Official 01

Passage 01

Elements of Life

The creation of life requires a set of chemical elements for making the components of cells. Life on Earth uses about 25 of the 92 naturally occurring chemical elements, although just 4 of these elements-oxygen, carbon, hydrogen, and nitrogen-make up about 96 percent of the mass of living organisms. Thus, a first requirement for life might be the presence of most or all of the elements used by life.

生命的创造需要一套用于制造细胞成分的化学元素。“地球上的生命”使用了 92 种天然化学元素中的 25 种，尽管仅这些元素中的 4 种——氧，碳，氢和氮——构成了大约96%的活生物体。因此，生命的第一个要求可能是生命需要用到的大部分或全部元素的存在。

Interestingly, this requirement can probably be met by almost any world. Scientists have determined that all chemical elements in the universe besides hydrogen and helium (and a trace amount of lithium) were produced by stars. These are known as heavy elements because they are heavier than hydrogen and helium. Although all of these heavy elements are quite rare compared to hydrogen and helium, they are found just about everywhere.

有趣的是，几乎所有的星球都可以满足这个要求。 科学家们已经确定，除了氢和氦（以及微量的锂）之外，宇宙中的所有化学元素也都是由恒星产生的。这些被称为重元素，因为它们比氢和氦重。尽管与氢和氦相比，所有这些重元素都很罕见，但它们几乎遍布各处。

Heavy elements are continually being manufactured by stars and released into space by stellar deaths , so their amount compared to hydrogen and helium gradually rises with time. Heavy elements make up about 2 percent of the chemical content (by mass) of our solar system; the other 98 percent is hydrogen and helium. In some very old star systems, which formed before many heavy elements were produced, the heavy-element share may be less than 0.1 percent. Nevertheless , every star system studied has at least some amount of all the elements used by life. Moreover, when planetesimals-small, solid objects formed in the early solar system that may accumulate to become planets-condense within a forming star system, they are inevitably made from heavy elements because the more common hydrogen and helium remain gaseous. Thus, planetesimals everywhere should contain the elements needed for life, which means that objects built from planetesimals-planets, moons, asteroids, and comets-also contain these elements. The nature of solar-system formation explains why Earth contains all the elements needed for life, and it is why we expect these elements to be present on other worlds throughout our solar system, galaxy, and universe.

重元素不断由恒星制造并通过恒星死亡释放到太空中，因此它们的量与氢和氦相比随着时间的推移逐渐增加。重元素占我们太阳系化学含量的百分之二（按质量计），另外百分之九十八是氢和氦。在一些非常古老的，形成于诸多种元素出现之前的恒星系统中，重元素份额可能低于 0.1%。尽管如此，被研究过的所有恒星系统都至少有一定数量的生命使用的元素。而且，当星子——在早期的太阳系中形成的，可以积聚组成行星的小的固体物质——凝聚成一个稳定的行星系统，它们不可避免地由重元素制成，因为更常见的氢和氦气保持气态。因此，任何地方的星子都应该包含生命所需要的元素，这意味着由星子组成的物体——行星 、卫星、小行星和彗星等——也包含这些元素。太阳系形成的本质解释了为什么地球包含生命所需的所有元素，这就是为什么我们预期这些元素存在于整个太阳系，银行系乃至宇宙中的其他地方。

Note that this argument does not change, even if we allow for life very different from life on Earth. Life on Earth is carbon based, and most biologists believe that life elsewhere is likely to be carbon based as well. However, we cannot absolutely rule out the possibility of life with another chemical basis, such as silicon or nitrogen. The set of elements (or their relative proportions) used by life based on some other element might be somewhat different from that used by carbon-based life on Earth. But the elements are still products of stars and would still be present in planetesimals everywhere. No matter what kinds of life we are looking for, we are likely to find the necessary elements on almost every planet, moon, asteroid, and comet in the universe.

