hair?) glued to her hand. By the time I had shooed her out, “Write or Die” had erased most of what I had got done.

17:00 Have used child’s stencil set to make a very professional poster that says “Do not enter: I am working”. I will paste it on my door here. Good to get this done. Need a pick-me-up, so am going to attend laughter-therapy session that the company has been advertising.

17:30 Couldn’t get sound to work for some reason. Everyone looked completely mad on the laughter-therapy thing. Have logged the problem with IT.

17:45 Third (well, second) email-batching session begins. Notifications back on, and email opened. Torrent of messages. Four calls from my boss. Hard to tell what is going on, but everyone seems upset that I have been consciously prioritising work. Typical.

18:00 Ring boss. I have until 9am tomorrow morning to get something done for a new client. Feel much better. If only people could just set me an urgent deadline every day. ■



熊彼特

如何避免航班大混乱

非常成功却毁了圣诞假期的西南航空和沃拉里斯航空给出的教训

许多人应该都在电视上看到了愁眉苦脸的西南航空（Southwest Airlines）旅客。这家美国最大的国内航空公司因飓风陷入瘫痪，导致他们无法趁假期探望家人。然而，很少有人见识过位于美墨边境南侧的蒂华纳

（Tijuana）机场的出行地狱——在那里，墨西哥目前最大的航空公司沃拉里斯（Volaris）廉价航空因为大雾而乱成了一锅粥。笔者亲身经历了。圣诞夜、圣诞节和圣诞节次日的大部分时间里，他和妻子还有成千上万名其他旅客都被困在那里，试图重新预订已经取消的航班，前往墨西哥各处的目的地。大多数时候，无奈压过了愤怒。但是，当人们排了11个小时的队重新订票，却被一名沃拉里斯航空的工作人员告知排错了队时，圣诞的欢快气氛还是烟消云散了。就在同一时间，该公司发了一条应景的推文：“圣诞的魔力沐浴着沃拉里斯的所有家人们。”

这两起事件有许多相似之处。它们都与天气有关，都在12月23日这一天变得最严重，并几乎一直延续到假期快结束时。它们的影响都令人极不愉快。据追踪航空活动的FlightAware称，西南航空在高峰期取消了近四分之三的航班。蒂华纳的浓雾迫使沃拉里斯航空取消了其网络中45%的航班，打击了自己的核心市场——从美国回家乡的墨西哥移民。两家航空公司遇到的麻烦都比那些全业务竞争对手更严重。例如，联合航空取消的航班比西南航空少得多，尽管这两家公司在丹佛和芝加哥都有很大的业务，而那里的形势尤其严峻。与沃拉里斯航空不同，大雾消散后，墨西哥老牌航空公司墨西哥航空（Aeromexico）立即恢复了从蒂华纳出发的航班。

那么能从这些糟糕的事件中学到什么，未来又能如何避免它们呢？在西南航空的案例中，大部分注意力都集中在它过时的技术上。新任首席执行官鲍勃·乔丹（Bob Jordan）曾在12月初承诺要升级部分技术。但航空业也是由人组成的。行业停摆无比清楚地突显了让飞行员、乘务员、机械师和地

勤人员在正确的时间出现在正确的地点有多么重要。沃拉里斯航空的老板恩里克·贝特雷内纳（Enrique Beltranena）接受的一次采访提醒人们，要解决人的问题至少和技术问题一样有难度。

他首先承认了错误，也找了个借口。在美国和墨西哥，天气问题撞上了圣诞节，航空公司特别不愿意在这个时间点取消航班，因为会严重影响乘客的情绪。“我们可能拖得太久了，最后才咬咬牙，真的把不得不取消的航班取消了。”他承认。这对于西南航空和沃拉里斯航空来说尤其是个问题，因为这两家的飞机大多都是点对点飞行，也就是说它们的飞机是从一个机场跳到另一个机场，而不是像传统航空公司那样返回某个枢纽机场。因西南航空而出名的点对点模式有很多优点。飞机飞来飞去地赚钱，而不是在停机坪上闲着。例如，一架沃拉里斯航空的飞机平均一天要飞往五个以上不同的机场。但是一旦出现问题，从一个枢纽机场派飞机去营救滞留的乘客要比让分散在大批机场的航班改变路线更便捷，也更容易找到空闲且休息好了的机组人员。

正如贝特雷内纳所解释的那样，为了阻止一个问题如滚雪球般演变成一场危机，需要抢先一步取消航班，以让飞机能够快速改变航线，准备支援。不过，先发制人取消航班是个艰难的选择。咨询公司Atmosphere Research Group的总裁亨利·哈特维尔特（Henry Harteveldt）将这比作决定“该把自己的哪个孩子扔出飞机”。西南航空和沃拉里斯航空都没能足够迅速地做出这个决定以保护它们的整个网络。从FlightAware的数据可以看出西南航空的问题愈演愈烈。数据显示，在风暴来临前的几天，该公司几乎没有取消任何航班，随后航班取消率从12月23日的33%飙升至三天后的74%。FlightAware的凯瑟琳·邦兹（Kathleen Bangs）说，“西南航空几乎全面重启了航线，是我前所未见的程度。”几天后，沃拉里斯航空采取了类似的激烈措施。“我们基本上重启了整个流程。”贝特雷内纳说。

下一个问题发生在地面上。乘客们恳求取回他们的行李箱。但是地勤人员也是人。在丹佛，一些人没有去上班。在蒂华纳，贝特雷内纳说行李搬运工加班太多，等到开始新的轮班时已是筋疲力尽。此外，当乘客试图重新预订航班时，沟通长时间缺位。沃拉里斯航空人手有限，无法应对数千名

滞留在蒂华纳的乘客。而该航空公司的呼叫中心却承诺为乘客重订已经被取消了的航班，更是在火上浇油。贝特雷内纳认为解决的办法是增加员工，即使这在正常时期会导致人力冗余。

最大的重启将发生在IT系统。西南航空的机组人员管理技术已经跟不上该公司日益复杂的网络。沃拉里斯航空的技术显然也没能支撑起自己的网络。咨询公司CA Advisors的贾汉·阿拉姆扎德（Jahan Alamzad）表示，问题在于航空公司一直专注于开发面向客户的有吸引力的应用，如订票系统，而跟踪飞机、机组人员、维护和天气的各种后端应用却是各自为政。要在压力之下改变飞机和机组人员的航线，实时掌握全局状况很重要。

新的IT基础设施不易部署。航空公司不能直接撤下旧的，换上新的，各个系统必须要整合起来。黑客攻击也是个普遍的担忧。然而，最大的障碍可能还是在人这边。西南航空和沃拉里斯航空之类的航空公司自认为很卓越。它们发展得太快，有变得自满的风险。反常的天气或许如贝特雷内纳所言是不可抗力。但没有任何理由不为最坏的情形做好准备。■



Schumpeter

How to avoid flight chaos

Lessons from Southwest and Volaris, two highly successful airlines that ruined the holidays

MANY WILL have seen TV footage of woebegone travellers unable to visit their families during the holidays because of a cyclone-induced meltdown at Southwest Airlines, America's largest domestic carrier. Very few, however, know about the travel hell just south of the border at Tijuana airport, due to fog-induced mayhem at Volaris, a low-cost carrier that is Mexico's largest airline. Your columnist does. He and Mrs Schumpeter spent much of Christmas Eve, Christmas Day and Boxing Day stranded there along with thousands of other travellers, trying to rebook cancelled flights to destinations across Mexico. For most of the time, resignation not rage prevailed. But yuletide cheer did fade when, after standing in line for 11 hours to rebook tickets, people were told by a Volaris representative they were in the wrong queue. At exactly the same moment, the company sent out a seasonal tweet: "The magic of Christmas extends to the whole Volaris family."

The two incidents share many similarities. Both were weather-related. They became critical on the same day, December 23rd, and dragged on through much of the holidays. Their effects were traumatic. According to FlightAware, which tracks airline activity, at its peak Southwest cancelled almost three-quarters of its flights. The thick fog in Tijuana forced Volaris to cancel 45% of flights across its network, hitting its core market—Mexican migrants returning home from America. Both airlines were caught out worse than full-service rivals. United Airlines, for example, cancelled far fewer flights than Southwest, even though both have big presences in Denver and Chicago, where the situation was particularly acute. Unlike

Volaris, Aeromexico, a legacy Mexican carrier, immediately resumed flights from Tijuana when the fog lifted.

So what can be learned from the mishaps—and how can they be avoided in the future? In Southwest's case, much of the attention has focused on its outdated technology, some of which its new CEO, Bob Jordan, had promised in early December to upgrade. But the airline industry is also human. When it stops working, it becomes all too clear how important it is that pilots, flight attendants, mechanics and ground staff are in the right place at the right time. An interview with Enrique Beltranena, boss of Volaris, provides a reminder that human problems can be at least as difficult to solve as technological ones.

He starts with both a *mea culpa* and an excuse. In America and Mexico the weather problems occurred at Christmas when airlines are particularly reluctant to cancel flights because of the emotional toll on passengers. "We probably took too much time before biting the bullet and really cancelling what we had to cancel," he admits. For Southwest and Volaris, this was a particular problem because both airlines mostly fly point to point—in other words, their planes hopscotch from one airport to the next—rather than returning to a hub, as do legacy carriers. The point-to-point model made famous by Southwest has many advantages. Planes make their money in the air, not sitting on the tarmac. A Volaris aircraft, for example, flies on average to more than five different airports in a single day. But when problems arise, it is easier to send planes from a hub to rescue stranded passengers, rather than rerouting flights from myriad airports. It is also easier to find spare—and rested—crew members.

As Mr Beltranena explains, to stop a problem snowballing into a crisis, you need to pre-emptively scrap flights in order to quickly reroute aircraft as backup. Pre-emptive cancellation is a tough choice, though. Henry Harteveldt, president of Atmosphere Research Group, a consultancy, likens

it to deciding “which one of my children am I going to throw out of the aircraft”. Both Southwest and Volaris failed to do it swiftly enough to safeguard their wider networks. You can see the cascading problems at Southwest in FlightAware’s data. They show it barely scrapping any flights in the days before the storm, and then cancellations soaring from 33% of its flights on December 23rd to 74% three days later. “Southwest came as close to doing a full airline reboot as I’ve ever seen,” says Kathleen Bangs of FlightAware. A few days later Volaris took similarly drastic measures. “We basically restarted the entire process,” Mr Beltranena says.

The next problem was on the ground. Passengers pleaded for their suitcases. But ground staff are also human. In Denver some failed to show up for work. In Tijuana, Mr Beltranena says baggage handlers put in so much overtime that they were exhausted by the time they started a new shift. Moreover, as passengers tried to rebook flights, there was a chronic lack of communication. A handful of Volaris staff were unable to handle the thousands of stranded passengers in Tijuana, and the airline’s call centre made things worse by promising to rebook passengers on flights that no longer existed. The answer, Mr Beltranena believes, will be to increase staffing, even if that leads to spare capacity in normal times.

The biggest reboot will be to IT systems. Southwest’s crew-management technology has failed to keep pace with the airline’s increasingly complex network. Volaris’s, too, clearly let it down. Jahan Alamzad of CA Advisors, a consultancy, says the problem is that airlines have focused on creating attractive customer-facing applications, such as booking systems, while back-end ones such as those keeping track of planes, crews, maintenance and weather operate in silos. In order to reroute planes and crews in times of stress, it is important to have the complete picture in real time.

New IT infrastructure is hard to install. Airlines cannot rip out the old and put in the new. Systems must be integrated. There is also widespread fear of

hacking. Yet the biggest hurdle is probably, again, a human one. Airlines like Southwest and Volaris think they are exceptional. They have grown so fast that they risk becoming complacent. Freak weather may, as Mr Beltranena puts it, be an act of God. But there is no excuse not to prepare for the worst.





基因工程

《扮演上帝》带你初探一门充满争议的科学

马修·科布阐述基因工程引发的道德问题【《扮演上帝》书评】

《扮演上帝》，马修·科布著。Basic Books出版社，464页；35美元。英国版名为《基因时代》，Profile Books出版社；25英镑。

二〇一八年，中国生物学家贺建奎宣布首例基因编辑婴儿诞生，迅速在世界各地登上头条。贺建奎使用强大的基因编辑新技术CRISPR-Cas9，尝试在一对婴儿身上重建基因突变，已知这些突变可以抵抗导致艾滋病的HIV病毒。

贺建奎或许期待着满堂喝彩，结果却收获一片骂声。遗传学家纷纷谴责这一实验（有人称之为“道德沦丧”）。结果表明这次基因编辑出了差错，在婴儿们身上产生了新的、从未见过的突变，而非预期的突变。而且至关重要的是，贺建奎的基因编辑具有遗传性，意味着这些孩子会把出错的编辑结果传递给自己的后代。2019年，他被判处三年监禁并处罚金300万元人民币。

除了让少数领导人有能力摧毁文明的核物理学以外，没有什么科学分支能像基因工程那样引发巨大的公众恐惧和争议——这是一个操纵生命本身的学科。这些道德问题给曼彻斯特大学的动物学家马修·科布（Matthew Cobb）的新书带来了生动的题材。

《扮演上帝》（As Gods）讲述了基因工程及其引发的忧虑的历史——这些忧虑或合理，或可疑，有时则是彻头彻尾的阴谋论。这项技术已经取得了诸多成功。例如，现在可以通过经基因改造的细菌生产糖尿病患者所需的胰岛素，而不再需要大费周章地从死猪身上提取。经改造而携带某种失灵基因的修复版本的病毒已经能够治愈一些罕见疾病，例如脊髓性肌萎缩症，英国最近就批准了这种疾病的基因疗法。

但它也一路磕磕绊绊。从1970年代起，大批资金涌入这个领域，让人们对其寄予厚望，却又势必要失望。不够精确的工具难以发挥好功效，令研究举步维艰。大自然创造的遗传学简直是一个复杂难解的噩梦，单个基因就会同时影响动植物的许多特征，而且往往无法预料。

与此同时，尽管科学家实际上可以读取基因编码的字母，但将它们翻译成有意义的单词和句子比大多数观察家在30年前会猜想的要困难得多。转基因作物一直毁誉参半；对疾病的基因治疗则失败多于成功。

科布轻快地讲述了这些发展进程，通俗易懂地解释了基因编辑的分子基础及其各种可能用途，从修复导致疾病的突变到把细菌转化为药物的工厂等等。更先进和推测性的想法包括“基因驱动”，也就是不遵守通常的自然选择规则的遗传信息片段，有可能成为消灭蚊子等害虫的一种方法。此外还有长久以来增强人类基因的梦想。

和这门科学一样，这本书也有瑕疵。对贺建奎的实验的讨论言辞激烈，有点用力过猛，其结果是未能强化、反而淡化了这一事件的影响。科布的行文通俗易读，但偶尔也会冒出一些未加解释的专业术语。他对人类基因工程的一些反对意见是基于当前使用的工具还很不可靠。这确实是一个重要障碍，但读者可能更想了解一个更宏大的问题：如果这些问题得到解决，又可能会有或者应该有怎样的发展。

无论如何，任何人若想要找到一份详实的探讨来了解这门长久充满争议的科学的道德义涵，《扮演上帝》是一本出色的入门书。掩卷而思，读者会感到，尽管取得了这样那样的突破，基因工程尚未兑现其承诺。而如果，或者说到了时候，承诺最终兑现，又会发生什么？这一切仍然值得深思。





Genetic engineering

“As Gods” is a valuable primer on a controversial science

Matthew Cobb illuminates the moral issues raised by genetic engineering

As Gods. By Matthew Cobb. Basic Books; 464 pages; \$35. Published in Britain as “The Genetic Age”; Profile Books; £25

IN 2018 HE JIANKUI, a Chinese biologist, made headlines around the world when he announced the birth of the first genetically modified human beings. Using a new and powerful gene-editing technique called CRISPR-Cas9, Dr He had tried to recreate mutations in the babies that are known to confer resistance to HIV, the virus that causes AIDS.

Dr He may have been expecting plaudits. Instead, he got brickbats. Geneticists decried the experiment (one called it an “ethical fiasco”). The gene editing turned out to have gone wrong, introducing new, never-before-seen mutations in the babies instead of the intended ones. And, crucially, Dr He’s tweaks are heritable, meaning the children will pass on the botched edits to their own offspring. In 2019 he was sentenced to three years in prison and a fine of 3m yuan (\$435,000).

Apart from nuclear physics, which has empowered a handful of leaders to destroy civilisation, few branches of science have inspired as much public dread and disputation as genetic engineering, which allows tinkering with the stuff of life itself. These moral concerns animate a new book by Matthew Cobb, a zoologist at the University of Manchester.

“As Gods” is a history of both genetic engineering and the worries—justified, dubious and sometimes outright conspiracist—it has provoked. The technology has had many successes. The insulin needed by diabetics is now produced by modified bacteria, for instance, instead of being laboriously

harvested from pig corpses. Modified viruses carrying fixed versions of malfunctioning genes have been able to cure some rare diseases, such as spinal muscular atrophy, for which a genetic-engineering treatment was recently approved in Britain.

But there have been many setbacks, too. The tide of money that flowed into the field from the 1970s raised expectations that were bound to be disappointed. Research has been plagued by imprecise tools that are hard to use well. Genetics as implemented by Mother Nature has proved to be a knotty, Heath Robinson nightmare, with individual genes affecting many of an animal's or plant's characteristics at once, often unpredictably.

Meanwhile, though scientists can in effect read the letters of the genetic code, translating them into meaningful words and sentences has been much harder than most observers would have guessed 30 years ago. Genetically modified crops have been a mixed bag; genetic therapy for the sick has failed more than it has succeeded.

Mr Cobb rattles through these developments briskly, accessibly explaining the molecular basics of gene editing and all sorts of possible uses for it, from fixing the mutations that cause diseases to turning bacteria into drug factories. More advanced and speculative ideas include “gene drives”—bits of genetic information that do not obey the usual rules of natural selection, and have been proposed as a way of wiping out pests such as mosquitoes—and the long-standing dream of human genetic enhancement.

There are glitches in this book as there are in the science. The discussion of Dr He's work feels polemical and a bit overwrought; that ends up diluting its impact rather than amplifying it. The occasional technical term goes unexplained in Mr Cobb's otherwise readable prose. Some of his objections to human genetic engineering are based on the observation that the tools involved are, for now, rather unreliable. That is an important obstacle—but

readers may be more interested in the bigger question of what could or should happen if those problems are solved.

Nevertheless, “As Gods” is an excellent primer for anyone seeking a well-informed discussion of the moral implications of this enduringly controversial science. Readers are left with the impression that, for all the breakthroughs, it has yet to live up to its promise. It is still worth pondering what might happen if—or when—it ultimately does. ■



疫情后的生活

全面重新开放对中国乃至世界意味着什么

今年最大的经济事件已经启动【深度】

中国在1月8日这一天开放边境，结束了1016天关闭国门的时光。该国的清零政策是一项史无前例的社会和经济实验。这场大规模的公共卫生运动在大部分时间里避免了疫情大面积传播，令习近平感到骄傲和喜悦，末了对14亿中国人中的许多人却成了一场活生生的噩梦。

政府派出大批“大白”，采集了以百亿计的鼻咽拭子。数以百万的人被隔离或拉到方舱，经常是任意而为。在发现病例的办公室和工厂，人们因为害怕被隔离而仓皇逃离。民众拍摄的视频捕捉到了居民在被隔离多周后从住宅楼上一跃而下身亡的瞬间。在大城市，日常生活被按下暂停键长达数月之久。中国年轻富有的国际化阶层被迫接受了不能出国旅行的生活。外国企业家和高管也无法返回他们在中国的居所和企业。

在疫苗广泛普及之前，官员可能会争辩说需要以这种方法来挽救生命。但到最后，这场实验以非同寻常的代价换来了惨淡的现实。中国经济在2022年的增长率可能不到3%。根据研究公司牛津经济研究院（Oxford Economics）的数据，由于中国当初没有像其他国家那样重新开放，在过去18个月里，GDP少增长了一万亿美元。封控限制扰乱了最先进的全球供应链。11月工业企业利润同比下降了9%。与此同时，中国与外界的交流跌至几十年来的最低点。外国留学生基本都走了。境外旅游已经崩溃。过去两年半的时间里习一直在国内，最近才又开始出访。

清零政策持续的时间比任何人最初预期的都要长，解除的速度又比任何人能想象得到的都快。仅仅几周内，中国从采取全世界最严厉的一些封控措施转向了几乎毫无限制。广大民众不再担心会被封锁和隔离。经过一段时间的混乱动荡后，经济活动很可能会急剧反弹。世界各地都将感受到能源和大宗商品的需求增加。投资者和跨国公司高管很快就能造访办公室和工

厂。中国重新连接上外部世界的重大事件标志着全球大流行病时代的结束。

常态不会立即恢复。据一项估计，现在每天有3700万人感染新冠病毒。医院人满为患。火葬场超负荷运行。官员承认的死亡数字很少，并且面临着保持生产线运转的巨大挑战。汽车制造商特斯拉于12月24日暂停了上海工厂的生产。一位高管担心地方官员可能会封锁乡镇以减少感染人数。德国商业银行（Commerzbank）的汤米·吴（Tommy Wu，音译）表示，经济可能会在开放后的头三个月收缩。但复苏的到来将比分析师此前预期的更快。许多人认为波动期将在3月底结束。届时复苏就将开始，并随着时间的推移而增强势头。

李鹏飞原本是北京一家工业软件公司的产品经理，和很多人一样，他也迫切希望能尽快恢复常态。去年2月，李鹏飞失业，当时的封控政策让他几乎无法完成到外地拜访客户等基本工作。后来他和姐姐住了一段时间，最终不得不回到东北吉林的老家，一个即便在疫情之前经济前景就很黯淡的地方。“形势看起来很不稳定，连大公司都在裁员。”他说。

在世界其他地方，老板们普遍担心“大辞职潮”，也就是工人辞职或完全退出劳动力市场。中国不大有这方面的担忧。疫情期间，政府并没有像美国那样随意地发放现金刺激。经济学家认为，像李鹏飞这样的失业人员会在机会出现时重返工作岗位，这将有助于稳定工厂产出。

消费也会增加。收入下降了，但清零政策也抑制了支出，因为人们都尽量避免出行和外出就餐。总体而言，去年家庭收入有三分之一存了起来。疫情期间许多人丢了饭碗、工资停涨、房产贬值，开放后要重新站稳脚跟，这也意味着挥霍会有限度。但法国巴黎银行（BNP Paribas）的荣静估计，2023年家庭消费将增长9%左右，即使算不上是对近年来被迫节制的全面报复，也会比上一年的增长率有很大提高。

重新开放也将让中国陷入困境的房地产业受益，尽管程度大小取决于政治决策。11月，随着防疫政策的放松，政策制定者放宽了房地产开发商的融

资渠道。这应该有助于实力更强的公司避免违约，最终将已预售后给购房者的楼盘完工交付。在12月的中央经济工作会议上，政策制定者承诺支持与投机性购房相对的“刚性和改善性住房需求”。为此他们可能会进一步降低房贷利率和首付要求。

广义的房地产业包括建筑、服务和装修装饰等，各方对行业表现的预测差别很大。汇丰银行的刘晶表示，今年该行业的业务量可能将增长3%，足以带动中国GDP增加0.9个百分点。她认为，更乐观的情况是房地产行业活动增长5%，推动GDP增长1.5个百分点。一些家庭可能会判定，趁着价格还没回升或对购房的监管限制还未恢复，目前是“逢低买入”的好时机。

重新开放的经济影响还会延伸到国境之外。清零政策压制了中国对全球产品、服务和大宗商品的需求。例如，去年上半年上海封城期间，全国石油需求每天减少了200万桶。在过去，中国的支出以这种幅度下跌会让世界经济失去一个重要的增长引擎。疫情造成的需求低迷有所不同，它恰逢美国经济过热和欧洲各地能源供应中断。“至少这次中国没有助长通胀。”评级机构标普全球（S&P Global）的高路易（Louis Kuijs）说。

中国的复苏将提振全球经济增长，原因很简单——中国是世界经济的最大组成部分。汇丰银行估计，从现在起的一年后，也就是2024年的第一季度，中国的GDP可能将比2023年麻烦不断的头三个月高出多达10%（见图表1）。根据我们的粗略计算，这一期间复苏中的中国可能将在全球增长中占到三分之二。

然而，假以时日，中国的复苏可能会带来不良副作用。在其他大型经济体中，货币政策对经济扩张具有约束力，因为央行会提高利率以抑制通胀。如果中国的重新开放看起来会增加全球需求，并因此导致价格压力达到令人不安的程度，其他国家的央行可能就不得不通过收紧政策来应对这一威胁。在这种情况下，中国重新开放对世界其他地区的影响可能不会表现为增长加快，而是通胀或利率升高。

中国开放最直接的影响表现在大宗商品需求上。它消耗了全球近五分之一

的石油，一半以上的精炼铜、镍和锌，以及超过五分之三的铁矿石。11月4日，仅是中国要重新开放的传言就导致铜价在当天收盘时上涨了7%。随着传言成为现实，中国对金属、农作物和能源的需求将有利于大宗商品出口国，而不利于进口国，并让世界各国央行在对付通胀时又多了一个令人头疼的问题。

在清零期间，中国对金属的需求依然强劲，因为政府鼓励在电动汽车、可再生能源和其他形式的绿色基础设施方面进行投资，这些产业都需要大量的铝、铜和其他金属。但买家缺乏储备这些金属的信心，铜库存降至15年来的最低点。重新开放将鼓励买家补货。去年11月，高盛估计铜价将在12个月内上涨至每吨9000美元。现在它认为价格将达到1.1万美元。

能源需求的韧性欠佳，尤其是清零政策行将结束时。与上年同期相比，2022年前11个月中中国液化天然气（LNG）进口量下降了约五分之一。这让欧洲得以增加进口，以弥补俄罗斯供气的缺口。因此，中国的清零政策抵消了俄罗斯入侵乌克兰的部分影响——一个错误帮助减轻了另一个错误对欧洲的冲击。

根据买家已签定的合同以及他们不愿在高价位购买LNG的心态，分析人士预计今年中国的LNG进口量将温和增长。如果进口恢复得更快，欧洲可能会感到压力。在去年12月的压力测试中，官方预测机构国际能源署

（IEA）做了以下假设：中国的需求在未来一年将增长约四分之一，回到2021年的水平；俄罗斯将彻底切断通往欧洲的管道天然气；冬季如期而来。在这种情况下，欧洲将面临270亿立方米的天然气短缺，相当于年需求量的7%，这已经把目前正在努力增加的供应计算在内。国际能源署警告说，如果不采取其他措施，欧洲可能将被迫实行配给制。

对石油的影响可能也很显著。澳新银行（ANZ）的索尼·库马里（Soni Kumari）估计，如果中国经济在2023年全面复苏，其原油进口将在这一年逐步增加，直至日均进口增加100万桶。这将弥补欧洲和美国的需求减少，这两者都处在经济衰退边缘。事实上，高盛预测中国的需求增加可能会将每桶油价推高约15美元。它估计今年第三季度布伦特原油价格可能再

次突破100美元，让全球抗击通胀一役变得更加艰难。

大宗商品价格上涨将有利于智利和巴西等出口国，但会损害中国那些需要进口能源的邻国。对印度而言，价格上涨带来的损失可能会抵消对中国大陆出口增加带来的收益。更紧密地融入了中国制造业供应链的其他国家似乎更能从中受益。但原始统计数据可能具有欺骗性。尽管2021年台湾对中国大陆的商品出口相当于GDP的15%以上，但其中许多是产品零部件，组装后的成品最终还是销售给了中国境外的客户，因此可能不受政策变化的影响。

对邻国经济提振最大的将不是向中国出售商品，而是吸引中国公民前往旅游（见图表2）。来自上海的倪娜（Ni Na，音译）是两个孩子的母亲，疫情之前每年大约出国旅行五次，通常会在国外生活三四个月。2022年她曾试着在国内旅行，但因封控措施而放弃。隔离要求解除后，倪娜将再次踏上旅途。她已经提前更新了护照和两个儿子的旅行证件。

高盛估计，一旦中国完全重新开放，泰国这个热门目的地的GDP可能会因此提振升三个百分点。牛津经济研究院的阿勒普·拉哈（Arup Raha）表示，这将消除包括货币在内的当地资产价格的不确定性，从而减轻泰国央行加息的压力——一个实际产出仍低于潜在产出的国家会很乐意保留这一自由。但最大的赢家将是中国香港。全面重新开放后，包括旅游业在内的出口增加可能会将其GDP提高近8%。这座城市曾经每月吸引超过400万大陆游客。没有了他们，香港感觉没那么拥挤了，但经济也更差了。

共产党善于改写历史。然而习将难以摆脱自己的声望在2022年受到的损害。不当实施清零政策，随后又仓促放弃，这将是被人们长久记得的失误。许多投资机构调整了对中国的风险评估，未来三年将减少对中国的配置，除非获得补充。11月约有180亿美元的外汇流出中国，10月为110亿美元。预计当中国经济在2023年企稳时，资金外流将会出现逆转，但不太可能迅速恢复到疫情之前的资金流入规模。

中国的部分供应链受到了严重破坏。华中地区一家生产苹果iPhone 14的工

厂爆发新冠疫情，随后引发抗议，延误了订单生产。对于外国公司而言，在这场危机中中央政策首次干预了地方官员维持工厂运转的承诺。许多公司现在愿意支付更多成本在其他地方生产。以推出新产品的过程为例，在总部（通常设在西方）的研究人员和科学家经常需要到中国的工厂出差。疫情期间人员往来难以维系。工程师不再到访工厂，在中国推出的新品减少，跨国公司被迫（通常很不情愿）将新品的推出转至别处。

但在经历了几年的清零政策之后，企业老板已经更能接受从中国撤离了。新“绿地”工厂的入境投资大降（见图表3）。与此同时，迁出中国的外资企业数量猛增，供应链咨询公司East West Associates的阿历克斯·布莱恩特（Alex Bryant）说。布莱恩特的公司在过去一年中协助完成的大部分搬迁都是迁往国外。他认为中国重新开放不太可能让这一走向立即逆转。

政策制定者已经开始意识到问题。据一则官媒报道，福建、广东、四川、浙江等地的官员和企业家正在计划出国行程以赢回投资者。“一次见面，胜过千封邮件。”该文称。12月，中国领导人宣布将吸引外资作为重点工作任务，强调地方政府应将招商引资放在工作首位。摩根士丹利的邢自强指出，这样的讲法已经多年没有在政治局会议上出现了。“他们显然想保住自己在全球供应链中的地位。”他说。然而，要弥补2022年的混乱带来的损失，将需要太多的见面了。





Life after covid-19

What the great reopening means for China—and the world

This year's biggest economic event is already under way

WHEN ITS borders open on January 8th, China will have spent 1,016 days closed to the outside world. The country's "zero-covid" policy has been a social and economic experiment without precedent: a vast public-health campaign that mostly kept the disease at bay; Xi Jinping's pride and joy; and, by the end, a waking nightmare for many of China's 1.4bn people.

Armies in white hazmat suits have been deployed to collect tens of billions of throat and nasal swabs. Millions were quarantined or hauled off to fever camps, often arbitrarily. Fear of isolation sent people fleeing from offices and factories where cases were found. Amateur videos captured residents leaping to their deaths from apartment blocks after weeks of seclusion. In major cities daily life stood still for months on end. A cosmopolitan class of young, wealthy Chinese was forced to come to grips with a life without international travel. Foreign entrepreneurs and executives were barred from returning to their homes and businesses in the country.

Before vaccines were widely available, officials could argue this approach was needed to save lives. By the end, the experiment offered a bleak existence at an extraordinary cost. China's economy probably grew by less than 3% in 2022. Over the past 18 months, it has forgone about \$1trn-worth of GDP, according to Oxford Economics, a research firm, compared with what it would have produced had its reopening resembled the rest of the world's. Restrictions on movement snarled the most advanced global supply chains. In November profits at industrial firms dropped by 9% year on year. Meanwhile, exchanges between China and the outside world fell to their lowest in decades. Few foreign students remain. Overseas tourism has

collapsed. Mr Xi has only recently resumed foreign travel after remaining in China for two-and-a-half years.

Zero-covid lasted longer than anyone initially expected, then collapsed faster than anyone could have imagined. In a matter of weeks China has gone from some of the world's strictest restrictions to almost none. For the population at large, fear of lockdowns and quarantine has vanished. Following a period of turbulence, economic activity is likely to rebound sharply. Increased demand for energy and commodities will be felt around the world. Investors and multinational executives will soon be able to visit offices and factories. The great reconnecting of China with the outside world marks the end of an era: that of the global pandemic.

Normality will not arrive immediately. According to one estimate, 37m people a day are catching covid. Hospitals are overwhelmed. So are crematoria. Officials acknowledge few deaths—and face an immense challenge keeping production lines running. Tesla, a carmaker, halted operations at its factory in Shanghai on December 24th. Local officials may seal off towns to keep cases down, worries an executive. The economy could contract in the first three months of opening up, says Tommy Wu of Commerzbank. But the recovery will arrive earlier than analysts had expected. Many think the period of volatility will draw to a close by the end of March. At that point, a recovery will begin that should gain strength as the year progresses.

Li Pengfei, until recently a product manager at an industrial-software firm in Beijing, is among those desperate for a return to normality. Mr Li lost his job in February when restrictions made basic duties, such as travelling to meet clients, near-impossible. He spent part of last year living with his sister, but was forced to return home to Jilin province in China's far northeast, where economic prospects were dismal even before the pandemic. "Things seem so volatile that even the big companies are

downsizing,” he says.

Elsewhere in the world bosses worry about a “great resignation”, with workers quitting jobs or dropping out of the labour force altogether. This is less of a concern in China. The government did not hand out stimulus cheques willy-nilly, as America’s did, during the pandemic. People who lost jobs, such as Mr Li, will return to work when the opportunity arises, economists believe, helping to steady factory output.

Consumption will rise, too. Incomes have fallen, but zero-covid also squashed spending, as people avoided travelling and eating out. All told, households saved one-third of their income last year. Many will be getting back on their feet after job losses, stagnating pay and declines in the value of their homes, meaning the splurge will be limited. But Jacqueline Rong of BNP Paribas, a bank, reckons household consumption will grow by about 9% in 2023—a big improvement on the previous year’s growth rate, if not full retribution for the enforced abstemiousness of recent years.

Reopening will also benefit China’s troubled property sector, though quite how much depends on political decisions. In November, as covid restrictions were relaxed, policymakers eased property developers’ access to financing. This should help stronger firms avoid default and at last finish building flats they have already sold to homebuyers. At China’s Central Economic Work Conference in December, policymakers promised to support “fundamental demand”, as opposed to speculative purchases. To that end, they may make further cuts to mortgage rates and down-payment requirements.

Forecasts for the performance of the property sector, broadly defined to include construction, services and furnishings, range widely. Activity in the industry could grow by 3% this year, according to Jing Liu of HSBC, a bank—enough to add 0.9 percentage points to China’s GDP growth. A more

optimistic scenario has activity expanding by 5%, she thinks, adding 1.5 points to growth. Some households might decide that now is a good time to “buy the dip”, before prices revive or regulatory restrictions on home purchases return.

The economic implications of reopening extend further afield. Zero-covid kept a lid on China’s demand for global goods, services and commodities. During the lockdown of Shanghai in the first half of last year, for instance, the country’s oil demand fell by 2m barrels per day. In the past, such drops in Chinese spending would have deprived the world economy of a crucial engine of growth. The covid downturn has been different. It coincided with an overheated economy in America and an interrupted supply of energy across Europe. “At least this time China isn’t contributing to inflation,” says Louis Kuijs of S&P Global, a rating agency.

China’s recovery will lift global growth for the simple reason that the country is a large part of the world economy. HSBC reckons that one year from now, in the first quarter of 2024, China’s GDP could be as much as 10% higher than it will be in the first three troubled months of 2023 (see chart 1). According to our rough calculation, a recovering China could account for two-thirds of global growth in that period.

In time, however, China’s recovery may have unfortunate side-effects. In other big economies, the binding constraint on economic expansion is monetary policy, as central banks raise interest rates to suppress inflation. If China’s reopening looks like raising global demand and therefore price pressure to an uncomfortable degree, central banks elsewhere may have to respond by tightening policy to offset the threat. In such a scenario, the impact of China’s reopening on the rest of the world may show up not in higher growth but in higher inflation or interest rates.

China’s most direct channel of influence is through commodities. It

consumes almost one-fifth of the world's oil, over half of refined copper, nickel and zinc, and more than three-fifths of iron ore. On November 4th the mere rumour of a reopening caused a 7% increase in the price of copper by the end of the day. As the rumours are realised, China's demand for metals, crops and energy will help exporters of commodities, hurt importers and give the world's central banks another headache in their fight against inflation.

China's appetite for metals remained strong during zero-covid, as the government encouraged spending on electric vehicles, renewable energy and other forms of green infrastructure, all of which require lots of aluminium, copper and other metals. But buyers lacked the confidence to stock up on these materials: inventories of copper fell to their skimpiest in 15 years. Reopening will encourage restocking. In November Goldman Sachs, a bank, reckoned the price of copper would increase to \$9,000 per tonne within 12 months. Now it thinks the price will reach \$11,000.

Demand for energy proved less resilient, particularly towards the end of zero-covid. China's imports of liquefied natural gas (LNG) fell by about one-fifth in the first 11 months of 2022, compared with the same period of the previous year. This allowed Europe to increase purchases to make up for the loss of Russian gas. Thus China's zero-covid policy acted as a counterweight to Russia's invasion of Ukraine—one blunder helping to save Europe from the other.

Analysts assume a modest rise in Chinese LNG imports this year, based on the contracts buyers have already signed and their reluctance to buy LNG when prices are high. If imports recover faster, Europe could feel the pinch. In a stress test in December the International Energy Agency (IEA), an official forecaster, assumed Chinese demand would increase by about a quarter in the year ahead, returning to 2021 levels; Russia would cut off piped gas to Europe entirely; and winter would start punctually. In such

a scenario Europe would face a shortfall of 27bn cubic metres of gas, equivalent to 7% of annual demand, even after its current efforts to increase supply are taken into account. The IEA warns that if nothing else is done, Europe may be forced to introduce rationing.

The impact on oil could also be significant. If China's economy makes a full recovery in 2023, it will gradually increase crude imports throughout the year until it has added an average of 1m barrels a day, reckons Soni Kumari of ANZ, a bank. This will compensate for reduced demand in Europe and America, both of which are courting recession. Indeed, Goldman Sachs forecasts that China's increased appetite could push up oil prices by about \$15 per barrel. The price of Brent could exceed \$100 again in the third quarter of this year, it reckons, making the global battle against inflation still more difficult.

Higher commodity prices will be a boon to exporters like Chile and Brazil, but hurt China's energy-importing neighbours. For India, the loss from higher prices may cancel out gains from increased exports to the mainland. Other countries, more tightly enmeshed in China's manufacturing supply chain, seem better placed to benefit. But raw statistics can be deceptive. Although Taiwan's merchandise exports to the mainland were equivalent to more than 15% of GDP in 2021, many were components for products that are ultimately sold to customers outside China, and may thus be unaffected by the change of policy.

The biggest boost to neighbours will come not from selling goods to China but from selling tourist destinations to Chinese citizens (see chart 2). Ni Na, a mother of two from Shanghai, travelled overseas about five times a year pre-pandemic, often spending three or four months a year outside the country. She attempted to travel once within China in 2022, only to give up owing to restrictions. When quarantine requirements are lifted, Ms Ni will get back on the road. She has renewed her passport and her sons' travel

documents in anticipation.

Thailand, a popular destination, could enjoy a three-percentage-point boost to growth once China has fully reopened, reckons Goldman Sachs. That would remove the uncertainty weighing on local asset prices, including the currency, says Arup Raha of Oxford Economics, reducing pressure on the central bank to raise rates—welcome freedom in a country where output is still below potential. But the biggest winner will be Hong Kong. Increased exports, which include tourism, could boost its GDP by almost 8% after full reopening. The city used to attract more than 4m mainland visitors a month. Without them, it has felt roomier but poorer.

The Communist Party is deft at rewriting history. Yet Mr Xi will struggle to shake the damage done to his reputation in 2022. The clumsy enforcement of zero-covid, followed by its hasty abandonment, will go down as an error for the ages. Many investment houses adjusted their risk assessments for China, and will allocate less to the country over the next three years unless they are compensated for it. About \$18bn of foreign exchange flowed out of China in November, up from \$11bn in October. These outflows are expected to reverse when China's economy stabilises in 2023, but a swift return to the type of inflows witnessed before the pandemic is unlikely.