请注意，即使我们考虑到与地球上的生命截然不同的生命体，这个论点也不会改变。地球上的生命是以碳为基础的，大多数生物学家认为其他地方的生命也可能以碳为基础。但是，我们不能完全排除使用另一种化学基础如硅或氮的生命的可能性。基于某些其他元素的生命所使用的元素（或其相对比例）可能与地球上基于碳的生命所使用的元素有所不同。但这些元素仍然是恒星的产物，并且仍然会在各处的星子中出现。无论我们在寻找什么样的生物，我们都可能在宇宙中的几乎每个行星，月球，小行星和彗星上找到必要的元素。

A somewhat stricter requirement is the presence of these elements in molecules that can be used as ready-made building blocks for life, just as early Earth probably had an organic soup of amino acids and other complex molecules. Earth`s organic molecules likely came from some combination of three sources: chemical reactions in the atmosphere, chemical reactions near deep-sea vents in the oceans, and molecules carried to Earth by asteroids and comets. The first two sources can occur only on worlds with atmospheres or oceans, respectively. But the third source should have brought similar molecules to nearly all worlds in our solar system.

一个更严格的要求是分子中存在这些元素，这些元素可以作为现成的生命基石，就像早期的地球可能有氨基酸和其他复杂分子的有机汤一样。地球的有机分子可能来自三种来源的某一种组合：大气中的化学反应，海洋深海通风口附近的化学反应以及小行星和彗星携带到地球的分子。 前两个来源分别只能出现在有大气或海洋的星球上。 但是第三个来源应该给我们的太阳系中的几乎所有星球带来类似的分子。

Studies of meteorites and comets suggest that organic molecules are widespread among both asteroids and comets. Because each body in the solar system was repeatedly struck by asteroids and comets during the period known as the heavy bombardment (about 4 billion years ago), each body should have received at least some organic molecules. However, these molecules tend to be destroyed by solar radiation on surfaces unprotected by atmospheres. Moreover, while these molecules might stay intact beneath the surface (as they evidently do on asteroids and comets), they probably cannot react with each other unless some kind of liquid or gas is available to move them about. Thus, if we limit our search to worlds on which organic molecules are likely to be involved in chemical reactions, we can probably rule out any world that lacks both an atmosphere and a surface or subsurface liquid medium, such as water.

对陨石和彗星的研究表明，有机分子在小行星和彗星中都很普遍。由于太阳系中的每个个体在被称为重度轰炸的时期（大约 40 亿年前）一再遭到小行星和彗星的袭击，所以每个个体至少应该接受一些有机分子。然而，这些分子往往被不受大气保护的表面上的太阳辐射破坏。此外，尽管这些分子可能会在表面下保持完整（如它们明显在小行星和彗星表面下保持完整），但除非某种液体或气体可用于移动它们，否则它们可能无法相互反应。因此，如果我们将研究范围限制在仅有有机分子可能参与化学反应的星球上，我们可以排除任何缺乏大气和表面或地下液体介质（如水）的星球。

Passage 02

The Commercialization of Lumber

In nineteenth-century America, practically everything that was built involved wood. Pine was especially attractive for building purposes. It is **durable** and strong, yet soft enough to be easily worked with even the simplest of hand tools. It also floats nicely on water, which allowed it to be transported to distant markets across the nation. The central and northern reaches of the Great Lakes states-Michigan, Wisconsin, and Minnesota-all contained extensive pine forests as well as many large rivers for floating logs into the Great Lakes, from where they were transported nationwide.

在十九世纪的美国，几乎所有建筑的建筑材料中都有木头。松木在建筑用途中尤为受欢迎。它耐用而坚固，却又足够软到即使用最简单的手工工具也能轻易打造。它还能非常好地漂浮在水上，因而它可以穿过国家被转移到遥远的市场。五大湖地区中部和北部的河段地区——密歇根，威斯康星，以及明尼苏达——全都包含了广阔的松木林并且拥有许多大河流来将原木漂流输送进五大湖内，松木由此被输送至全国各地。

By 1860, the settlement of the American West along with timber shortages in the East converged with ever-widening impact on the pine forests of the Great Lakes states. Over the next 30 years, lumbering became a full-fledged enterprise in Michigan, Wisconsin, and Minnesota. Newly formed lumbering corporations bought up huge tracts of pineland and set about systematically cutting the trees. Both the colonists and the later industrialists saw timber as a commodity , but the latter group adopted a far more thorough and calculating approach to removing trees. In this sense, what happened between 1860 and 1890 represented a significant break with the past. No longer were farmers in search of extra income the main source for shingles, firewood, and other wood products. By the 1870s, farmers and city dwellers alike purchased forest products from large manufacturing companies located in the Great Lakes states rather than chopping wood themselves or buying it locally.