Deep damage has been done to parts of China's supply chain. A covid outbreak, followed by protests, at a plant making Apple's iPhone 14 in central China has delayed orders for the product. For foreign firms, the crisis was the first time that central policy interfered with local officials' commitment to keep factories running. Many companies are now willing to pay more to manufacture elsewhere. Take the process of launching new products, which requires an almost continuous flow of researchers and scientists between headquarters, usually in the West, and plants in China. The covid years made this dance impossible. Engineers stopped visiting; fewer new products were launched in the country. Multinational firms have

been forced, often reluctantly, to launch elsewhere.

But after years of zero-covid, bosses have become more comfortable with moving away from China. Inbound investment in new “greenfield” factories has plummeted (see chart 3). At the same time, the number of firms moving operations out of China has jumped, says Alex Bryant of East West Associates, a supply-chain consultant. Most of the moves Mr Bryant’s firm has assisted with over the past year have been outbound. He thinks the reopening of China is unlikely to lead to an immediate turnaround in the direction of traffic.

Policymakers are waking up to the danger. Officials and businessfolk from Fujian, Guangdong, Sichuan, Zhejiang and elsewhere are planning trips abroad to win back investors, according to a state-media report. “A meeting is worth a thousand emails,” it said. In December China’s leaders announced a focus on attracting foreign money, emphasising that local governments should prioritise finding investors. Such language has not been used at a Politburo meeting in many years, notes Robin Xing of Morgan Stanley, a bank. “They clearly want to keep their place in the global supply chain,” he says. Nevertheless, making up for the chaos of 2022 will require an awful lot of meetings. ■

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新冠病毒

全球各地的新冠病毒监测都渐趋松懈

最让人担忧的是这一点，而非中国病例激增

一月五日是中国科学院武汉病毒研究所的研究人员分离出新型冠状病毒的三周年纪念日。当时，这种病毒在该市一家医院引发神秘肺炎院感。之后，这种被世界卫生组织命名为SARS-CoV-2的新病毒感染了全球大部分人口。在欧洲部分地区，从未被感染过的人口大概只占个位数比例。

现在，疫苗接种和既往感染减缓了新冠病毒的传播。但该病毒已经变异，可以部分逃逸疫苗和感染赋予的免疫力。再感染成为常事。有鉴于此，全球注意力再次转向中国。这个疫情始发国直到最近才跟随世界其他国家解除了隔离封控。这一点，再加上疫苗接种进度不佳（意味着许多中国人没有机会通过感染或疫苗接种获得免疫力），导致感染病例激增。其他国家已对此做出应对。

许多国家加强了对自中国入境人士的新冠检测。美国、英国、法国和意大利等国现在要求始发自中国机场的旅客提供新冠检测阴性证明。美国之前一直对来自30多个国家的入境者在匿名、自愿的情况下做采样检测，以监测海外传播的新冠病毒变体，现在把这项检测覆盖的航班数量扩大到每周500个，包括290个来自中国的航班。

大多数专家都质疑飞行前检测的意义。他们认为，目前在中国流行的变体在要求这项检测证明的国家人口中早已广泛传播，所以中国旅客入境并不会带去什么变化。但监测病毒演变则是另一回事，是明智之举。一个潜在的担忧是，中国解除封控意味着可能演化出一种新变体，从疫情始发地卷土重来。中国仍在持续公布新冠病毒的基因组测序数据，但已不再公布感染、住院或死亡人数，令上述担忧难以平息。

但其他国家也在逐渐放松监测。世卫组织的玛丽亚·范克尔霍夫（Maria Van Kerkhove）表示，自2022年初至今，提交给国际病毒基因信息库

GISAIID的新冠病毒基因序列数量已减少了90%，提交数据的国家数量也变少了。她说，官方的态度变得自满起来，认为这种疾病已变得更温和，无需再多做什么，还认为（不考虑中国的情况）新冠大流行已经结束。但它并没有结束。全球每周仍有一万人死于新冠，而且有不少是可以避免的。

实验室网络对全球各地流行的病毒样本基因做测序，以追踪新冠病毒的进化。病毒在受感染的个体中繁殖后代时并不总是完全准确地复制自身。在复制过程中基因编码经常出现“拼写错误”，由此产生的影响大多是表面上的，改变的是病毒的外观，而非其功能。但偶尔也会出现一些变异，能影响病毒感染人体细胞的能力或决定哪类细胞（比如是上呼吸道还是下呼吸道细胞）最易受感染。有了许多这样的变异后，病毒可能变得传染性更强或致病力更强，或兼而有之。

假如发现突变异常多的新毒株，流行病学家会跟进。他们调查该毒株呈上升势头的地方是否比其他地方感染速度更快、病情更重，或者是否有证据表明当地的病毒检测、药物和疫苗收效比其他地方差。如果这些信息表明现有措施正在失效，世卫组织会把该新毒株列为关切变异株（VOC），并以希腊字母命名。

关切变异株的传染性一代比一代强。此外，德尔塔变异株的致病力更强。最新的奥密克戎毒株致病力弱于德尔塔，但未来变异株的致病力可能再次转强。“有一种观点认为，病毒传播越广，致病力就会越弱。但这绝非必然。”范克尔霍夫说。

自奥密克戎在2021年底出现后，世卫组织至今没有命名新的关切变异株。新的谱系已经演化而来，免疫逃逸力一代胜过一代，但在世卫组织看来，无须为它们大幅改变公共卫生措施。所以，它们未被升级为关切变异株，只是被冠以字母数字代码，如用“XBB.1.5”代表目前在美国成为主导的奥密克戎变异株。

没有人确切知道新冠病毒是怎样进化出更强的变异株的。一种假设是它们是从免疫系统受抑制的人群身上变异出来的，如癌症患者、艾滋病患者，

或正在服用药物防止器官移植排斥反应的人士。这类人群会在几个月里持续感染新冠病毒，使得病毒在复制时有充分时间积累突变。

针对免疫系统受损人群的研究确实发现他们体内的新冠病毒变体包含异常多的突变。但2022年6月发表于《自然医学》（Nature Medicine）的一项对27名此类患者的研究显示，他们身上的新冠病毒变体并没有关切变异株中常见的那些与传染性增强相关的重要突变。而且这些患者也没有把病毒传给其他人（但这可能是因为他们多为卧床病人，也有些人采取了自我隔离措施）。这项研究表明，在这类病人身上出现的新冠病毒变体在其体内的复制能力更强，但传染力没有更高。

另一个关于关切变异株来源的理论认为，它们产生于新冠病毒在人和其他动物之间的交叉感染。现在已有人传猫、狗、水貂和鹿的记录。一些研究发现，感染人源新冠病毒的动物体内的病毒突变可在关切变异株的改变了的基因组中找到，例如病毒用来附着细胞的刺突蛋白的编码基因。

若要以这种方式产生关切变异株，由动物传人的变体随后必须要能人传人。2020年丹麦一个养殖场发生过多宗水貂传人的新冠病例，却没出现人传人的情况。水貂传人的新冠病毒在貂体内经过高度变异，看起来很恐怖，但感染该病毒的人并没有再传染其他人。尽管如此，这类传播依然令人担忧。流感病毒也会在动物和人之间交叉传播。尽管动物流感病毒在传给人之后通常不再扩散，但也有例外，如2009至2010年的全球流感可能是从猪传播而来。

疫情发展到现在这个阶段，另一个担忧是可能出现重组病毒。如果有人同时感染两个变种，就会出现这种情况。这两个变种可以交换基因物质，产生兼具来自两者的突变的后代。这就可能出现特别麻烦的组合，例如由两个奥密克戎谱系融合演变而来XBB.1.5。最初的XBB变体善于逃避抗体，但不善于附着人体细胞（这决定感染性）。而XBB.1.5在这两方面都很擅长。

伦敦卫生和热带医学学院（London School of Hygiene and Tropical Medicine）的戴维·海曼（David Heymann）表示，如果说关于关切变异株

存在某个共识，那就是它们是随机出现的，而且可能在任何地方、任何时间出现。没有证据表明变异株更可能出现在新冠病毒免疫力较低的人群中，比如中国的人口。感染人数增加确实意味着这种随机事件发生的机率加大，这就是为什么中国突然放开以及随之而来的病例激增令人担忧。但所增加的风险与世界其他地区业已存在的风险只是在程度上不同，性质是一样的。

然而，不管中国对病毒变异有何影响，全球以后都仍会爆发一波又一波的阶段性疫情。这是因为目前可用的新冠疫苗都无法在接种后较长时间内有效预防感染。因此，要对付新冠病毒变体，更重要的不是阻止病毒传播，而是不断监测病毒演变并根据需要调整检测、治疗和疫苗。

而监测正变得越来越困难。世卫组织的新冠病毒监测系统依赖世界各地的实验室向GISAID等组织提交的基因组测序数据，以显示世界各地流行何种病毒变体、其毒性高低，以及药物和疫苗的功用。没有测序数据就意味着没有关于这些方面的信息。同样，世卫组织还追踪感染新毒株而需要入院治疗的病例比例，以及住院后从普通病房转入重症监护室的数字。这有助衡量致病严重性的变化。但据范克尔霍夫称，收集这些数据的手段也在逐渐消失。

还有一个更深层次的问题。过去三年建立起来的检测、测序和监测能力一旦废弃，下一次大流行病来袭时全球可能会措手不及。期许政客们最终能视大流行病如同国土防卫，须维持一个常设机制以随时应对威胁的希望似乎正在消逝。

仅就这一点来看，中国手忙脚乱地放开，虽然让其民众苦不堪言，但仍可能带有一线光明。假如这能让其他地方反思长期监测的重要性，那将对全球有益。 ■



Covid-19

All around the world, covid surveillance is faltering

That, rather than the surge of cases in China, is the main reason for worry

JANUARY 5TH is the third anniversary of the day that researchers at the Wuhan Institute of Virology, in China, isolated a coronavirus which had caused a cluster of mysterious pneumonia cases in one of the city's hospitals. This new virus, named SARS-CoV-2 by the World Health Organisation (WHO), has subsequently infected most of the world's population. In parts of Europe the percentage of people who have never caught it is probably in single digits.

Vaccines and prior infections have now slowed SARS-CoV-2's spread. But it has evolved partial means to evade the immunity they confer. Reinfections have become routine. In light of this, attention has turned once more to China. The country in which covid started has only recently followed the rest of the world by abandoning isolation and lockdowns. That, combined with its patchy record on vaccination—meaning many Chinese have had no opportunity to acquire immunity from either an infection or a vaccine—has resulted in a surge of cases. And the outside world has responded.

Many countries have increased their testing of arrivals from China. America, Britain, France and Italy, in particular, now require travellers from Chinese airports to produce evidence of a negative covid test. And America, which already gathers swabs anonymously and voluntarily from people arriving from more than 30 countries, in order to monitor variants circulating overseas, is expanding the number of flights per week covered by the programme to 500, including 290 from China.

Most experts question the value of preflight testing. The variants dominant

in China are already circulating through the populations of countries requiring it, so Chinese arrivals, these experts reckon, will make little difference. But monitoring is a different matter. That is sensible. One underlying fear is that the end of China's lockdown means a new, resurgent, variant of the virus may evolve and emerge from covid's original homeland. Such fears are not assuaged by the fact that China, though still reporting genomic-sequencing data, no longer publishes numbers of cases, hospital admissions or deaths.

But other countries, too, are doing less than they used to in the matter of monitoring. According to Maria Van Kerkhove of the WHO, the number of SARS-CoV-2 sequences submitted to GISAID, an international repository of viral genetic information, has dropped by 90% since the start of 2022, and the number of countries submitting data has also fallen. Official attitudes have, she says, become complacent. The thinking has been that the illness is now milder, that there is nothing more to do and that (events in China notwithstanding) the pandemic is over. But it isn't. Covid still kills 10,000 people a week, and many of those deaths are preventable.

Following the evolution of SARS-CoV-2 is the task of networks of laboratories that sequence the genetic makeup of viral samples circulating around the world. When the virus breeds in an infected individual the offspring are not always exact replicas of those from which they are spawned. Spelling mistakes in the genetic code occur routinely during replication. Most of the results are cosmetic, changing a virus's look, but not how it functions. Occasionally, though, alterations occur that dictate how easily it infects human cells, or which types of cell (upper- or lower-respiratory-tract cells, for example) are most susceptible. With many such changes, a virus may become better at spreading, at making people ill, or both.

If a variant with unusually many mutations is spotted, epidemiologists

chime in. They investigate whether places where this particular variant is on the rise are also seeing a faster spread of infections, cases that are more severe, or evidence that covid tests, drugs and vaccines are less effective than elsewhere. If this information suggests existing measures are failing, the new virus is designated a variant of concern (VOC) by the WHO, and is given a name from the Greek alphabet.

Each new VOC has been more transmissible than its predecessors. Delta was, on top of that, more severe. Omicron, the latest, is less severe than Delta. But a future variant might swing the other way again. “There is this notion that the more this virus circulates, the less severe it will become. There is absolutely no guarantee of that,” says Dr Van Kerkhove.

Since Omicron emerged in late 2021, no new VOC has been designated. New lineages have evolved, each better than its predecessor at evading immunity—but these do not, in the WHO’s view, merit radical changes in public-health measures. They have thus not been upgraded to VOCs and instead go by alphanumeric codes, such as “XBB.1.5” for the form of Omicron now becoming dominant in America.

Nobody knows exactly how fitter lineages of SARS-CoV-2 emerge. One hypothesis is that they originate in people with suppressed immune systems, such as those with cancer or HIV/AIDS, or who are taking drugs to prevent the rejection of transplanted organs. Individuals like these can remain infected with SARS-CoV-2 for months, giving the virus lots of time to accumulate mutations as it replicates.

Research on people with compromised immune systems has indeed found that the SARS-CoV-2 variants in their bodies have unusually large numbers of mutations. But a study of 27 such patients, published in June 2022 in *Nature Medicine*, showed that the variants they carried were missing important mutations, common in VOCs, which are related to better

transmission. Nor did these patients transmit the virus to others (though that could be because many were bedridden, and some had isolated themselves). This study suggests that variants which arise in such patients are better at replicating in those patients' bodies, but no better at transmitting themselves to others.

Another theory about how VOCs originate is back-and-forth transmission of SARS-CoV-2 between people and other animals. Transmission from humans to cats, dogs, mink and deer has been documented. Some research has found that viral mutations in animals infected by human-derived SARS-CoV-2 are in parts of the genome that are changed in VOCs, such as that encoding the spike protein which the virus uses to latch onto cells.

For a VOC to arise in this way, a variant transmitted from an animal to a human must be able to spread subsequently from person to person. This did not happen in a cluster of mink-to-human SARS-CoV-2 transmissions at a fur farm in Denmark in 2020. The mink virus that infected people looked scary because it was heavily mutated in the animals. But people who caught it did not pass it to others. Still, such transmissions remain a concern. Flu viruses also cross back and forth between animals and people. And though animal flu viruses that infect humans usually go no further, there are exceptions, such as the 2009-10 flu pandemic, which was caused by a virus that probably came from pigs.

Another worry at this stage of the pandemic is the possibility of recombinant viruses. These happen when someone is infected with two variants simultaneously. This allows the pair to swap genetic material, resulting in offspring that carry mutations from both. That permits particularly troublesome combinations. XBB.1.5, for example, evolved from a fusion of two Omicron lineages. The original XBB lineage was good at dodging antibodies but poor at latching onto human cells (which determines infectivity). XBB.1.5 is good at both.

If a consensus exists on one thing about VOCs, says David Heymann of the London School of Hygiene and Tropical Medicine, it is that they emerge at random, and may do so anywhere at any time. No evidence is known that variants are more likely to arise in populations with less immunity, such as China's. More infections do mean a greater chance of such a random event happening, which is why China's sudden unlocking, and the surge of cases that has accompanied it, is worrisome. But the additional risk is different only in degree, not in kind, from that which already exists in the rest of the world.

Regardless of any Chinese contribution, though, periodic covid waves are here to stay. That is because none of the covid-19 vaccines so far available is good at preventing infections for more than a short period after administration. Dealing with SARS-CoV-2 variants is therefore less a matter of stopping transmission than of constant monitoring and adjusting covid tests, treatments and vaccines as needed.

And it is this monitoring which is getting harder. The WHO's covid-surveillance system relies on genomic-sequence data submitted from laboratories around the world to organisations such as GISAID, to show which variants are becoming dominant in various parts of the planet, whether those variants are more virulent, and how successful drugs and vaccines are against them. No sequences means no information on these points. Similarly, the WHO also tracks the proportion of cases caused by new variants that require admission to hospital, and, once there, transfer from normal wards to intensive care. That helps gauge changes in severity. But the means to collect these data, too, are disappearing, according to Dr Van Kerkhove.

There is a deeper problem, as well. Dismantling the testing, sequencing and surveillance capacity built up in the past three years risks leaving the world unprepared for the next pandemic. Hopes that politicians might, at last,

see pandemic illness in the way that they see the defence of the realm, as something requiring the maintenance of a permanent establishment ready to counter threats, seem to be fading.

In this respect alone, China's botched unlocking, though terrible for the people of that country, may have a silver lining. If it causes a rethink elsewhere about the importance of monitoring for the long term, that will be a global good. ■



杀死新冠病毒

酸化空气或可预防新冠感染

一点点硝酸即可【新知】

在中国，呼吸道疾病流行的标志之一是醋会变得热销。民间医疗认为，只要把醋煮沸，富含醋酸的蒸汽就会清除空气中引发咳嗽的任何秽物。这种信念里头也许有那么点道理，因为要让通过空气传播的病毒——比如新冠病毒——变得无害，一个可靠的方法就是加大携带这些病毒的液滴的酸性。

不过洛桑联邦理工学院的塔玛·科恩（Tamar Kohn）和苏黎世联邦理工学院的托马斯·彼得（Thomas Peter）指出，要使用比醋酸更强的酸（例如硝酸）才能达到良好的病毒灭活效果。他们在刚发表于《环境科学与技术》（Environmental Science and Technology）的一项研究中指出，硝酸进入液滴后就会形成令病毒难以生存的环境。

在构成携带病毒的自然气溶胶的液体（特别是肺液和鼻涕）中，科恩、彼得及其团队对悬浮其中的多种病毒进行了实验，研究让不同种类的病毒失活所需的酸度。根据之前有关化合物扩散进入此类液滴的实验，他们还计算了硝酸进入液滴的难易程度。

下一步按理是研究富含硝酸的空气对气溶胶传播病毒的影响。但碍于生物安全法规的限制，他们无法这样做，所以转而基于收集到的结果做计算机建模分析。

该模型显示，一般室内空气已相当不利于流感病毒存活，几分钟内便可令其失去活性。但新冠病毒更难对付。在正常室内空气中，其活性可保持数日，但也并非没有弱点。如果空气中的酸度足够高，液滴内的新冠病毒不消一分钟就会失活。这就引向了一个有趣的点子。模型显示，透过通风系统向建筑物内空气注入硝酸或许可以让身处其中的人们感染几率下降1000倍。

这样做会让人们吸入强酸，但应该没有危害。消灭新冠病毒所需的硝酸浓度不到美国以及欧洲大部分地区的工作场所法定安全水平的十分之一。

即使有这样的保证，人们真的愿意为防御病毒而接受酸性空气吗？这还是个未知数。但这项研究的一个明显推论是，值得考虑在博物馆和图书馆等建筑物中戴上口罩，因为酸性气体有害馆藏，所以这些场馆内的空气会经过处理，酸度被降低而非增强。 ■



Killing SARS-CoV-2

Acidifying the air may protect against covid

A soupçon of nitric acid could do the trick

IN CHINA, ONE sign a respiratory disease is doing the rounds is a rise in sales of vinegar. Folk medicine says that when you boil it, the acetic-acid-rich fumes clear the air of whatever nastiness is bringing on the cough. And there may be a grain of truth in this belief, for one sure way to render airborne viruses, such as SARS-CoV-2, the cause of covid-19, harmless, is to make the droplets of fluid which carry them more acidic.

Tamar Kohn of the Swiss Federal Institute of Technology in Lausanne, and Thomas Peter of its Zurich counterpart, reckon, though, that this can be done well only by a stronger acid than acetic—nitric, for example. They observe in a study just published in Environmental Science and Technology that once inside a droplet, nitric acid creates conditions which viruses find really hard to take.

Dr Kohn, Dr Peter and their collaborators experimented with various viruses suspended in liquids of the kinds that natural virus-carrying aerosols are made of—lung fluid and nasal mucus in particular—to see how acidic these would have to be to inactivate different viral species. Based on previous experiments on the diffusion of compounds into such droplets, they also calculated how easily nitric acid would enter them.

The logical next step would have been to study the effect on aerosol-borne viruses of air rich in nitric acid. They were, however, prevented from doing this by biosafety regulations, so instead they used a computer model based on the results they had collected.

For influenza viruses, the model suggested, normal room air is already quite

harmful. Flu bugs are inactivated by it in minutes. SARS-CoV-2, however, is a harder nut to crack. In normal room air it can remain active for days. But invulnerable it is not. Droplets become death traps for it in under a minute if the acidity of the air is increased sufficiently. And that suggests an intriguing idea. Injecting nitric acid into a building's air, via its ventilation system, might, the model indicates, reduce the chance of infection for people 1,000-fold.

That would involve people breathing in strong acid. But this should not be harmful. The concentration required to destroy SARS-CoV-2 is less than a tenth of the legal safe level for workplaces in America and much of Europe.

Whether, even with that reassurance, people would actually be willing to accept acidic air in exchange for viral protection remains to be seen. But one clear consequence of this work is that it is worth considering wearing a mask in buildings such as museums and libraries which are filled with things that acid is bad for, and thus have their air treated to reduce, rather than increase, its acidity. ■



熊彼特

贝尔纳·阿尔诺是如何成为世界首富的

这位奢侈品之王是个典型的欧洲资本家，但带有美国特色

贝尔纳·阿尔诺（Bernard Arnault）喜欢讲述他与已故苹果联合创始人和iPhone之父乔布斯会面的故事。当时乔布斯即将推出Apple Store。阿尔诺是法国人，他的公司LVMH为上流社会提供路易威登箱包、迪奥时装、蒂芙尼珠宝和唐培里侬（Dom Pérignon）香槟，他比大多数人都更深谙如何将店面变成欲望的殿堂。二人交谈间，话题转向了他们的产品。阿尔诺问乔布斯他是否认为30年后iPhone仍将存在。乔布斯回答说不知道，随后就1921年诞生的唐培里侬香槟问了阿尔诺同样的问题。在故事中，阿尔诺向乔布斯打包票唐培里侬定会世代相传。乔布斯同意他的说法。

作为第一个登顶世界富豪榜的欧洲人，阿尔诺在很多方面都是个典型的旧大陆生意人。正如他对乔布斯所说的那样，他考虑的是久远的过去和未来几十年的发展，而不仅仅是明年的利润。他热爱精工细作，支持另类的设计师、调香师和酿酒大师，而又往往将产品细节的最终决定权握在自己手中。作为商业巨头，他的存在十分低调。与前几位世界首富伊隆·马斯克、杰夫·贝索斯和比尔·盖茨不同的是，除了在高端时尚界，阿尔诺并不是一个家喻户晓的名字。他是巴黎时装秀巡回演出的常客，却只让时装和穿着时装的人成为众人瞩目的焦点。他说话轻声细语，但绝不是个软柿子。正如本刊的一位撰稿人在1989年所写的，他“有着迷人的笑容，但显然也有一副铁齿钢牙”。这样的名声与他狼一般的外表相得益彰，但他似乎从不介意。

阿尔诺在富豪榜上位列前茅已有15年多。有些人可能认为，他以1800亿美元的净资产（福布斯数据）在12月登顶首富，是市场周期性波动下的偶然事件，缘于美国科技股不再受追捧、马斯克不断烧钱、以及在未受生活成本危机冲击时非数字产品的一时风光。然而，无论73岁的阿尔诺与科技大亨有何不同，他同样也重塑了商业世界。用投资公司盛博的卢卡·索尔卡

(Luca Solca) 的话来说，阿尔诺发明了一个悖论：“以百万计销售尊享奢侈品”。为实现这一目标，他把美式商业策略引入了最传统的行业之一，让它适应全球化、高端化、Instagram营销。这是其他人应该效仿的做法。

1980年代初，他为了逃离法国式社会主义来到纽约，在这里接受了恃强凌弱的资本主义。人们对他在纽约的经历知之甚少，但在1984年回到法国时，他迅速开始运用在华尔街上兴起的野蛮人策略。首先是进行杠杆收购。他相中了一个陷入困境的纺织集团旗下潦倒的品牌克里斯汀·迪奥(Christian Dior)。他卖掉了那个破落集团，留下了有38年历史的迪奥，为这颗皇冠上的明珠拭去灰尘。然后他开始恶意收购，在上世纪80年代后期瞄准了酩悦·轩尼诗-路易·威登集团(LVMH)，并最终将其从背后的老牌望族手中夺走。他也并非次次成功。意大利时装品牌古驰(Gucci)就一直没让他得手。但他保持了一贯的风格，巧妙利用资产负债表收购古老发霉的时装公司，把它们变成超级大牌。价值近3500亿欧元(3720亿美元)的LVMH现在旗下拥有75个品牌。

他不仅仅善于收购，还是个炒作大师，招募了引人注目的设计师（其中许多来自法国以外的地方）来撼动老牌时尚公司。他们的震撼价值不仅限于秀场，还为香水和手袋等高利润时尚配饰引来了关注，而这些都是LVMH的主要收入来源。此外，他让整个集团如机器般高效运转，将生产流程现代化，主要通过LVMH的自营店而非加盟店来销售产品，并招募了业内最优秀的人才。

他的纪律性延伸到对利润的管理。尽管他着眼于长期的品牌资产，但季度业绩也鲜有差池。路易·威登是旗舰品牌。索尔卡估计其销售额为200亿欧元（约占LVMH2021年收入的三分之一），营业利润率接近50%。这令古驰相形见绌。充沛的现金流让他能够开出比竞争对手更大的手笔，打造最豪华的店面，发起最引人注目的营销活动。由安妮·莱博维茨(Annie Leibovitz)在世界杯前夕拍摄的一则广告就是个很好的例子，广告中足球运动员梅西和C罗在一个路易·威登公文包上下棋（当然，要是用法国前锋姆巴佩替换C罗会是更明智的选择）。

LVMH也并非无懈可击。阿尔诺很早就看到了全球化的潜力，他首先发现了日本人对奢侈品的喜爱，然后是中国人。在2021年，亚洲拥有2200多家LVMH门店，是该集团最大的收入来源，遥遥领先于其他地区。然而，俄罗斯入侵乌克兰凸显了地缘政治威胁。假如该集团不得不撤出中国市场，那将是一场灾难。此外，在消费高端化的同时，全球社会不平等也在不断加剧。只要人们相信他们可以赶得上富人，这门生意就会兴隆。但如果他们感觉到自己永远无法加入周身大牌奢侈品的精英阶层，可能就会心生挫败感。

然而，阿尔诺的欧洲血统让他在财富管理上别具优势。他对血统有着旧世界式的信仰。马斯克在推特上挥霍了部分特斯拉股票，贝索斯将部分亚马逊股份让给了前妻，盖茨出售了大部分微软股票。与他们不同的是，阿尔诺的头等大事是保留LVMH的控制权，目前他的家族稳稳握有48%的股份。他的五个孩子都在集团工作——尽管因此有着索尔卡所说的“达尔文式竞争”——以求能在阿尔诺最终退休后继承家业。没有人比奢侈品之王更清楚牢牢把控家族传承的价值。 ■



Schumpeter

How Bernard Arnault became the world's richest person

The lord of luxury is a model European capitalist—but with American characteristics

A STORY BERNARD ARNAULT likes to tell is of a meeting with Steve Jobs, the late co-founder of Apple and father of the iPhone. Jobs was on the verge of launching the Apple Store. Mr Arnault, a Frenchman whose company, LVMH, provides high society with its Louis Vuitton luggage, Christian Dior couture, Tiffany jewellery and Dom Pérignon champagne, knows more than most about turning storefronts into temples of desire. As they talked, the conversation turned to their products. Mr Arnault asked Jobs whether he thought the iPhone would still be around in 30 years' time. The American replied that he did not know. Jobs then asked the same question about Dom Pérignon, whose first vintage was in 1921. Mr Arnault, the story goes, assured him it would still be drunk for generations to come. Jobs agreed.

In many ways Mr Arnault, the first European to rise to the top of the world's rich lists, is the epitome of how to do business in the old continent. As his remarks to Jobs suggested, he thinks about the distant past and decades into the future, not just about next year's profits. He relishes craftsmanship, championing outré designers, perfumers and cellar masters, while often reserving for himself the last word on product details. His own presence as a business titan is understated. Unlike Elon Musk, Jeff Bezos and Bill Gates, his most recent predecessors as the world's richest people, he is not a household name—unless the household is a maison de couture, or palatial. He is a regular on the Parisian fashion-show circuit, yet lets the clothes and those that wear them grab the spotlight. He is soft-spoken but is no soft touch. As a writer on this newspaper put it back in 1989, he has “a charming smile but teeth, apparently, of steel”. That reputation, which goes well with his lupine looks, is one he has never seemed to mind.

Mr Arnault has been high on the rich list for more than 15 years. Some might think that his rise to the top this month, with a net worth, according to Forbes, of \$180bn, is a cyclical fluke, the result of American technology stocks falling out of vogue, Mr Musk immolating his fortune, and analogue stuff—when untouched by the cost-of-living crisis—having a moment of glory. Yet however different the 73-year-old Mr Arnault is from a tech mogul, he, too, has remade the world of business. In the words of Luca Solca of Bernstein, an investment firm, he has invented a paradox: “selling exclusivity by the million”. To achieve that, he has brought American-style business tactics to one of the most traditional of industries and equipped it for a global, premiumised, Instagrammable world. It is an approach others should emulate.

His indoctrination into swashbuckling capitalism came in New York in the early 1980s, where he fled from French socialism. Little is known about his time there, but when he returned to France in 1984, he was quick to deploy the barbarian tactics emerging on Wall Street. First came the leveraged buy-out. He spotted a down-at-heel Christian Dior buried within a struggling textile conglomerate. He sold the dross and polished up Dior, the 38-year-old crown jewel. Then he went hostile, targeting Moët Hennessy-Louis Vuitton in the late 1980s, and ultimately ripping it away from the old money behind it. He was not always successful. Gucci, the Italian fashion house, continues to elude him. But his modus operandi is consistent. Make crafty use of the balance-sheet to buy musty fashion houses and turn them into megabrands. LVMH, worth almost €350bn (\$372bn), now has 75 maisons.

He is more than just a dealmaker. He is a master of hype, recruiting eye-catching designers, many from outside France, to shake up the fashion establishment. Their shock value is not just confined to the catwalk. It provides publicity for high-margin fashion accessories, such as perfumes and handbags, that are LVMH’s more mainstream bread and butter. Moreover, he imposes a machine-like efficiency on the group, modernising

production processes, mainly selling through LVMH's own stores rather than licensees, and recruiting the best in the business.

His discipline extends to profits. Though he has his eye on long-term brand equity, quarterly results rarely miss a beat. Louis Vuitton is the flagship. Mr Solca estimates it generates €20bn in sales (about a third of LVMH's revenues in 2021), with operating margins close to 50%. Gucci pales in comparison. The cashflow enables him to outspend rivals on the fanciest stores and the splashiest marketing campaigns. An advertisement in the run-up to the World Cup, shot by Annie Leibovitz, showing footballers Lionel Messi and Cristiano Ronaldo playing chess on a Vuitton briefcase, is a case in point (even if Kylian Mbappé, the French striker, would have been a more inspired choice than Ronaldo).

LVMH has vulnerabilities. Mr Arnault was early to spot the promise of globalisation, first identifying the Japanese taste for luxury, and then the Chinese one. Asia, which had more than 2,200 LVMH stores in 2021, is by far its biggest source of revenue. However, Russia's invasion of Ukraine has highlighted geopolitical threats. If the firm had to pull out of China, it would be a disaster. Moreover, premiumisation has accompanied the rise of social inequality around the world. While people believe they can emulate the rich, that is good for business. But if they feel they will never be able to join the monogrammed elite, frustrations may rise.

Yet Mr Arnault's European heritage gives him an extra edge in the wealth stakes. He has an old-world faith in bloodlines. Unlike Mr Musk, who has squandered some of his Tesla stock on Twitter, Mr Bezos, who surrendered part of Amazon to his ex-wife, and Mr Gates, who has sold most of his Microsoft shares, his number-one priority is to retain control of LVMH, in which his family holds an unassailable 48% stake. His five children all work in the business—albeit in what Mr Solca calls a “Darwinian contest” to succeed him when he eventually retires. No one knows better than the lord

of luxury the value of keeping hold of the family silver. ■



巴托比

教你如何玩转领英

在商界最热门社交网络上的生存发展指南

社交媒体和职业发展通常不沾边。无论是刷马斯克的推文吸收负能量，还是沉迷于TikTok上最新的热门视频，都对你的职业前景没有多少帮助。但如果所用的社交网络是领英（LinkedIn），那就另当别论了。这个专业人士的人际网络平台于2003年在硅谷成立，2016年被微软以260亿美元收购，现已成为企业网络空间的标配，在全球拥有超过8亿注册用户。其中美国用户达1.71亿，超过了全美劳动人口数量。高中生也在上面创建个人档案，好把它加入大学申请书。你很可能也有一个账号。那么，该如何充分利用它呢？

对于那些尚未注册领英的人来说，第一步，也是至关重要的一步，就是精心打造个人档案。首先，选一张好照片，能让你看上去散发着一股远见卓识者的坚定，加之以带有共情的真诚。接下来，列出你的教育和就业经历。记住，没有什么是不值一提的。曾经就读一个招生严格的幼儿园？把它写下来，这说明你赢在起跑线上。在罗列清单时，确保内容读起来尽可能地不动声色：不用形容词，也不带个人色彩。机械而平淡的叙事就很能加分。

写好个人档案后，就可以着手干正事了：创建自己的人脉网络。你的档案里至少要有500个好友才会有人拿你当回事。要做到这一点，就得走出自己的舒适区，与完全陌生的人搭讪。不要觉得这就像是邀请完全不熟的同学来参加你的生日派对。在现实生活中这会让你看起来太拼了，但在领英的字典里没有尴尬。来本专栏客串的笔者已经积累了6315个好友，其中真正认识的可能也就300个。

还记得你母亲常在电话里提到的那个在波士顿的贝恩资本（Bain Capital）工作的表哥迪米特里斯（Dimitris）吗？发送一条无伤大雅的领

英邀请来重新联系上他再合适不过了——顺便在他的私募股权人脉圈里小小露个脸。还有从芝加哥返程的红眼航班上坐在你旁边的那个人呢？哪怕你只记得他的名字（也不知道姓啥）和公司，领英的算法应该也会让你不用太费劲就能找到他。

如果你是高盛的分析师，请把摩根大通、摩根士丹利和瑞银的每一位分析师都加为好友。别担心，他们也正有此意，所以大概率都会接受。另外，顺手把高盛里里外外的每个人都加一遍吧。如果某位上司——最好是CEO——碰巧接受了邀请，你就赚大了。这位老板现有的好友会觉得你是个跟自己平起平坐的人；那些挖空心思想接近大佬的人会来套近乎。你的人脉网络将会暴涨。

接下来，显摆你的每项成功。领英之于职场白领，正如Instagram之于时尚达人：都是用来展示自己最令人羡慕的那一面的。“非常荣幸登上（此处为某个胡乱发放头衔的不知名组织的名字）思想领袖全球精英榜单。”

如果你想让所有人都知道你曾在彭博全球监管论坛上发言，那就附上你在讲台上的照片——大大方方地宣传。发帖本质上就是一种炫耀，所以任何试图淡化一些的做法读起来都像“凡尔赛”（“同事说我应该分享自己的成功。所以，我骄傲地宣布我获邀参加‘创新领袖’专家讨论环节。”）笔者就直接把自己的专栏文章（比如这篇）往上一贴，不再多做任何解释。

当你往领英上传自己的光荣事迹时，不要过于关注别人的成就——这能让你看起来泰然自若，而不是羡慕嫉妒。不要理会系统自动生成的提示，例如“祝贺迪米特里斯上任KKR欧洲私募股权联席主管”。这些都是有意而为的，简直像是你母亲一手策划，目的是为了让你自惭形秽，从而激发你的雄心壮志（细想一下，她确实有提到过你表哥搬去了伦敦）。

你需要表现得沉着冷静，直接无视一切自动提示，例如“花点时间回顾你与同事成为好友的一年”。有这时间，还不如花在结交新的好友上，把人脉数字堆起来——在追求满足、游戏化的社交网络世界里，这才是领英的终极核心所在。最新的推送通知说，“本周你在搜索中出现了178次”。那你

肯定是找对了方向。 ■



Bartleby

How to make the most of LinkedIn

A guide to surviving and thriving on the business world's favourite social network

SOCIAL MEDIA and career development typically don't mix. Doom-scrolling Elon Musk's tweets or getting sucked into the latest TikTok craze do not exactly enhance your work prospects. Unless, that is, the social network in question is LinkedIn. Founded in 2003 in Silicon Valley as a platform for professional networking, and purchased in 2016 by Microsoft for \$26bn, it has become a fixture of corporate cyberspace, with more than 800m registered users worldwide. Its 171m American members outnumber the country's labour force. High-school students are creating profiles to include with their college applications. The chances are you probably have one, too. How do you make the most of it?

For those who have yet to link up with LinkedIn, the first, critical, step is fashioning your profile. First, choose a slick photo: think visionary resolve meets empathetic authenticity. Next, list your educational and professional history. Remember, nothing is too trivial. Went to a selective kindergarten? Say so; it illustrates that you were a winner from a tender age. As you draw up your list, make sure that it reads in the most deadpan way possible: no adjectives, no personal touch. The mechanical and the matter-of-fact is at a premium.

Armed with your profile, you can get down to business and begin creating your network. You need to have 500 or more connections in your profile to be taken seriously. To achieve this, you need to step out of your comfort zone and accost complete strangers. Do not treat it as you would inviting classmates you do not know to your birthday party, which in real life makes you look desperate. On LinkedIn, cringeworthy is not part of the lexicon.

Your columnist, a guest Bartleby, has amassed 6,315 connections, of whom she actually knows maybe 300.

Remember that cousin Dimitris your mother always mentions on the phone, who works at Bain Capital in Boston? What better way than an innocuous LinkedIn invite to reconnect—and get a toehold in his private-equity network. And that man who sat next to you on the red-eye back from Chicago? Even if you recall only his first name and the company he works at, LinkedIn's algorithm should be able to let you track him down with relative ease.

If you are an analyst at Goldman Sachs, connect with every analyst in JPMorgan Chase, Morgan Stanley and UBS. Don't worry, they are thinking the same thing, so are likely to oblige. While you are at it, you might as well approach everyone with a pulse at Goldman, too. If a higher-up—best of all, the CEO—happens to accept, you have struck gold. The boss's existing connections will treat you as more of an equal; those desperate to get one degree of separation closer to the top dog will come begging. Your network will explode.

Next, flaunt your every success. LinkedIn is to white-collar workers what Instagram is to fashionistas: a way to present the most envy-provoking version of yourself. "Deeply honoured to have been ranked in the Global Elite category of Thought Leaders by [insert name of obscure organisation which hands out random titles]."

If you want everyone to know that you were a speaker at the Bloomberg Global Regulatory Forum, attach photos of yourself on the podium—and own it. Posting is, in essence, showing off, so any attempt to mitigate invariably comes across as humble-bragging ("I was told by colleagues I should be sharing my successes. So I am proud to announce that I was invited to participate in the Innovation Leaders panel."). Bartleby posts only

her columns (such as this one) with zero commentary.

While you are feeding the app your achievements, do not pay too much attention to those of others—that will allow you to appear poised and unflappable, not envious. Ignore automatically generated prompts like “Congratulate Dimitris on starting a new position as co-head of European Private Equity at KKR”. These are designed, as if by your mother, to rub it in your face and motivate you to be more ambitious (come to think of it, she did mention your cousin had moved to London).