到 1860 年，美国西部的定居伴随着东部地区的木材短缺趋势对于在五大湖地区松木林的影响不断扩大。在之后三十年，伐木业在密歇根，威斯康星，明尼苏达成为了一个完全成熟的行业。新成立的伐木公司买了大片的松木林土地并开始系统化地砍伐树木。殖民者与之后的工业家都把木材看作是货物，而后者采取了更加彻底及精明的方式砍伐树木。在这个意义上，在 1860 到 1890 年发生的事代表了一个对过去的重大突破。农民们不再从墙面板，木柴以及其他木制品中寻求额外收入。到 19 世纪 70 年代，农民和城市居民同样从五大湖的大制造企业中购买森林产品而不是亲自伐木或去当地购买。 伐木业的商品化是科技化转变产物的一部分。早先，粗锯条更容易浪费大量的木头，大约有三分之一的原木被当做锯末或碎片留在地上。然而，在 19 世纪 70 年代，英国发明了带锯，它有着更细的锯条，成为五大湖伐木业的标配。同时，新兴起的蒸汽工厂通过使用更有效率，集中，连续不断的方式砍伐木头实现了流水式的生产。蒸汽促使许多任务实现自动化，从伐木到废料处理。工厂还用蒸汽来加热原木池，防止它们结冰，从而实现了全年的木材生产。

The commercialization of lumbering was in part the product of technological change. The early, thick saw blades tended to waste a large quantity of wood, with perhaps as much as a third of the log left behind on the floor as sawdust or scrap. In the 1870s, however, the British-invented band saw , with its thinner blade, became standard issue in the Great Lakes states` lumber factories. Meanwhile, the rise of steam-powered mills streamlined production by allowing for the more efficient, centralized, and continuous cutting of lumber. Steam helped to automate a variety of tasks, from cutting to the carrying away of waste. Mills also employed steam to heat log ponds, preventing them from freezing and making possible year-round lumber production.

伐木业的商品化是科技化转变产物的一部分。早先，粗锯条更容易浪费大量的木头，大约有三分之一的原木被当做锯末或碎片留在地上。在 1870 年代，然而，英国发明的带锯条，它有着更细的缝刃，成为五大湖伐木业的标配。同时，随着蒸汽工厂的兴起，用更有效率，集中，连续不断的方式砍伐木头，流程化地进行产出。蒸汽帮助使许多任务实现自动化，

从伐木到带走废料。工厂还让蒸汽来加热原木池，防止它们结冰，从而实现了全年的原木生产。

For industrial lumbering to succeed, a way had to be found to neutralize the effects of the seasons on production. Traditionally, cutting took place in the winter, when snow and ice made it easier to drag logs on sleds or sleighs to the banks of streams. Once the streams and lakes thawed, workers rafted the logs to mills, where they were cut into lumber in the summer. If nature did not cooperate-if the winter proved dry and warm, if the spring thaw was delayed-production would suffer. To counter the effects of climate on lumber production, loggers experimented with a variety of techniques for transporting trees out of the woods. In the 1870s, loggers in the Great Lakes states began sprinkling water on sleigh roads, giving them an artificial ice coating to facilitate travel. The ice reduced the friction and allowed workers to move larger and heavier loads.

为了工业化伐木业的成功，必须找到一种能消除生产中的季节性影响的办法。通常，伐木在冬天进行，雪和冰使得用雪橇将原木拖到河流岸边变得更加容易。一旦溪水和湖泊解冻，工人们用木筏运载木头到工厂，夏天木头在那儿被砍成木材。如果自然不配合——如若冬天又干又暖和，春天解冻延迟了——生产将遭受困难。为了对抗气候在原木生产中的影响，伐木工人试验了很多不同的技术来将树木运送出树林。在 19 世纪 70 年代，工人们在五大湖滑雪道上洒水，人工给路铺上一层冰来使运输变得便利。冰减轻了摩擦并使工人能移动更大更重的货物。

But all the sprinkling in the world would not save a logger from the threat of a warm winter. Without snow the sleigh roads turned to mud. In the 1870s, a set of snowless winters left lumber companies to ponder ways of liberating themselves from the seasons. Railroads were one possibility. At first, the remoteness of the pine forests discouraged common carriers from laying track. But increasing lumber prices in the late 1870s combined with periodic warm, dry winters compelled loggers to turn to iron rails. By

1887, 89 logging railroads crisscrossed Michigan, transforming logging from a winter activity into a year-round one.