You need to play it cool so disregard all automatic prompts such as “Take a moment to recognise one year of being connected to your co-worker”. That time is better spent forging fresh connections to rack up the numbers—which, in the gratification-seeking, gamified world of social-networking, is ultimately a big part of what LinkedIn is all about. According to the latest notification, “You appeared in 178 searches this week.” So you must be doing something right. ■



复杂的救世主 新科技世界观

硅谷可能正在变得脚踏实地。但科技界的大思想家们却不是这样

萨姆·阿尔特曼（Sam Altman）在自家书房里俯瞰着旧金山的金门大桥，他翘着双脚，向后靠在椅子上，几乎快要躺下了。这位37岁的企业家穿着水洗牛仔裤和T恤。一个大脑飞速旋转的人再悠闲也不过就这模样了吧。不过这位OpenAI（这家创业公司据称估值接近200亿美元，其使命是让人工智能造福人类）的CEO并不是个可以轻松交谈的对象。唯一透露出他活泼一面的是书架上两双粉色的高帮球鞋，上面的logo代表了他最热爱的两项技术：AI和核聚变。有时他也会不自觉地冒出一些书生气的话。有一刻，他热切地想要说服笔者相信AI的发展速度会超出人们的想象，说：“我很好奇这是否让你更新了先验。”倒是挺像个机器人在说话。

四十岁的乔·朗斯代尔（Joe Lonsdale）和阿尔特曼截然不同。他坐在位于硅谷中心地带的家中，穿着亚麻衣服，梳着整齐的背头。这位科技投资者兼企业家已经帮助创建了四家独角兽公司，以及为国防和情报部门服务的价值约150亿美元的数据分析公司Palantir。他语速很快，经常打断别人。他家泳池边摆放着一个巨大的王座，曾经是《权力的游戏》的道具。这很契合他宏大的世界观——他珍视西方思想自由和言论自由的传统价值观，他认为西方应该在内部开启一场史诗级的斗争，以免滑向自我厌弃。

你可能会认为这俩人没什么共同点。但他们都属于朗斯代尔所说的“创建者阶层”——由一些还算年轻的理想主义者组成的智囊团，其中包括价值740亿美元的支付公司Stripe的联合创始人帕特里克·科里森（Patrick Collison），以及其他一些以白人男性为主的科技业人士。他们提出的问题远超出硅谷巨头们通常关心的范围。这些问题包括人与机器的未来、经济增长的制约因素，以及政府的本质等。

他们还有其他相像之处。商业为他们带来了影响力，但似乎并没能满足他

们的雄心。他们衡量自己社会地位的标准与其说是豪宅和游艇，不如说是人们对他们的帖子和文章（有些非常冗长难读）的关注度。他们掌控着大笔新注入的、带着理想主义色彩的资金。在美国，科技亿万富翁的数量（包括科里森在内）在十年内翻了一倍多。他们中的一些人就像中世纪佛罗伦萨的美第奇家族一样，热衷出资支持离经叛道的思想。他们的思考受到不少有志于创业的人的狂热追捧。

这群聪明脑袋有着共同的出发点：他们认为自己所处的世界裹足不前，并为此感到沮丧。一些人认为，大型科技公司带来的变革配不上它们引起的兴奋，也配不上它们带来的财富。支付公司PayPal的联合创始人彼得·蒂尔（Peter Thiel）是许多离经叛道者的导师，他曾经说：“我们想要会飞的汽车，却得到了只能发140个字符的推特。”阿尔特曼的说法要乐观些，“iPhone和云计算带来了新技术的寒武纪大爆发。有些进展顺利，有些搞砸了。但有一件事情却顺利得很诡异，就是很多人发了财，然后他们会说，‘好了，接下来呢？’”

这种新思维模式的实质是相信有了金钱和才智，他们就能重启社会进步。这个想法绝对积极向上。然而，人们很难不对此表示怀疑。各国政府都在对硅谷围追堵截，以限制科技巨头的势力。科技股去年遭受重创，科技公司纷纷大举裁员。最糟糕的是，曾经试图成为“哲学王”典范的加密货币创业者萨姆·班克曼-弗里德（Sam Bankman-Fried）被捕，表明了这些所谓的开明精英的道德品质是多么不堪一击。问题是，这些人中剩下的那些是进一步证明科技行业的狂妄与堕落，还是显示一种可喜的复兴能力的勃兴？

硅谷在过去展现了一种不可思议的自我重塑能力。上世纪70年代，惠普和英特尔等行业中坚本可以推出个人电脑，但因为担心会冲击自己现有的产品线而放弃尝试。史蒂夫·乔布斯和史蒂夫·沃兹尼亚克（Steve Wozniak）这两个嬉皮士创建了苹果，填补了这一空白，开启了个人计算的新时代。本世纪初，傲慢保守的风险资本家成了妖魔鬼怪；他们对那些有着济世热情的年轻创始人爱答不理——这些人可是做出了创办谷歌这样的佳绩——结果自己落得个无人问津。事情很快有了转机，有远见的创始人兼CEO出

现了，随之而来的是商业理念向更加冷酷无情转变。Facebook的联合创始人、Meta的马克·扎克伯格有一句名言：“快速行动，打破常规”。

那个时代出现了两位著名的企业家，他们为今天的一些技术迷提供了思想的种子资本。最著名的是蒂尔，一个有意成为自由意志论思想家的投资者。另一位是创业孵化器Y Combinator的联合创始人保罗·格雷厄姆（Paul Graham），他的文章题材广泛，涉及从城市到政治的各个领域，被视为科技圈的指定读物。

本世纪初，在蒂尔的帮助下，一个由网络博主构成的小社群开始崭露头角，他们自诩“理性主义者”，专注于消除思维中的认知偏见。（蒂尔后来开始置身其外。）这种思想传承可以追溯到更早时候的“密码朋克”和“负熵主义者”，前者琢磨密码学，后者相信通过延长寿命可以改善人类处境。在经历了不温不火的成长期之后，理性主义运动已经进入了主流。结果带来了对宏大想法的迷恋，其拥护者认为这股热忱不只是停留在理想化的技术乌托邦主义上。

一个快速兴起的例子是“进步研究”。2019年，科里森和经济学家、科技界预言家泰勒·考恩（Tyler Cowen）在《大西洋月刊》（Atlantic）上发文倡导这一运动。他们认为，进步包括经济、技术和文化等各方面的发展，应该自成一个研究领域。科里森表示自己对进步的痴迷是受很多人影响，并引用了经济学家罗伯特·卢卡斯（Robert Lucas）的话：“一个人一旦开始思考（增长），就很难再去思考其他任何事情。”他的爱尔兰血统可能也是原因之一——他年轻时，爱尔兰经历了奇迹般的经济增长。“我从小就灌输了卢卡斯的思想。”他说。他与人共同创立了Arc研究所（Arc Institute），该研究所已经筹集了6.5亿美元，用来试验科学的新方法。

还能举出其他和这种宏阔世界观相关的例子。在2021年的一篇文章中，阿尔特曼提出了一个愿景，他称之为“万物的摩尔定律”，其逻辑与半导体革命类似。他在文章中预测，智能机器能够制造出越来越智能的人力替代方案，在未来几十年将在工作上超越人类。这将为一些人创造惊人的财富，

也会让另一些人失业，因而需要彻底改革税制和再分配。他在OpenAI和核聚变上的押注最近都很火——前者的聊天机器人ChatGPT风靡一时。他还向计划建造热核反应堆的Helion公司投资了3.75亿美元。

在意识形态方面，与蒂尔一样有自由意志论倾向的朗斯代尔将注意力集中在试图修复社会和政府的不足之处上。在今年一篇名为《为我们辩护》（In Defence of Us）的文章中，他反对“历史虚无主义”，即反对过度关注西方的失败。出于对古罗马哲学的热爱，他在奥斯汀创办了西塞罗研究所（Cicero Institute），希望在公共政策中引入竞争和透明等自由市场原则。他还将创业文化引入学术界，支持创办了强调言论自由的新学习场所奥斯汀大学（University of Austin）。

这三人都与自己的导师有着商业上的联系。阿尔特曼十几岁时就参加了格雷厄姆创办的Y Combinator的首批创始人项目，这里后来又孵化了爱彼迎和Dropbox等成功企业。2014年，阿尔特曼取代格雷厄姆成为Y Combinator的总裁，并在一段时间内将蒂尔算作合伙人（阿尔特曼的书房里保存着蒂尔《从0到1》[Zero to One]一书的手稿）。科里森和弟弟约翰在创立Stripe之初也得到了蒂尔的支持。帕特里克·科里森还在读书时，格雷厄姆就看到了他的潜力。他很快就被邀请进入Y Combinator。到现在格雷厄姆仍然是他的粉丝，“就算你把帕特里克扔在一个荒岛上，他也会想办法再发起一次工业革命。”他说。

大学期间，朗斯代尔在《斯坦福评论》（Stanford Review）担任编辑，这是一份由蒂尔和其他人联合创办的唱反调的刊物。后来他继续为他的导师工作，两人最终共同协助创立了Palantir。朗斯代尔现在仍然称蒂尔为“天才”——尽管现如今他声称自己没有导师那么“愤世嫉俗”。

他们的观点对于其追随者圈子以外的人来说是否重要？FTX交易平台滥用价值数十亿美元的客户资金后，班克曼-弗里德的加密王国轰然倒塌，这是一个严重的危险信号。他曾承诺将自己财富（峰值时达到260亿美元）的一部分用来支持有效利他主义，这是一种意在运用严格的成本效益分析来行善的哲学运动。他的败落必定会让人们对那些自诩足够富有和聪明、

可以策划激进社会变革的人的信心大打折扣。

一些人对他们的理想主义很不屑，认为其中除了救世情怀，也有唯利是图的一面。《科技巨头所谓的思考》（What Tech Calls Thinking）一书的作者、斯坦福大学的阿德里安·多布（Adrian Daub）说：“科技行业总是把自己的故事讲得惊天动地。”多布认为这是为了说服新员工和投资者押注他们的高风险项目。“这对于他们的商业模式极为便利。”

然而，它最终可能产生积极的影响。对社会进步迟缓的沮丧已经促使他们投入金钱和才智，尝试破解科研基金、财富再分配，以及创办全新的大学等问题。他们对科学的推崇可能会鼓励人们更加关注“硬科技”，而不是互联网应用。如果他们能激励未来的创业者踏上创建未来的万亿美元公司的艰辛旅程，那他们的高谈阔论将是值得的。

插图：基斯·奈格利 ■



Complex saviours

The new tech worldview

Silicon Valley may be coming down to earth. Not so tech's big thinkers

SAM ALTMAN is almost supine. He is leaning back in his chair, feet up, in his home library overlooking San Francisco's Golden Gate Bridge. In washed jeans and a T-shirt, the 37-year-old entrepreneur looks about as laid-back as someone with a galloping mind ever could. Yet the CEO of OpenAI, a startup reportedly valued at nearly \$20bn whose mission is to make artificial intelligence a force for good, is not one for light conversation. The only signs of playfulness are two pairs of pink-coloured high-tops sitting on a bookshelf, with logos representing his two favourite technologies, AI and nuclear fusion. Occasionally he drifts into nerd-speak. At one point, keen to convince your correspondent that AI will progress faster than people think, he says, sounding rather robotic himself: "I'm curious if that caused you to update your priors."

Joe Lonsdale, 40, is nothing like Mr Altman. He's sitting in the heart of Silicon Valley, dressed in linen with his hair slicked back. The tech investor and entrepreneur, who has helped create four unicorns plus Palantir, a data-analytics firm worth around \$15bn that works with soldiers and spooks, talks fast—and interrupts frequently. By his pool is a giant throne, from the set of "Game of Thrones". It fits with the grandeur of his worldview that the West, which he cherishes for its classical values of free thought and free speech, should be fighting an epic internal battle not to give in to self-loathing.

You might think these men have little in common. But they are both part of what Mr Lonsdale calls a "builder class"—a brains trust of youngish idealists, which includes Patrick Collison, co-founder of Stripe, a payments

firm valued at \$74bn, and other (mostly white and male) techies, who are posing questions that go far beyond the usual interests of Silicon Valley's titans. They include the future of man and machine, the constraints on economic growth, and the nature of government.

They share other similarities. Business provided them with their clout, but doesn't seem to satisfy their ambition. They measure their status not so much in mansions and yachts as in engagement with their blog posts and essays, some mind-numbingly long. There is a lot of fresh, idealistic money behind them. The number of techno-billionaires in America (Mr Collison included) has more than doubled in a decade. Some of them, like the Medicis in medieval Florence, are keen to use their money to bankroll the intellectual ferment. Their musings are treated with cultish reverence by scores of aspiring entrepreneurs.

This cohort of eggheads starts from common ground: frustration with what they see as sluggish progress in the world around them. Some think the transformation wrought by big tech has not lived up to the excitement—and wealth—that it generated. As Peter Thiel, the co-founder of PayPal, a payments firm, and mentor to many of these iconoclasts once remarked, “We wanted flying cars, instead we got 140 characters.” Mr Altman puts it more optimistically: “The iPhone and cloud computing enabled a Cambrian explosion of new technology. Some things went right and some went wrong. But one thing that went weirdly right is a lot of people got rich and said ‘OK, now what?’”

A belief that with money and brains they can reboot social progress is the essence of this new mindset, making it resolutely upbeat. Yet it is hard not to be sceptical. Governments are hounding Silicon Valley over the power of big tech. Tech stocks have been hammered last year and firms are laying off workers in droves. To cap it all, the arrest of Sam Bankman-Fried, a crypto entrepreneur who once sought to be the epitome of a philosopher king,

has shown how flaky the morality of supposedly enlightened elites can be. The question is: are the rest of them further evidence of the tech industry's hubristic decadence? Or do they reflect the start of a welcome capacity for renewal?

Silicon Valley has shown an uncanny ability to reinvent itself in the past. In the 1970s business stalwarts such as Hewlett-Packard and Intel could have launched the personal computer, but didn't, worried about the impact on their legacy products. Two hippies, Steve Jobs and Steve Wozniak, filled the void by creating Apple, unleashing a new age of personal computing. In the early 2000s buttoned-up venture capitalists became the bogeymen; they were dismissed for snubbing messianic young founders who created triumphs like Google. Soon came the turn of visionary founder-CEOs, and with them a shift in business philosophy to something more ruthless. As Meta's Mark Zuckerberg, co-founder of Facebook, memorably put it, "Move fast and break things."

Two well-known entrepreneurs from that era provided the intellectual seed capital for some of today's techno nerds. The most well known is Mr Thiel, a would-be libertarian philosopher and investor. The other is Paul Graham, co-founder of Y Combinator, a startup accelerator, whose essays on everything from cities to politics are considered required reading on tech campuses.

In the 2000s Mr Thiel supported the emergence of a small community of online bloggers, self-named the "rationalists", who were focused on removing cognitive biases from thinking (Mr Thiel has since distanced himself). That intellectual heritage dates even further back, to "cypherpunks", who noodled about cryptography, as well as "extropians", who believed in improving the human condition through life extensions. After a slow-burning adolescence, the rationalist movement has hit the mainstream. The result is a fascination with big ideas that its advocates

believe goes beyond simply rose-tinted tech utopianism.

A burgeoning example of this is “progress studies”, a movement that Mr Collison and Tyler Cowen, an economist and seer of the tech set, advocated for in an article in the Atlantic in 2019. Progress, they think, is a combination of economic, technological and cultural advancement—and deserves its own field of study. Mr Collison points to an array of influences for his progress fetish and cites the economist Robert Lucas: “Once one starts to think about [growth], it is hard to think about anything else.” His Irish heritage may also have contributed; the country experienced a growth miracle in his youth. “I was Lucas-pilled by my upbringing,” he says. He has co-founded the Arc Institute, which has raised \$650m to experiment with new ways of doing science.

There are other examples of this expansive worldview. In an essay in 2021 Mr Altman set out a vision that he called “Moore’s Law for Everything”, based on similar logic to the semiconductor revolution. In it, he predicted that smart machines, building ever smarter replacements, would in the coming decades outcompete humans for work. This would create phenomenal wealth for some, obliterate wages for others, and require a vast overhaul of taxation and redistribution. His two bets, on OpenAI and nuclear fusion, have become fashionable of late—the former’s chatbot, ChatGPT, is all the rage. He has invested \$375m in Helion, a company that aims to build a fusion reactor.

On the more ideological side, Mr Lonsdale, who shares a libertarian streak with Mr Thiel, has focused attention on trying to fix the shortcomings of society and government. In an essay this year called “In Defence of Us”, he argues against “historical nihilism”, or an excessive focus on the failures of the West. With a soft spot for Roman philosophy, he has created the Cicero Institute in Austin that aims to inject free-market principles such as competition and transparency into public policy. He is also bringing

the startup culture to academia, backing a new place of learning called the University of Austin, which emphasises free speech.

All three have business ties to their mentors. As a teen, Mr Altman was part of the first cohort of founders in Mr Graham's Y Combinator, which went on to back successes such as Airbnb and Dropbox. In 2014 he replaced him as its president, and for a while counted Mr Thiel as a partner (Mr Altman keeps an original manuscript of Mr Thiel's book "Zero to One" in his library). Mr Thiel was also an early backer of Stripe, founded by Mr Collison and his brother, John. Mr Graham saw promise in Patrick Collison while the latter was still at school. He was soon invited to join Y Combinator. Mr Graham remains a fan: "If you dropped Patrick on a desert island, he would figure out how to reproduce the Industrial Revolution," he says.

While at university, Mr Lonsdale edited the Stanford Review, a contrarian publication co-founded by Mr Thiel. He went on to work for his mentor and the two men eventually helped found Palantir. He still calls Mr Thiel "a genius"—though he claims these days to be less "cynical" than his guru.

Do their views matter to anyone beyond their circle of acolytes? The unravelling of Mr Bankman-Fried's crypto kingdom, after his FTX trading platform mishandled billions of dollars-worth of client funds, is a big red flag. He had promised to divert part of his wealth, measured at \$26bn at its peak, to support effective altruism, a philosophical movement that purports to use rigorous cost-benefit analysis to do good. His downfall is bound to strain belief in anyone who boasts of being rich and clever enough to engineer radical social change.

Some dismiss their idealism as mercenary as well as messianic. "The tech industry has always told these grand stories about itself," says Adrian Daub of Stanford University and author of the book, "What Tech Calls Thinking". Mr Daub sees it as a way of convincing recruits and investors to bet on their

risky projects. “It’s incredibly convenient for their business models.”

Yet the impact could ultimately be positive. Frustrations with a sluggish society have encouraged them to put their money and brains to work on problems from science funding and the redistribution of wealth to entirely new universities. Their exaltation of science may encourage a greater focus on hard tech, rather than internet apps. If they can inspire future entrepreneurs to engage in the hard slog of building tomorrow’s trillion-dollar firms, their lofty theorising will have been worth it. ■

ILLUSTRATION: KEITH NEGLEY ■



熊彼特

美国最大港口陷入一种新的瘫痪

去年不堪重荷，如今门庭冷落

那是一场拯救了圣诞节的推特风暴。2021年10月，几十艘满载进口商品的货轮停留在美国西岸的海上无法卸货，因为码头上已满是堆积如山的集装箱。为了找出症结所在，物流公司Flexport的创始人莱恩·彼得森（Ryan Petersen）乘坐小艇考察了美国最大的港口综合体。他的结论是，相邻的洛杉矶和长滩港之所以陷入停滞，主要是因为空间不足，导致空集装箱无法从码头运走。“打破瓶颈！”他发推呼吁。这个帖子在网上疯传。政客被迫采取行动。长滩放松了对集装箱堆放高度的限制。货物又再次流动起来。圣诞老人终于松了一口气。

近日，本专栏作者也同样乘船参观了一番。他看到的不是圣诞节前的喧嚣，而是另一种怪异的瘫痪。只不过这次的原因不是船只太多，而是太少。洛杉矶港只停靠着四艘集装箱船。去年这个时候的数量应该是现在的三倍以上。眼前几乎看不到码头工人，也看不到船上的船员。吊机静静伫立，就像《圣诞颂歌》里的往事幽灵。唯一锚泊在近海的是一艘古老的双桅帆船。

这幅惨淡景象反映出南加州这两大港口货运量骤减，这里一般会接收美国37%的进口货物。12月14日，洛杉矶港表示，11月进口量同比下降了24%。长滩港最近也遭遇了类似的跌幅。从商业角度来看，这种低迷提出了一些有趣的问题，包括通胀的未来、工人的谈判地位，以及美国经济地理格局的转变。在这些问题上，戴夫·克拉克（Dave Clark）很有发言权，今年年初之前他一直担任亚马逊的物流主管，亲手打造了世界最大的供应链之一。他最近加入了Flexport，与彼得森共同担任联席CEO。

新冠疫情期间，港口对众多美国公司的重要性得到了充分体现，自称“供应链极客”的克拉克对港口满是溢美之词。“它们是国宝，”他说，“当你看

到来来往往的卡车、满是货物的堆场……停泊着等待进港的大量船只，美国经济实力在这里一目了然。”

但情况恶化之时，经济风险也同样一目了然。除了宽松货币政策、财政刺激，以及今年的乌克兰战争以外，疫情期间通胀飙升的原因还有供应链拥堵。然而，瓶颈已经骤然消失。这两个港口等待进港的船只数量从1月的109艘减少到6月的20艘，过去几周已经少到可以忽略不计。克拉克指出，以前一直积极进货的进口商在二季度突然开始担心手里货物积压。于是纷纷急忙取消订单。

结果，根据Flexport的数据，近几个月来被取消的海运航次创下纪录，集装箱运价暴跌至疫情前的水平，船公司从大块朵颐变成食不果腹。12月12日，全球第二大集装箱航运公司马士基任命了新的CEO来带领公司度过一段“日益艰难”的时期。该公司股价自3月以来一路暴跌。

供应链的压力放松可能是商品价格通胀缓解的原因之一。然而，商品仅占消费者支出的三分之一，服务占了另外三分之二。此外，正如克拉克所指出的，码头工人、卡车司机和仓库工人等人手短缺，意味着供应链中的劳动力成本仍然很高。“美国国内的劳动力成本并没有降低，”他说，“被裁员的大部分是白领，而不是一线工人。”因此，他并不认为通胀的威胁已经解除。

工会的谈判能力也让工资在未来更有可能上涨。疫情期间为了保持货物流动，工人加班加点辛勤劳动，期间航运和铁路公司等雇主也赚取了空前利润，因此工会的谈判能力得以提升。洛杉矶和长滩港的情况正是如此，自7月1日以来，国际码头和仓库工会（International Longshore and Warehouse Union）就一直在没有劳动合同的情况下运营，同时与海运承运商和码头运营商谈判新的合同。双方都坚称不会发生罢工或停工。但最近铁路罢工危机再起，直到国会通过一项法案才得以避免，加剧了人们对行业动荡的担忧。工会想要在此前的盈利中分一杯羹，而运货商却要为即将到来的亏损做准备，这让情况更加棘手。

克拉克预计，这些谈判仍将“激烈火爆”。但进口商还意识到一种更具灾难性的威胁。它已经导致许多进口商将船只从西海岸目的地转向墨西哥湾和东海岸的港口，哪怕通过巴拿马运河会增加成本，航程也更长。这在很大程度上导致了洛杉矶港在今年夏末将它保持了22年的“美国最繁忙集装箱码头”的桂冠让给了纽约和新泽西港。此外，亚洲的供应链也开始从中国转移到东南亚和南亚等地，这些地方倾向于把更多货物通过苏伊士运河运往美国东海岸。

经济地理格局的变化十分明显。不过，克拉克相信西海岸仍将反弹。他说：“人都是健忘的，最后还是成本说了算。”尽管他预计美国经济明年仍将下行，之后才会回稳，但他有信心贸易最终将回到疫情前的水平。全球化也是如此。如果是这样，洛杉矶和长滩等港口将必须提高环保和自动化水平来为未来做好准备（但他坚称，技术应该“提升”而不是取代工人）。在加州，乐观的拓荒者精神依然生生不息。 ■



Schumpeter

America's biggest ports face a new kind of paralysis

Rather than too much cargo as last year, ships are now bringing in too little

IT WAS CALLED the tweetstorm that saved Christmas. In October 2021 scores of freighters idled at anchor off the west coast of America unable to deliver imports to docks already choc-a-bloc with containers. To find out what was wrong Ryan Petersen, founder of Flexport, a logistics firm, took a boat tour of America's biggest port complex. He concluded that the adjacent ports of Los Angeles and Long Beach were at a standstill largely because of a shortage of space, which meant empty containers could not be removed from the dock. "OVERWHELM THE BOTTLENECK!" he tweeted. The thread went viral. Politicians were stung into action. Long Beach relaxed restrictions on how high containers could be stacked. Goods moved again. Santa Claus heaved a sigh of relief.

In recent days your columnist took a similar boat trip. Rather than the pre-Christmas bustle, he witnessed another eerie paralysis. Except this time the cause was not surfeit but deficit. Only four container ships were docked at the Port of Los Angeles. Last year there would have been more than three times as many. There was hardly a longshoreman in sight, or crewmen on the ships. The cranes stood silently, like Ghosts of Christmas Past. The only vessel anchored offshore was an antiquated brigantine.

The languor reflected a staggering drop in cargo volumes to the two southern Californian ports, which normally welcome 37% of imports to America. On December 14th the Port of Los Angeles said import volumes fell by 24% year on year in November. The Port of Long Beach has suffered similar shortfalls recently. From a business perspective, the slump raises interesting questions about the future of inflation, the bargaining position

of workers, and a shift in the country's economic geography. A good person to discuss these subjects with is Dave Clark, who until the start of this year was the logistics supremo at Amazon, and builder of one of the world's biggest supply chains. He has recently joined Mr Petersen as co-CEO of Flexport.

A self-styled "supply-chain geek", Mr Clark waxes lyrical about ports, whose importance to so many American firms was on display during the covid-19 pandemic. "They are national treasures," he says. "When you saw those trucks cruising, and the yards full...the number of ships parked, waiting to get into the port, it was a visualisation of the power of the American economy."

It was also a visualisation of the economic risks when things go awry. Supply-chain congestion was a cause of surging inflation in the pandemic, alongside loose monetary policy, fiscal stimulus and, this year, the war in Ukraine. Yet the bottlenecks ended abruptly. Ships waiting to enter both ports fell from 109 in January to 20 in June and negligible numbers in the past few weeks. Mr Clark says that in the second quarter, importers suddenly switched from wanting to get their hands on more merchandise to worrying they had too much. They rushed to cancel orders.

The result, according to Flexport, is that a record number of seaborne journeys have been cancelled in recent months, container-freight rates have plunged back to pre-pandemic levels, and shipowners have gone from feast to famine. Maersk, the world's second-largest container carrier, named a new CEO on December 12th to steer it through an "increasingly challenging" period. Its share price has tumbled since March.

This relaxation of supply-chain pressure may help explain why goods-price inflation is easing. However, goods account for only a third of consumer spending; services account for two-thirds. Moreover, as Mr Clark points out,

a shortage of personnel, such as dockers, truckers and warehouse workers, means the cost of labour in the supply chain remains high. “Labour costs inside the US haven’t budged,” he says. “Most of the job reductions are white-collar, not front-line workers.” For these reasons, he is not convinced the inflationary threat is over.

Adding to the prospect of wage inflation is union bargaining power. It has risen during the pandemic as workers went the extra mile to keep goods flowing, even as their employers, such as shipping and rail firms, raked in record profits. It is relevant in the ports of Los Angeles and Long Beach where, since July 1st, the International Longshore and Warehouse Union has operated without a labour contract as it negotiates a new one with ocean carriers and terminal operators. Both sides insist there will be no strikes or lockouts. But the fear of industrial unrest has been heightened by the recent threat of a rail strike, only averted by an act of Congress. It is all the more tricky when unions want a share of recent profits, while the shippers are braced for coming losses.

Mr Clark expects the discussions to remain “blustery”. But the threat of something more catastrophic is not lost on importers. It has caused many to divert ships from west-coast destinations to ports in the Gulf of Mexico and the east coast, even though costs via the Panama canal are higher and shipping times longer. That is a big reason why late this summer the Port of Los Angeles lost its 22-year-old crown as America’s busiest container terminal to the Port of New York and New Jersey. Added to this, Asian supply chains are beginning to shift away from China to new locations, including in South-East Asia and South Asia, that tend to send more freight via the Suez canal to America’s east coast.

The change in economic geography is stark. Still, Mr Clark believes the west coast will rebound. “People have short memories and cost usually wins,” he says. Though he expects the American economy to get worse next year

before it gets better, he is confident trade will eventually swing back to where it was before the pandemic. The same with globalisation. If it does, ports like Los Angeles and Long Beach will have to prepare themselves for the future by becoming cleaner and more automated (though technology should “elevate” workers, he insists, not replace them). In California the optimistic pioneer spirit is alive and well. ■



幕后故事

弱者之年

从泽连斯基到摩洛哥足球队，2022年他们光芒四射

洛奇一直是个很棒的拳手。他拼得很凶，鼻子从来没被打断过。问题是，他从来没有时来运转的时候。他住在一间破屋里，露指手套几乎不离手。但是平地起惊雷，世界重量级拳王阿波罗·奎迪（Apollo Creed）给了他一个挑战自己的机会。“这一次，”雇洛奇当打手的高利贷黑老大说，“幸运女神可能会站在你这边。”

“我们就是这届世界杯的洛奇。”摩洛哥队教练瓦利德·雷格拉吉（Walid Regragui）在这个弱者之年即将结束之际，提到了这位当代的弱者圣徒。他的球队并不是唯一一支在比赛中惊艳众人的黑马。沙特击败了阿根廷；日本赢了德国。但无畏的摩洛哥队是黑马之王，他们先后击败了比利时、西班牙和葡萄牙这三支热门球队，成为阿拉伯和非洲球队中首支闯进半决赛的队伍。（在看台上，一些伊朗球迷——一个愚昧国家里的弱者——在本国国歌奏响时狂嘘并哭泣。）

摩洛哥队证明了属于弱者的一条基本真理：就算严格说来他们失败了，他们依然可以是胜利者——就像是斯巴达人在温泉关的血战，芬兰人对抗苏联的“冬季战争”一样。洛奇在点数上输给了奎迪，但他向自己和世界表明，他不是“又一个街上的混混”。去看看摩洛哥中场索菲亚内·布法尔（Sofiane Boufal）拉着妈妈在球场上跳舞那一幕吧，如果你还没有看过的话。那是冠军的欢快舞蹈。

在2022年的荧幕上，故事中的弱者反复出现在两个常见环境之中。其一是职场。在《人生切割术》（Severance）中，办公室里的员工努力挣脱一家阴暗的反乌托邦公司。《流人》（Slow Horses）描绘了一群过气的特工，失意却并未彻底认输。在《白莲花度假村》（The White Lotus）中，花天酒地、精虫上脑的美国游客被西西里岛的一对妓女姊妹花玩弄于股

掌。而在《悲情三角》（Triangle of Sadness）中，豪华游艇的沉没让一个拥有生存技能的女工变成了海上霸主。

弱者的另一个所在地从来没有变过——家庭。《坏姐妹》（Bad Sisters）描绘了一个受虐待的妻子和她爱管闲事的妹妹。罗尔德·达尔（Roald Dahl）的《玛蒂尔达》（Matilda）是关于弱者逆袭的幻想小说，由它改编而来的音乐剧电影很快将在奈飞上映。诚然，玛蒂尔达拥有大多数劣势者没有的神奇魔力。但她也是心理学家称之为“有益的困难”的经典产物。

马尔科姆·格拉德威尔（Malcolm Gladwell）在他的《逆转》（David and Goliath）一书中重申了这一观点，探讨了有些时候童年的苦难是如何培养出韧性和独创性，让世界上的玛蒂尔达们能够胜过那些“遗传了过多心理健康”的有天赋的同龄人。格拉德威尔观察到，弱者可能因为无可失去而放手一搏。“真的无所谓，”洛奇谈到料想自己会惨败时说，“反正我以前什么都不是。”

这些故事之所以让人振奋，不仅是因为比起跨度较小的攀升，从底层到顶层的飞跃更摧枯拉朽、激动人心。逆袭的男女英雄所做的不只是克服障碍或打败对手。他们当中最优秀、最动人的那些击垮了整个腐朽的制度。他们坚信强权——或声誉、权力和影响力——不会永远占上风；即使规则被操控，还是有可能取胜。他们传递出的信息是“我命由我不由天”。

在2022年上演惊人逆袭壮举的还有一名演员，但他并不是在演戏。泽连斯基用智能手机摄像头、雄辩和勇气直面拥有核武器的侵略者。乌克兰平民则用肉身阻挡俄罗斯坦克前进。在书中，格拉德威尔认为，尽管歌利亚像个反派摔跤手一样自吹自擂，但笨拙的他往往会被一个灵活的牧羊人手中的投石器和那五块光滑的石头。作者指出，非常规战术往往能打败重武器。同样，十个月的战争里，乌克兰的勇气和创造力似乎已成为令人生畏的财富。

但是当2月俄罗斯军队越过乌克兰边境时，这场竞争看起来远没有那么势均力敌。弱者的反抗之歌已成为年度最佳配乐：7岁的阿米莉亚·阿尼索维

奇 (Amelia Anisovych) 在基辅的防空洞里唱起了《Let It Go》；乌克兰摇滚明星安德烈·赫利夫纽克 (Andriy Khlyvnyuk) 穿着迷彩服，在圣索菲亚广场唱起了抗争赞歌《哦，草地上的红茉莉》 (Chervona Kalyna)。

这一切可以换一种方式来说：到最后，高利贷黑老大对洛奇的看法是错误的。他的故事无关运气，而是关乎正义。最鼓舞人心的弱者只是拿到了他们应得的。他们需要的只是一个机会。■



Back Story

The year of the underdogs

From Volodymyr Zelensky to the Moroccan football team, they shone in 2022

ROCKY HAS always been a good fighter. He hits like hell and his nose has never been busted. The trouble is, he never got a break. He lives in a hovel and rarely takes off his fingerless gloves. But lightning strikes, and Apollo Creed, the world heavyweight champion, gives him a shot at the title. “This time”, says the loan shark who employs Rocky as muscle, “Lady Luck may be in your corner.”

“We are the Rocky of this World Cup,” said Walid Regragui, Morocco’s football coach, invoking the latter-day saint of underdogs at the close of what has been the underdog’s year. His team were not the only outsiders to stun the tournament. Saudi Arabia beat Argentina; Japan beat Germany. But the dauntless Moroccans were the underdog kings, seeing off the Belgians, Spanish and Portuguese, three of the favourites, to become the first Arab and African side to reach a semi-final. (In the stands, some Iranian fans, underdogs in a benighted nation, booed their country’s anthem and cried.)

Morocco proved an essential verity of underdogs: they can triumph even when, technically, they lose—as the Spartans did at Thermopylae and the Finns to the Soviets in the “winter war”. Rocky loses on points to Creed, but shows himself, and the world, that he is more than “just another bum from the neighbourhood”. If you haven’t already seen it, look up the clip of Sofiane Boufal, a Moroccan playmaker, dancing with his mother on the pitch. It is the jig of a champion.

Fictional underdogs prowled two of their habitual environments on screen in 2022. One was the workplace. In “Severance”, office grunts struggled to

break free of a shadowy dystopian company. “Slow Horses” portrayed a bunch of has-been spies, down but not quite out. In “The White Lotus”, American tourists with more money and libido than sense were rinsed by a pair of Sicilian hookers. In “Triangle of Sadness”, meanwhile, the sinking of a superyacht turned a minion with survival skills into an overlord.

The other underdog habitat—as always and everywhere—was the family. “Bad Sisters” depicted an abused wife and her officious siblings. A musical adaptation of “Matilda”, Roald Dahl’s underdog revenge fantasy, is out soon on Netflix. True, Matilda has magic powers that most underdogs lack. But she is also a classic product of what psychologists have called “desirable difficulties”.

Riffing on that idea, in his book “David and Goliath” Malcolm Gladwell explores how childhood hardships can sometimes nurture resilience and ingenuity, leading the Matildas of the world to outperform gifted peers who “inherited an excessive amount of psychological health”. The underdog, observes Mr Gladwell, may be liberated by having nothing to lose. “It really don’t matter,” Rocky says of his expected thrashing. “I was nobody before.”

It is not just the ride from the bottom to the top, wilder and more exhilarating than shorter ascents, that makes these stories so rousing. Underdog heroes and heroines do not merely surmount obstacles or defeat adversaries. The best and most moving beat a whole rotten system. They hold out hope that might—or reputation, power and influence—will not always prevail; that even if the rules are rigged, the game can still be won. They suggest life is not predetermined. They make their own fate.

The staggering underdog feat of 2022 involved an actor, but he wasn’t acting. Volodymyr Zelensky faced down a nuclear-armed invader with a smartphone camera, rhetoric and guts. Ukrainian civilians lay down in the path of Russian tanks. In his book Mr Gladwell argues that, though he brags

like a wrestling villain, lumbering Goliath was always likely to lose to a nimble shepherd, equipped with a sling and those five smooth stones. Unconventional tactics, he notes, often vanquish heavy arms. Likewise, in ten months of war Ukraine's grit and invention have come to seem formidable assets.

But the contest looked much less even when Russian forces rolled across the border in February. The underdog's resistance songs became the soundtrack of the year: a rendition of "Let It Go" by seven-year-old Amelia Anisovych in a bomb shelter in Kyiv; Andriy Khlyvnyuk, a Ukrainian rock star, dressed in fatigues and singing "Chervona Kalyna" ("Red Viburnum"), an anthem of defiance, in front of St Sophia cathedral.

To put all that another way: in the end, the loan shark is wrong about Rocky. His story is not about luck; it is about justice. The most inspiring underdogs get only what they deserve. All they needed was a break. ■



沉默突触

成人大脑何以学新而不忘旧

它们储备了大量未使用的突触，可以在需要时激活【新知】

学习新东西不易。记住旧知识更难。无论是大脑还是人工智能软件，任何成功的学习系统都必须在稳定和灵活之间取得恰当的平衡。首先必须足够稳定，能够记住重要的旧知识，同时又足够灵活，能够在不破坏旧记忆痕迹的情况下学习新知识——最好在整个生命周期都能保持这种平衡。

学习是大脑神经连接模式变化的结果。神经细胞之间的各个连接称为突触，是这些细胞分支末端之间的微小间隙。信息以一种称为神经递质的分子形式穿越这些间隙。目前估计人类大脑中有600万亿个突触。

那么，如何处理稳定性与可塑性之间的两难呢——尤其是在大脑不断老化，也可以说是被逐渐填满时？麻省理工学院的迪米特拉·瓦尔达拉基（Dimitra Vardalaki）、郑光勋（Kwanghun Chung，音译）和马克·哈奈特（Mark Harnett）近期在《自然》杂志上发表的研究提出，一种方法是将儿童时期一种形成记忆的突触一直保存到成年。这些突触称为沉默突触。

顾名思义，沉默突触不在神经细胞间传递信号，它们通常存在于神经细胞伸出的细长而未成熟的突起（称为丝状伪足）的末端。在此之前，人们一直认为它们会随着大脑成熟而消失。但是瓦尔达拉基、郑光勋和哈奈特证明，至少在小鼠体内，它们不仅存在于成年期，而且还很常见。在他们从成年小鼠的视觉皮质中取样的连接中，有略超过四分之一属于丝状伪足上的沉默突触。根据鼠脑和人脑之间的相似程度，几乎可以肯定人类大脑也有相似的现象。

为了寻找丝状伪足，三位学者使用了一种名为eMAP的灵敏显微技术。一种名为锥体神经元（如图）的皮层神经细胞每个都有数千个突触，他们研究了其中的2234个。通过eMAP显微镜观察就可以确定哪些细胞突起是丝

状伪足。但并不能显示上面的哪些突触处于沉默状态。

要确定这一点，他们需要测试丝状伪足对谷氨酸的反应，谷氨酸是大脑主要的兴奋性神经递质。首先，他们必须对被测试的那个突触受控地释放谷氨酸。为此，他们在被测试的神经元上倒入“束缚态”谷氨酸溶液。这种状态下的谷氨酸分子是惰性的，在两束激光交汇的能量冲击下才会被激活。

将激光对准待研究的突触，可以释放出谷氨酸这种神经递质，并通过超细电极测量该神经元对应部位的电活动，就可以观察突触有无反应。他们发现，接触到谷氨酸时，成熟的锥体神经元突起产生了电活动，与预期一致。但丝状伪足没有活动，证实其突触的沉默状态。

然而，沉默的突触是没有用的，除非能够在适当时机被开启。研究人员已经证实这是可行的。他们想办法让一种对释放谷氨酸的模拟在神经元内产生电涌，从而诱导丝状伪足上的沉默突触转化为成熟、活跃的突触。

在这种操作的诱导下，沉默突触在几分钟内便开始表现出活跃突触的受体分子特征。同样的操作却没有对成熟突触产生任何作用。研究人员由此证明，成熟突触的连接强度难以改变（从而满足了两难困境中的稳定性要求），但要激活沉默突触却很容易（满足了可塑性要求）。

接下来要研究的是新的丝状伪足是如何、为何以及何时形成的。哈奈特说，这些“求知若渴”的沉默突触和丝状伪足的发现，“为我们提供了一种手段来了解成年人的学习能力，以及如何能通过某种干预，使其不随衰老或疾病发展而退化。”■



Silent synapses

How adult brains learn the new without forgetting the old

They keep a stock of unused synapses in reserve, to be activated as needed

LEARNING NEW things is hard. Remembering what has already been learned is harder. Any successful learning system, be it a brain or a piece of artificial-intelligence software, must strike the right balance between stability and flexibility. It must be stable enough to remember important old things yet flexible enough to learn new ones without destroying old memory traces—preferably for as long as it exists.