但是在这个世界上任何洒水行为都不能在暖冬的威胁下拯救一个伐木工人没有雪, 滑雪道会变成泥路。在 19 世纪 70 年代，一连串的无雪冬日，让伐木公司思考从季节性影响中解放出来的方法。铁路是一种可能性。一开始，松树林的偏僻阻拦了普通运输公司铺设轨道。但是在 19 世纪 70 年代末，木材价格不断上涨，结合周期性回暖，以及干燥的冬天，促使工人们寄希望于靠铁路解决问题。到 1887 年，89 条木材轨道纵横交错穿越密歇根，将伐木从一个冬季活动变成全年的活动。

Once the logs arrived at a river, the trip downstream to a mill could be a long and tortuous one. Logjams (buildups of logs that prevent logs from moving downstream) were common-at times stretching for 10 miles-and became even more frequent as pressure on the northern Midwest pinelands increased in the 1860s. To help keep the logs moving efficiently, barriers called booms (essentially a chain of floating logs) were constructed to control the direction of the timber. By the 1870s, lumber companies existed in all the major logging areas of the northern Midwest.

一旦原木到达一条河，顺流到工厂的路程将是又长又艰险的。漂浮原木造成的阻塞（堆积起来的原木使得原木难以往下游移动）是常见的——有时绵延十公里——并且在 19 世纪 60 年代，当中西部松林北部的伐木压力增加的时候，（这种阻塞）变得越来越频繁。为了帮助原木运输更有效率，人们制造了叫做吊杆的障碍物（本质上是漂浮的原木链）来控制木材的方向。到 19 世纪 70 年代，中西部地区北部的所有主要伐木区都有木材公司。

Passage 03

Overkill of the North American Megafauna

Thousands of years ago, in North America`s past, all of its megafauna-large mammals such as mammoths and giant bears-disappeared. One proposed explanation for this event is that when the first Americans migrated over from Asia, they hunted the megafauna to extinction. These people, known as the Clovis society after a site where their distinctive spear points were first found, would have been able to use this food source to expand their population and fill the continent rapidly. Yet many scientists argue against this "Pleistocene (the period between about 2.5 million and 11,700 years ago during which humans first appeared on Earth) overkill" hypothesis. Modern humans have certainly been capable of such drastic effects on animals, but could ancient people with little more than stone spears similarly have caused the extinction of numerous species of animals? Thirty-five genera or groups of species (and many individual species) suffered extinction in North America around 11,000 B.C., soon after the appearance and expansion of Paleo-Indiansa group of hunters active in America during the late Pleistocene throughout the Americas (27 genera disappeared completely, and another 8 became locally extinct, surviving only outside North America).

数千年前，在过去的北美，所有巨型动物——猛犸象和巨熊这些大型动物——都消失了。对此事件的一个解释是，当第一批美国人从亚洲迁移过来时，他们狩猎巨型动物以至于使其灭绝。这些人，他们使用的独特的矛头在首次被发现后，人们把他们称为克洛维斯族人，这些人能够使用这些食物源来扩展他们的人口，并且很快的充满了整个大陆。然而，许多科学家反对这种“更新世过度捕杀”假说。现代人对动物确实具有如此剧烈的影响，但难道只有石矛等武器的古代人也同样能造成无数种动物的灭绝吗?在公元前 11000 年前后，北美洲有 35 个属或种群(以及许多单个物种)，在古印第安人在美洲出现和扩张后不久就灭绝了。(27 属全部消失，另有 8 个属于局部灭绝，幸存下来只生活在北美以外的地区)。

Although the climate changed at the end of the Pleistocene, warming trends had happened before. A period of massive extinction of large mammals like that seen about 11,000 years ago had not occurred during the previous 400,000 years, despite these changes. The only apparently significant difference in the Americas 11,000 years ago was the presence of human hunters of these large mammals. Was this coincidence or cause-and-effect?

尽管更新世末期气候发生了变化，但变暖趋势发生在此之前。但在过去的 40 万年中，尽管发生了这些变化，但像这样在大约 11，000 年前大型哺乳动物大规模灭绝的时期，并没有出现。11,000 年前的美洲与以前相比，唯一明显的差异是，这些大型哺乳动物的猎人的存在。这是巧合还是有因果关系?