Learning is a result of changes in the pattern of neural connectivity in the brain. Each connection between nerve cells, called a synapse, is a tiny gap between the ends of branches ramifying from such cells. Messages jump across these gaps in the form of molecules called neurotransmitters. Current estimates suggest there are 600 trillion synapses in a human brain.

How, then, to deal with the stability-plasticity dilemma—particularly as brains age and, as it were, fill up? Research by Dimitra Vardalaki, Kwanghun Chung and Mark Harnett at the Massachusetts Institute of Technology, just published in *Nature*, suggests one way is to preserve into adulthood a type of memory-forming synapse found in children. These are called silent synapses.

Silent synapses—which, as their name suggests, transmit no signal from one nerve cell to another—are often found on the ends of slender, immature protrusions from nerve cells, called filopodia. Until now, it had been thought that these disappeared as a brain matured. But Drs Vardalaki, Chung and Harnett have shown not only that they are present in adulthood, but also that they are common, at least in mice. Just over a quarter of the

connections they sampled in adult mouse visual cortices were silent synapses on filopodia. And murine and human brains are sufficiently alike that something similar almost certainly applies to people.

To carry out their search for filopodia, the trio used a sensitive microscopy technique called eMAP. They studied 2,234 synapses between cortical nerve cells of a type called pyramidal neurons (pictured), which have thousands of synapses each. Peering through an eMAP microscope is enough to determine which cellular protrusions are filopodia. But it cannot show which synapses on them are silent.

To do that, they needed to test how the filopodia responded to glutamate, the brain's main excitatory neurotransmitter. First, they had to deliver a controlled flow of glutamate to the particular synapse they wanted to test. To this end, they poured a soup of "caged" glutamate over the neuron under examination. This form of the molecule is inert until hit with energy from the intersection of two laser beams.

Aiming those at the synapse under study enabled them to uncage the neurotransmitter and see, by measuring the electrical activity in that part of the neuron using an ultrafine electrode, whether the synapse responded. They found that mature pyramidal-neuron protrusions generated electrical activity when exposed to glutamate, as expected. Filopodia did not, confirming the silence of their synapses.

Silent synapses are, however, useless unless they can be switched on at the appropriate moment. And the researchers confirmed this is possible. They were able to induce the silent versions on filopodia to turn into mature, active synapses by pairing the simulated release of glutamate with a subsequent surge of electricity inside the neuron.

This pairing of events caused silent synapses to start, within minutes,

displaying receptor molecules characteristic of active synapses. The same pairing, applied to mature synapses, did nothing. The researchers thereby show it is hard to get a mature synapse to change the strength of its connection (thus satisfying the stability side of the dilemma), but easy to unsilence a silent one (satisfying the plasticity side).

The next thing to investigate is how, why and when new filopodia appear. The discovery of all these eager-to-learn silent synapses and filopodia, Dr Harnett says, “is a lever for us to get into understanding learning in adults and how potentially we can get access to make it not degrade over the course of ageing or disease”. ■



光密码学

处理加密数据的更佳方式

用光来做全同态加密并不难【新知】

现代生活的数字化意味着数据安全变得愈加重要。存储和传输中的数据通常做了加密，难以窥探。但要进行计算，一般必须先解密数据。这是云计算（实际上也就是服务器农场里一排排的计算机）特有的一个问题，因其计算过程不受数据所有者的控制。而且这个问题日渐严重，因为越来越多的设备都把计算从本地转到了各种云端。

一个可行的解决办法是运用名为全同态加密（以下简称FHE）的技术。它可以实现直接在加密数据上进行计算。拥有正确密钥的人可以通过FHE把信息发送至云端进行处理并收到结果，不存在敏感数据泄密的风险。

使用该方法的难点是速度慢，非常慢。英国一家小公司Optalysys的老板尼克·纽（Nick New）表示，在未加密数据上用时一秒的计算换用FHE来做可能需要100万秒。他的解决办法正如其公司名称所暗示的，是采用光子计算而非电子计算。

光子计算以光束而非电流对数据编码，通过操纵光束来完成计算，特别适合线性代数这种数学运算。而且傅里叶变换（一种令FHE所用的乘法运算加速的方法）也正好很适合用这种方式进行。纽估计，结合FHE和光子计算，他所假定的问题的处理用时可以从100万秒减至10到100秒。

在Optalysys的系统中，信息被编码进许多不同光束的相位和振幅。然后通过名为波导的结构向特定方向发射这些光束，再照进自由空间，在那里光束相互结合、相互干涉。

由此形成的波前穿过特制的透镜时，计算就发生了，所得结果会由一台摄像机被转译为电子信号，用于更传统的处理方法。一个好处是，和所有光子计算一样，这里的实际计算不消耗任何能源，既省钱，又能减少二氧化

碳排放。 ■



Optical cryptography

A better way to process encrypted data

Fully homomorphic encryption is easy if you do it with light

THE DIGITISATION of modern life means data security is ever more important. Data in storage and transit are normally encrypted, and therefore safe from prying eyes. But for computation to happen, they usually have to be unencrypted first. This is a particular problem with so-called cloud computing (in reality, just row upon row of stacks of computers in server farms), which happens beyond a data-owner's control. And it is getting worse, as more and more devices refer calculations back to various clouds, rather than doing them locally.

A possible answer is a technique called fully homomorphic encryption (FHE). This permits computation directly on encrypted data. Someone with the correct key could, using FHE, send information to a cloud, have it processed there, and get the results back without putting anything sensitive at risk.

The difficulty with this approach is that it is slow. Very slow. Nick New, boss of Optalysys, a small firm in Britain, says a computation that takes a second on unencrypted data might require 1m seconds with FHE. Mr New's answer, as his firm's name suggests, is to employ optical rather than electronic computing.

Optical computing encodes data in beams of light instead of electric currents. The computation is done by manipulating the beams. This works well for a type of mathematics called linear algebra—and luckily, Fourier transforms, a way of speeding up all the multiplications involved in FHE, are easily handled this way. Mr New reckons FHE and optical computing

together would reduce the processing time in his putative problem from 1m seconds to between ten and 100.

In Optalysys's system, the information is encoded into the phase and amplitude of many different beams. These are then sent in particular directions by structures called waveguides, before being shone into free space, where they combine and interfere with each other.

The computation happens when the resulting wavefront passes through a specially designed lens, the output of which is translated into an electrical signal, for more conventional processing, by a camera. A bonus is that, like all optical computing, the actual computation consumes no energy, saving both money and carbon-dioxide emissions. ■



信息技术

人工智能与崛起的光子计算

光子数据处理与深度学习时代一拍即合【新知】

现代信息技术（以下简称IT）依赖分工合作：光子在全球传输数据，电子处理数据。但在光纤出现前，电子身兼这两职，而现在，有人希望完成转换，让光子在传输数据之外一并处理数据。

有别于电子，光子（电中性）之间可以交叉行进而不会相互作用，因此玻璃光纤可以处理许多同步信号，这是铜线做不到的。同样，光子计算机可以同时进行大量计算。利用光子还能减少耗电。电阻会产生热量，浪费能源。而光子在透明介质中穿行时没有阻力。

然而，要实现光子计算，现有的数字电子处理架构就要替换成相应的光子部件。不替换可能也行。有人正在研究一种新的光学架构，运用模拟计算而非数字计算，也就是说把数据编码为一个连续的信号而非离散的“比特”。目前，这种架构非常适合解答一类题：线性代数这个数学分支。但这可能有庞大的市场潜力，因为线性代数是人工神经网络等多种技术的基石，人工神经网络又是机器学习的基础，进而也是人工智能（AI）的根本。

线性代数处理的是矩阵，即由数字（代表联立方程的系数）构成的方阵，可以像单个数字一样进行加法和乘法运算。在可以用矩阵来描述的事物中就有19世纪由詹姆斯·克拉克·麦克斯韦（James Clerk Maxwell）发现的表达电磁辐射（例如光）行为的方程组。光的电磁特性意味着，只要使用适当的调制装置，就不难把矩阵数据编码到光束中，然后就可以处理这些数据。

人工神经网络是由节点层组成的程序，节点之间的连接对应矩阵内的数字。这些数字的值会随着输入信号的变化而变化，从而产生矩阵乘法计算。计算结果被传递到网络的下一节点层进行新一轮处理，以此类推，直

到最后的输出层将其合成为一个答案。这样的过程是为了让网络能识别和学习输入数据中存在的模式。

把神经网络转向基于光学的架构并非什么新鲜念头，早在上世纪90年代就已出现。但使之具备商业可行性的技术到现在才露头。观察到这一转变的人士之一是电气工程师德米特里·赛提斯（Demetri Psaltis）。他之前供职加州理工学院，如今在位于洛桑的瑞士联邦理工学院。他是用光神经网络做人脸识别的先行者之一。

赛提斯早年创建的神经网络较浅，只有一到两层，包含几千个节点。如今，所谓的深度学习的网络可以有超过100层，包含几十亿个节点。同时，电信业（IT行业中利用光纤传输数据的部分）的投资已使得人们有可能搭建和操控复杂程度远超以往的光学系统。

那是技术上的推动力。财务上的拉动力则来自降低能源成本的需要——现代网络及其处理的数据量越来越大，耗用了大量电力。

大多数光神经网络的研发项目并未完全舍弃电子，而是从实际出发，在适当的时候继续运用电子。例如，马萨诸塞州波士顿的两家公司Lightmatter和曦智科技（Lightelligence）正在研发光电混合型的“调制器”，根据电子反馈的数字操控光编码信号进行矩阵乘法。这样，在使用Lightmatter创始人尼古拉斯·哈里斯（Nicholas Harris）称为“傀儡大师”的较传统工具包时，还有光输入并行性高（是电子的一百倍）的好处。

这些调制器用硅制成。硅虽然不是光调制设备的最佳选择，但毫无疑问最完善的电子材料。使用硅意味着以往为制造传统芯片而设计的设备也可以用来制造混合芯片，甚至可能让这些设备焕发新生，正如曦智科技的工程副总裁莫里斯·斯坦曼（Maurice Steinman）所言，尽管电子产品持续了几十年的性能提升正在放缓，“我们在光子设备上的迭代升级才刚刚开始”。

瑞安·海默里（Ryan Hamerly）与他在麻省理工学院（曦智科技和Lightmatter都是在这里诞生）的团队尝试把光电混合装置低功耗的优点应用到智能音箱、轻型无人机，甚至自动驾驶汽车上。智能音箱不具备足够

的计算力和能量在本地运行深度学习程序，而是通过互联网向远程服务器发送听到内容的数字化信息，让服务器代为处理后传回答案。

但这一切耗时且不安全。在音箱内置入光子芯片就可以即时在本地完成所需的线性代数运算，功耗低且不必把可能的敏感数据传输到其他地方。

加州理工学院的乌格·特金（Ugur Tegin）等其他研究人员认为光子计算的真正好处是它能处理大型数据集。举个例子，目前图像识别系统是用低分辨率图片来训练的，因为高分辨率图片太大，即使系统能处理，效率也不高。只要处理过程中运用了电子组件，就会有带宽的限制。特金的解决办法是完全放弃电子元件，使用全光子设备。

但事实证明这很不容易，因为神经网络之所以能有效学习输入数据的模式，除了依赖各种线性处理，还用到了每个节点中的非线性函数。只使用线性函数就意味着系统只能学习线性模式。

幸运的是，尽管光的行为通常是线性的，但也存在例外。据特金解释，这个例外就是当一束超短强脉冲光照射过所谓的“多模光纤”，这样可以利用光的多种特性提高其传送平行信号的能力。在这种情况下，脉冲光的穿射会改变材料本身的属性，通过其中的光的行为也会随之发生非线性变化。

特金把这个特性用到了一个除最后输出层外其余各层均为全光学构造的网络中。他在2021年发表在《自然-计算科学》（Nature Computational Science）上的一篇论文中做了介绍。他能让所有信息都以光的形式传递，直至其到达最后一层，即呈现答案之处。到那里光数据才转换成电子数据，由构成这一层的较简单的小规模电子网络进行处理。

与此同时，在加州大学洛杉矶分校，埃尔多安·奥兹坎（Aydogan Ozcan）正尝试以另一种方法实现全光矩阵处理。在2018年发表在《科学》（Science）上的一篇论文中，他与合作者描述了如何设计完全不用电子的光子装置。

秘诀在于采用特制的玻璃薄片，每片为邮票大小，像一个人工神经网络那

样一层层堆叠起来。堆叠好的玻璃薄片按神经网络处理数字图像的方式让入射光线发生衍射。

在这种情况下，光学元件被动工作，就像照相机的镜头一样，而非接受主动反馈。奥兹坎说这有利于提高安全性。该系统从不捕捉图像或发送原始数据，只发送推断出的结果。但也有一个缺点。这些玻璃片不能重组再用，只要推导算法一改变，就必须更换。

这类光子计算能走多远还有待观察。但基于深度学习的AI正在快速发展，最近人工智能语言系统ChatGPT（该程序只需小小的提示就能生成还不赖的文章，甚至诗歌）引发的哄动就是例证。能进一步推动该领域加速发展的硬件很可能因而备受青睐。所以，裹足不前数十年后，光子计算的前景现在看起来相当光明。 ■



Information technology

Artificial intelligence and the rise of optical computing

Photonic data-processing is well-suited to the age of deep learning

MODERN INFORMATION technology (IT) relies on division of labour. Photons carry data around the world and electrons process them. But, before optical fibres, electrons did both—and some people hope to complete the transition by having photons process data as well as carrying them.

Unlike electrons, photons (which are electrically neutral) can cross each others' paths without interacting, so glass fibres can handle many simultaneous signals in a way that copper wires cannot. An optical computer could likewise do lots of calculations at the same time. Using photons reduces power consumption, too. Electrical resistance generates heat, which wastes energy. The passage of photons through transparent media is resistance-free.

For optical computing to happen, though, the well-established architecture of digital electronic processing would have to be replaced by equivalent optical components. Or maybe not. For some people are working on a novel optical architecture that uses analogue rather than digital computing (that is, it encodes data as a continuous signal rather than as discrete “bits”). At the moment, this architecture is best suited to solving one particular class of problems, those of a branch of maths called linear algebra. But that is a potentially huge market, for linear algebra is fundamental to, among other matters, artificial neural networks, and they, in turn, are fundamental to machine learning—and thus artificial intelligence (AI).

Linear algebra manipulates matrices. These are grids of numbers (representing coefficients of simultaneous equations) that can be added

and multiplied a bit like individual numbers. Among the things which can be described by matrices are the equations governing the behaviour of electromagnetic radiation (such as light) that were discovered in the 19th century by James Clerk Maxwell. Light's underlying Maxwellian nature makes it easy, using appropriate modulating devices, to encode matrix data into light beams and then manipulate those data.

Artificial neural networks are programs that represent layers of nodes, the connections between which represent numbers in matrices. The values of these change in response to incoming signals in a way that results in matrix multiplication. The results are passed on to the next layer for another round of processing, and so on, until they arrive at a final output layer, which synthesises them into an answer. The upshot is to allow a network to recognise and learn about patterns in the input data.

The idea of turning neural networks optical is not new. It goes back to the 1990s. But only now has the technology to make it commercially viable come into existence. One of the people who has observed this transition is Demetri Psaltis, an electrical engineer then at the California Institute of Technology (Caltech) and now at the Swiss Federal Institute of Technology in Lausanne. He was among the first to use optical neural networks for face recognition.

The neural networks of Dr Psaltis's youth were shallow. They had but one or two layers and a few thousand nodes. These days, so-called deep-learning networks can have more than 100 layers and billions of nodes. Meanwhile, investments by the telecoms industry—the part of IT that ships data around through all those optical fibres—have made it possible to fabricate and control optical systems far more complex than those of the past.

That is the technological push. The financial pull derives from shedding the cost of the vast amount of electricity consumed by modern networks as they

and the quantities of data they handle get bigger and bigger.

Most efforts to build optical neural networks have not abandoned electrons entirely—they pragmatically retain electronics where appropriate. For example, Lightmatter and Lightelligence, two firms in Boston, Massachusetts, are building hybrid “modulators” that multiply matrices together by manipulating an optically encoded signal according to numbers fed back electronically. This gains the benefit of parallelism for the optical input (which can be 100 times what electronics would permit) while using more conventional kit as what Nicholas Harris, Lightmatter’s founder, describes as the puppet master.

The modulators themselves are made of silicon. Though this is not the absolute best material for light modulation, it is by far the best-developed for electronics. Using silicon allows hybrid chips to be made with equipment designed for conventional ones—perhaps even affording it a new lease of life. For, as Maurice Steinman, vice-president of engineering at Lightelligence, observes, though the decades’ long rise in the performance of electronics is slowing down, “we’re just at the beginning of generational scaling on optics”.

Ryan Hamerly and his team at the Massachusetts Institute of Technology (the organisation from which Lightelligence and Lightmatter were spun out) seek to exploit the low power consumption of hybrid optical devices for smart speakers, lightweight drones and even self-driving cars. A smart speaker does not have the computational and energetic chops to run deep-learning programs by itself. It therefore sends a digitised version of what it has heard over the internet to a remote server, which does the processing for it. The server then returns the answer.

All this takes time, though, and is insecure. An optical chip put in such a speaker could perform the needed linear algebra there and then, with low

power consumption and without having to transfer potentially sensitive data elsewhere.

Other researchers, including Ugur Tegin, at Caltech, reckon optical computing's true benefit is its ability to handle large data sets. At the moment, for example, image-recognition systems are trained on low-resolution pictures, because high-res versions are too big for them to handle efficiently, if at all. As long as there is an electronic component to the process, there is limited bandwidth. Dr Tegin's answer is to forgo electronics altogether and use an all-optical machine.

This has, however, proved tricky—for what allows neural networks to learn pretty well any pattern thrown at them is the use, in addition to all the linear processing, of a non-linear function in each of their nodes. Employing only linear functions would mean that only linear patterns could be learned.

Fortunately, although light does behave mostly in a linear fashion, there is an exception. This, Dr Tegin explains, is when an extremely short and intense pulse of it is shone through a so-called multi-mode fibre, which exploits multiple properties of light to enhance its ability to carry parallel signals. In these circumstances, the pulse's passage changes the properties of the material itself, altering the behaviour of the passing light in a non-linear manner.

Dr Tegin exploited this feature in what is, save its final output layer, an all-optical network. He describes this in a paper published last year in *Nature Computational Science*. He is able to keep all of the information in an optical form right up until its arrival at the last layer—the one where the answer emerges. Only then is it converted into electronic form, for processing by the simpler and smaller electronic network which makes up this layer.

Meanwhile, at the University of California, Los Angeles, Aydogan Ozcan is taking yet another approach to all-optical matrix processing. In a paper published in *Science* in 2018, he and his collaborators describe how to create optical devices that do it without involving electrons at all.

The magic here lies in the use of thin sheets of specially fabricated glass, each the size of a postage stamp, laid on top of each other in stacks analogous to the layers of an artificial neural network. Together, these sheets diffract incoming light in the way that such a neural network would process a digital image.

In this case, the optics work passively, like the lens of a camera, rather than receiving active feedback. Dr Ozcan says that provides security benefits. The system never captures images or sends out the raw data—only the inferred result. There is a trade-off, though. Because the sheets cannot be reconfigured they must, if the inference algorithm changes, be replaced.

How far optical computing of this sort will get remains to be seen. But AI based on deep learning is developing fast, as recent brouhaha about ChatGPT, a program that can turn out passable prose (and even poetry) with only a little prompting, shows. Hardware which can speed up that development still more is thus likely to find favour. So, after decades in the doldrums, the future of optical computing now looks pretty bright. ■



阴云散去

航空公司正在接近新冠疫情前高度

但是寒冬可能会让长期乐观情绪受挫

要看新冠肺炎挥之不去的影响有多大，航空业是个不错的指针。2020年，由于防疫限制，人们居家不出，航空旅行几乎停止。自那以后，随着封锁放松，那些先前无法度假、探亲和出差的旅行者逐渐重返蓝天，航空业也在逐步爬升。根据咨询公司OAG的数据，到2022年底，航空运力将达到约47亿个座位数。尽管这仍旧比疫情来袭前的2019年低了12%，但比去年年底高出近三分之一。

在2024年之前，航空出行不太可能达到疫情前的水平。然而，从航空公司的长期计划中可以清楚地看出，它们相信病毒可以被战胜，也相信不断壮大的全球中产阶级不可动摇的出游渴望。美联航最近下了一笔购买新飞机的大订单。经营不善的国家航空公司印度航空（Air India）于2022年初被经营尚好且有重振计划的企业集团塔塔集团收购。有传言称印度航空将向欧洲的空客及其美国飞机制造劲敌波音订购500架飞机。鉴于对客机的需求如此可观，这两家航空巨头都计划在2023年增加产量，并在两三年内恢复到疫情之前的水平。

资金雄厚的新来者将进一步推动飞机销售。作为使自身经济从石油转向多元化努力的一部分，沙特阿拉伯准备推出一家新的国家航空公司RIA，与阿联酋航空、阿提哈德航空和卡塔尔航空这些老牌海湾航空公司竞争。沙特希望能从其主权财富基金及其他途径为航空业筹集1000亿美元。它计划在吉达（Jeddah）建造世界上最大的机场之一，到2030年前为1.2亿国内和中转旅客提供服务。

要想让这些宏伟的计划奏效，亚洲的国际旅游就必须反弹。这方面的消息也令人鼓舞。该地区主要航空市场中国近期放松了防疫限制，导致国内运力在几天内激增30%。进出中国的国际航班量停留在不到2019年水平的

5%，因此2023年并不会打破记录。但是OAG的约翰·格兰特（John Grant）认为，如果中国人获准重新开始出境游，2024年可能是中国的航空公司最赚钱的一年。

美国和欧洲的航空公司近年来为该行业贡献了大部分利润，它们可能会更早回到疫情前的水平。他们利用乘客迫不及待重新飞行的心理，并通过精明的运力管理来保持高票价。有些公司已经重新开始盈利了。行业组织国际航空运输协会（IATA）预测，经历了全球航空公司累计净亏损1870亿美元的糟糕三年后，赢家将推动全球航空业在2023年实现47亿美元的利润。

至于（为数更多）亏损者，高企的燃油价格、日益迫近的衰退以及疫情期间累积的2200亿美元额外行业总债务可能会迫使其中一些公司破产——或者对少数幸运者而言，迫使它们进行整合。业绩常年令人失望的国家航空公司意大利航空（Alitalia）的继任者ITA航空可能会被德国的汉莎航空收购。英国航空（British Airways）和西班牙国家航空（Iberia）的母公司IAG集团可能会将TAP葡萄牙航空纳入旗下。总比永远也飞不了要好。■



Parting of the clouds

Airlines are closing in on their pre-covid heights

But a cold winter could dent longer-term optimism

THE AVIATION industry is a useful altimeter for the lingering impact of covid-19. Air travel ground almost to a halt in 2020, as virus-induced restrictions kept people at home. Since then it has clawed its way upwards as lockdowns have eased and travellers who had been denied holidays, visits to loved ones and business trips have gradually returned to the air. Capacity, measured by available seats, is set to end 2022 at around 4.7bn, according to OAG, a consultancy. Although that remains down by 12% on 2019, before the pandemic struck, it is nearly a third higher than at the end of last year.

Flying is not likely to hit pre-covid levels until 2024. Nevertheless, carriers' confidence in the victory over the virus, and in the unshaken yearning for travel of the growing global middle-class, is evident in their longer-term plans. America's United Airlines has recently placed a big order for new aircraft. Air India, a poorly run flag carrier acquired in early 2022 by Tata Group, a rather better-run conglomerate with a turnaround plan, is rumoured to be close to ordering 500 planes from Europe's Airbus and its American planemaking arch-rival, Boeing. Healthy demand for passenger jets means that both aerospace giants are planning to increase production in 2023, and get back to pre-pandemic levels within a couple of years.

Aircraft sales will get an extra boost from deep-pocketed newcomers. As part of its attempts to diversify its economy away from oil, Saudi Arabia is poised to launch a new national airline, RIA, to compete with incumbent Gulf carriers: Emirates, Etihad and Qatar Airways. The kingdom hopes to raise \$100bn, including from its sovereign-wealth fund, for aviation. It is planning to build one of the world's biggest airports, in Jeddah, to serve

120m domestic and connecting passengers by 2030.

For such grand schemes to work, international travel must rebound in Asia. There, too, the news is encouraging. The recent loosening of covid restrictions in China, the region's dominant aviation market, led to a 30% jump in domestic capacity in a matter of days. International flights to and from China are stuck at less than 5% of levels from 2019, so 2023 won't break records. But if Chinese are allowed to restart foreign travel, 2024 could be the most profitable year yet for China's airlines, reckons John Grant of OAG.

American and European carriers, responsible for the bulk of the industry's profits in recent years, may get there sooner. They have exploited passengers' rush to get back in the air and used canny management of capacity to keep ticket prices high. Some are already making money again. After three awful years, when airlines worldwide suffered a combined cumulative net loss of \$187bn, the winners will propel the global industry to a profit of \$4.7bn in 2023, forecasts IATA, a trade body.

As for the (more numerous) lossmakers, high fuel prices, looming recession and \$220bn in additional industry debt accumulated during the pandemic may force some of them into bankruptcy—or, for a lucky few, consolidation. ITA, the successor to Alitalia, Italy's perennially disappointing flag carrier, could be snapped up by Germany's Lufthansa; IAG group, parent of British Airways and Iberia, may bring Portugal's TAP into its fold. Better that than permanent flightlessness. ■



巴托比

模拟技术价值恒久

当纸张胜过屏幕

在今天这样一个数字时代，对高管们的建议很明确。管理者需要具备数字化思维；他们管理的机构必须拥抱数字化转型。如果你不知道ChatGPT为何物，听到“code”（代码）这个词只会想到丹·布朗（Dan Brown），或者不喜欢与协作式机器人共事这个主意，那不如去享受退休生活吧。如此说来，这个圣诞季，你该给身边的高管送个什么礼物呢？答案是任何纸质的东西。即便收到礼物的人根本不会去用，它仍然能够有效地提醒他们，数字世界的局限性在哪里。

最近的研究凸显了造纸这项古老技术经久不衰的价值，无论是在做决策、提高生产率还是在赢得客户方面。先说决策。美国西北大学凯洛格管理学院（Kellogg School of Management at Northwestern University）的马费里马·图雷-蒂勒里（Maferima Touré-Tillery）和浙江大学的王丽丽做了一项研究。其中有这样一个环节：研究人员找陌生人参加一项虚构的调查。他们向一半的受访者提供了纸笔来填写表格，向另一半提供了iPad。测试结束时，受访者被问及是否愿意提供自己的电子邮箱来接收如何向慈善机构捐款的信息。那些使用纸张的人提供邮箱的可能性要大很多。

在调查的最后部分，研究人员向中国的大学生展示了一家书店的广告，然后让他们选择一些广告上正在促销的书籍。研究人员发现，使用纸张填写问卷的人与使用iPad的人的选择也有所不同。平均而言，前者更倾向选择阳春白雪的书籍。研究人员推测，人们会在纸上会做出更良性的决策，是因为比起像素化屏幕，纸张让人感觉更郑重其事。经过询问发现，使用纸笔的受访者确实比使用iPad的人更有可能认为自己的选择更能体现本人性格。笔墨吐真情。

其次，在适当的情况下，纸张可以提高生产率。哥伦比亚大学商学院

(Columbia Business School) 的维姬·莫维茨 (Vicky Morwitz)、德雷克塞尔大学 (Drexel University) 的黄燕柳和加州州立大学富勒顿分校 (California State University, Fullerton) 的杨震的一项研究发现，纸质日历与数字日历会引发不同的行为方式。相比使用日历应用的人，使用老式纸质日历的人制定的项目计划更详细，而且更有可能坚持执行这些计划。简单的多维度设计似乎很重要。研究人员认为，纸质日历能让人一眼看到许多日期这一点很管用；如果手机日历用户在自己的设备上使用“多日视图”，就更容易坚持执行计划。

第三，纸张能吸引顾客。在2017年的一项研究中，研究人员发现，人们认为产品的实物版比其数字版价值更大。比起只能下载的电子书和电影，消费者愿意花更多的钱购买可以拿在手里的纸质书和影碟。根据爱荷华大学 (University of Iowa) 的安德莉亚·韦伯·卢安格拉斯 (Andrea Webb Luangrath) 及其合著者去年的一项研究，人们在网购时，只是看到有人摆弄商品的画面就能提高购买欲。他们发现，在Instagram上，用手触摸咖啡杯或智能手机等产品的帖子比那些没有触摸画面的帖子获得了更多的点赞。同样，人们在浏览虚拟现实商店时，如果看到一件T恤衫被自己的虚拟手触摸过，就更愿意买下它。

这一切都有助于解释为什么零售商品目录仍然会不断被丢到人们的门垫上或者塞满他们的信箱。在一项新研究中，科罗拉多州立大学 (Colorado State University) 的张早早证实了之前的发现，即收到纸质商品目录和电子邮件的消费者比只收到数字营销广告的消费者花费更多。张早早还深入研究了这些商品目录在什么时候最有效，结果显示，是在销售价格较高、没那么实用的产品的时候，以及针对那些更多在线下购物的消费者时。

技术可以缩小纸张和屏幕之间的差距，但不能完全弥合。打出来的字永远不会像手写的那样别具一格。在手机上涂鸦也不会像手绘那样令人满足。随着数字技术变得更加普遍和强大，模拟技术的某些吸引力却愈发清晰。纸质目录不需要检查病毒（尽管在新冠疫情早期人们还是会着魔似的擦拭它们）。虽然机器生成文本的能力越来越强，但为了确保万无一失，更多的考试和面试可能还是会用纸笔来进行。掌握数字技术至关重要。但是触

感、真实度和人性仍然很重要——并且不只是在纸面上。 ■



Bartleby

The enduring value of an analogue technology

When paper beats the screen

THIS IS THE digital age, and the advice to executives is clear. Managers need to have a digital mindset; the organisations they run must embrace digital transformation. If you don't know what ChatGPT is, think of Dan Brown when you hear the word "code" or dislike the idea of working with a cobot, enjoy your retirement. So what present should you be getting the executive in your life this festive season? Answer: anything made of paper. Even if the recipient of your gift never uses it, it can still serve as a useful reminder of where the digital world's limitations lie.

Recent research underscores the enduring value of this ancient technology, whether in making decisions, enhancing productivity or winning over customers. Start with decision-making, and a study from Maferima Touré-Tillery of the Kellogg School of Management at Northwestern University and Lili Wang of Zhejiang University. In one part of their study, the researchers approached strangers and asked them to take a made-up survey. Half the respondents were given a pen and paper to fill out the form; the other half were handed an iPad. At the end of the exercise, respondents were asked if they wanted to give their email address to receive information on how to donate to a charity. Those who used paper were much likelier to provide their email addresses.

The researchers also saw differences in behaviour when they showed Chinese university students an ad for a bookseller at the end of the survey, and then asked them to select some of the books that were being promoted. Those using paper to fill out the questionnaire chose more highbrow books on average than those using the tablet. The researchers speculate that

people make more virtuous decisions on paper because it feels more consequential than a pixelated screen. When asked, paper-and-pen respondents were indeed more likely than iPad users to think their choices were more indicative of their characters. The nib is the nub.

Next, in the right circumstances paper can improve productivity. A study from Vicky Morwitz of Columbia Business School, Yanliu Huang of Drexel University and Zhen Yang of California State University, Fullerton, finds that paper calendars provoke different behaviours from digital calendars. Users of old-fashioned calendars made more detailed project plans than those looking at an app, and they were more likely to stick to those plans. Simple dimensions seem to count. The ability to see lots of days at once on a paper calendar matters, the researchers reckon; mobile-calendar users kept to their plans more if they used a “multi-day view” on their devices.

Third, paper appeals to customers. In a study from 2017 researchers found that people assigned a greater value to the physical version of a product than its digital instantiation. Shoppers were willing to pay more for books and films they could hold than ones they could only download. Even the sight of someone handling something can help online sales, according to a study last year by Andrea Webb Luangrath of the University of Iowa and co-authors. They found that Instagram posts showing hands touching products like cups of coffee or smartphones got more likes than those that were not being pawed. Similarly, people browsing in a virtual-reality shop were more willing to buy a T-shirt if they saw their own simulated hand touch it.

All of which helps explain why retail catalogues continue to thud onto doormats and jam mailboxes. In a new study Jonathan Zhang of Colorado State University confirmed previous findings that consumers who receive paper catalogues as well as emails spend more than those who receive only digital marketing. Mr Zhang also delved into when these catalogues work best—as it turns out, when they are selling pricier, less functional products,

and targeting consumers who do more of their shopping offline.

Technology can close the gap between paper and screen, but not entirely. Typing will never be as distinctive as handwriting. Doodling on a phone is just not as satisfying. And some of the attractions of the analogue become even clearer as digital technology becomes more pervasive and powerful. Catalogues do not have to be checked for viruses (however obsessively people wiped them down in the early days of covid-19). As machines get better at generating text, more exams and interview tests may be conducted with pen and paper, just to be sure. Mastery of digital technologies is vital. But a sense of touch, authenticity and humanity still matter—and not just on paper. ■



风雨满天

为航班设定碳排放价格步履维艰

欧洲领先世界，但走得仍然不够快

很少有话题能像航空旅行那样让环保人士恼火。飞机只占二氧化碳排放总量的一小部分——大约2.5%——但与取暖、其他交通和用电不同，乘坐飞机旅行一般被认为是奢侈行为，而非必不可少。航空旅行大体上也避开了碳定价。目前碳定价覆盖了全部排放量的四分之一。

不过，变化正在空中酝酿。自去年年初开始，联合国支持的一项计划要求航空公司通过购买碳积分来抵消超出基线的排放。12月6日，欧盟决定把航空公司更深入地纳入其碳交易计划。这些步骤都在向正确的方向迈进，虽然它们不太可能让欧洲有足够的脱碳速度，从而达成在2050年实现航空业净零排放的目标。

理想的碳定价方案应当应用于整个经济，允许人们在不同的活动之间权衡取舍。如果社会认为航空飞行特别重要，那么对炼钢的排放许可就要减少。碳价格既要体现用污染更少的能源替代碳燃料的难易程度，也要体现使用碳燃料的活动的价值。将航空公司排除在欧盟碳计划之外的逻辑是有问题的，因为目前还没有可行的航空燃料替代品。一种看法是向航班征收碳排放税只会惹恼乘客，并且将航空公司推向其他地方。

但是有一些方法可以降低航空飞行的碳浓度。更高效的飞机有帮助，使用更智能的定价确保每个座位都用得上也有帮助。即使没有碳定价，每客公里的碳浓度也已经从1960年的约1.4公斤二氧化碳下降到2018年的0.1公斤。碳定价还可以改变消费者的行为，鼓励他们尽量选择火车、长途客车或轮船。向航空公司发放免费排放许可相当于为坐飞机提供隐性补贴。

欧盟的新计划会让航空公司的免费许可逐年减少，直到2026年该行业的特殊碳配额完全被取消，比原计划提前一年。新计划涵盖英国和瑞士的航班，但飞往欧盟以外国家的航班仍将得到豁免。这主要源于2012年的一次

争执，当时中国威胁停止向欧洲公司空客购买飞机，而美国威胁如果欧盟要求把所有航班都纳入计划，它就不会遵守规则。

国际航空公司仍然必须遵守联合国支持的计划，即适用于整个行业的“国际航空碳抵消和减排计划”（Carbon Offsetting and Reduction Scheme for International Aviation，简称CORSIA）。根据CORSIA的规定，航空公司必须通过购买积分来抵消超出基线的排放，额度根据各航空公司在全行业排放总量中的份额来分配。在持续到2023年底的试行阶段，基线是该行业在2019年的排放量。

由于航空公司尚未完全从新冠疫情中恢复过来，目前还没有抵消排放的要求。从2024年开始，基准将降低到2019年排放量的85%。然而，即便如此也不会产生太大影响。积分很便宜，每吨约3美元，而在欧盟每吨约90欧元（96美元）。而且航空公司或许可以通过使用一点可持续的航空燃料来避免购买积分，这种燃料由废食用油制成，在美国获得了高额补贴。

到目前为止，还没有哪个国家选择在整个经济中实施碳定价机制。欧洲将航空公司纳入碳交易计划至少正朝着正确的方向前进。但由于该计划的局限性，加上世界其他地区拉后腿，航空业实现净零排放的进程将十分缓慢。 ■



Stormy skies

The struggle to put a carbon price on a flight

Europe is leading the world—but still not going fast enough

FEW TOPICS annoy green activists as much as air travel. Planes account for a sliver of total carbon-dioxide emissions—roughly 2.5%—but unlike heating, other transport and electricity, journeys on them are often luxuries not essentials. Air travel has also largely escaped carbon pricing, which covers a quarter of all emissions.

Change is in the air, however. Since the start of last year, a UN-backed scheme has required airlines to offset emissions above a baseline by buying credits. On December 6th the EU decided to bring airlines deeper into its carbon-trading scheme. These are steps in the right direction, even if they are unlikely to bring about fast enough decarbonisation for Europe to hit its goal of a net-zero aviation industry by 2050.

The ideal carbon-pricing scheme would apply across the economy, allowing trade-offs to be made between different activities. If society decided that flying was especially important, there would be fewer permits for steelmaking. The price of carbon would reflect both the ease of substituting a less polluting energy source and the value of the activity it fuels. The faulty logic behind excluding airlines from the EU's scheme was that there was not yet a viable alternative for jet fuel. It was thought a carbon price on flights would simply annoy flyers and push airlines elsewhere.

But there are ways of reducing the carbon intensity of a flight. More efficient aircraft help, as does smarter pricing to ensure every seat is used. Even without a carbon price, the carbon intensity of a passenger kilometre has fallen from around 1.4kg of carbon dioxide in 1960 to 0.1kg in 2018. Carbon

prices can also change the behaviour of consumers, encouraging them to opt for a train, bus or boat where available. Handing out free permits to airlines amounted to an implicit subsidy for flying.

The EU's new plan will see airlines lose more of these permits each year until the industry's special carbon allowances are phased out entirely in 2026, a year sooner than had been intended. Britain and Switzerland are included, but flights to other countries outside the bloc will remain exempt. This is mostly the result of a spat in 2012 when China threatened to stop buying planes from Airbus, a European firm, and America threatened non-compliance if the EU required all flights to take part.

International airlines will still have to hew to the UN-backed scheme, which is known as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and applies to the whole industry. Under CORSIA an airline must offset emissions beyond a baseline by buying credits, with the split based on the airline's share of total industry emissions. For the pilot stage, which runs until the end of 2023, the baseline is industry emissions in 2019.

As airlines have not fully recovered from the covid-19 pandemic, there is currently no requirement to offset emissions. From 2024 the baseline will be lowered to 85% of emissions in 2019. Yet even this will not have much impact. Credits are cheap, costing about \$3 a tonne compared with around €90 (\$96) a tonne in the EU. And airlines may be able to avoid buying them at all by using a bit of sustainable aviation fuel, made from waste cooking oil, which is heavily subsidised in America.

So far nowhere has opted for a carbon-pricing scheme that operates across the whole economy. By incorporating airlines into its carbon-trading scheme Europe is at least heading in the right direction. But with the scheme's limitations, and with the rest of the world lagging behind, the

journey to a net-zero aviation industry will be a slow one. ■