We do not know. Ecologist Paul S. Martin has championed the model that associates the extinction of large mammals at the end of the Pleistocene with human predation. With researcher J. E. Mosimann, he has co-authored a work in which a computer model showed that in around 300 years, given the right conditions, a small influx of hunters into eastern Beringia 12,000 years ago could have spread across North America in a wave and wiped out game animals to feed their burgeoning population.

我们不知道。 生态学家保罗・马丁(Paul S. Martin)提出将更新世末期大型哺乳动物灭绝与人类捕食相关联的模式。 研究人员 J.E Mosimann 与他合作撰写了一个计算机模型的研究报告，报告显示在大约 300 年的时间里，条件正确的话，12,000 年前在 Beringia 东部的小量涌入的猎人波浪式地快速传播到北美洲，消除野兽以养活其新增的人口。

The researchers ran the model several ways, always beginning with a population of 100 humans in Edmonton, in Alberta, Canada, at 11,500 years ago. Assuming different initial North American big-game-animal populations (75–150 million animals) and different population growth rates for the human settlers (0.65%–3.5%), and varying kill rates, Mosimann and Martin derived figures of between 279 and 1,157 years from initial contact to big-game extinction.

研究人员以多种方式运行该模型，他们总是从 11,500 年前的加拿大艾伯塔省埃德蒙顿的 100 人开始分析。评估了不同的北美大型野生动物独立种群(0.75-1.5 亿只动物)和不同的人类定居者的不同人口增长率(0.65%-3.5%)，以及不断变化的捕杀率，Mosimann 和 Martin 得出了数据，人类从最初开始接触到大型生物到其灭绝的这段时间是在 279 年到 1157 年之间。

Many scholars continue to support this scenario. For example, geologist Larry Agenbroad has mapped the locations of dated Clovis sites alongside the distribution of dated sites where the remains of wooly mammoths have been found in both archaeological and purely paleontological contexts. These distributions show remarkable synchronicity (occurrence at the same time).

许多学者继续支持这种说法。 例如，地质学家 Larry Agenbroad 已经绘制出了那个时期的克洛维斯遗址的位置，以及考古遗址的分布，在这些地方已经发现了羊毛猛犸遗体，这些都可以在考古学和纯粹生物学的文章中体现出来了。这些分布显示出明显的同步性(同时发生)。

There are, however, many problems with this model. Significantly, though a few sites are quite impressive, there really is very little archaeological evidence to support it. Writing in 1982, Martin himself admitted the paucity of evidence; for example, at that point, the remains of only 38 individual mammoths had been found at Clovis sites. In the years since, few additional mammoths have been added to the list; there are still fewer than 20 Clovis sites where the remains of one or more mammoths have been recovered, a minuscule proportion of the millions that necessarily would have had to have been slaughtered within the overkill scenario.

然而，这种模式存在很多问题。 值得注意的是，虽然有几个遗址令人印象深刻，但实际上很少有考古证据能支持它。1982 年，马丁写到，他自己承认自己缺乏证据; 例如，在那个时候，在克洛维斯遗址发现的只有 38 只个体猛犸象的遗骸。在那之后，几乎没有其它的

猛犸象被发现;但是仍然有不到 20 个克洛维斯遗址，其中一头或多头猛犸象的遗体已经被发现，其中数百万中的一些小部分必然会在过度屠杀的情况下被杀害。

Though Martin claims the lack of evidence actually supports his model-the evidence is sparse because the spread of humans and the extinction of animals occurred so quickly-this argument seems weak. And how could we ever disprove it? As archaeologist Donald Grayson points out, in other cases where extinction resulted from the quick spread of human hunters-for example, the extinction of the moa, the large flightless bird of New Zealand-archaeological evidence in the form of remains is abundant. Grayson has also shown that the evidence is not so clear that all or even most of the large herbivores in late Pleistocene America became extinct after the appearance of Clovis. Of the 35 extinct genera, only 8 can be confidently assigned an extinction date of between 12,000 and 10,000 years ago. Many of the older genera, Grayson argues, may have succumbed before 12,000 B.C., at least half a century before the Clovis showed up in the American West.

虽然马丁声称缺乏实际证据能够支持他的模型，并且已有的证据是稀疏的，因为人类的扩张和动物的灭绝发生得太快了，这个论点似乎很薄弱以至于不能支持他们的观点。我们怎么能反驳它呢?正如考古学家唐纳德格雷森指出的那样，在其他因人类猎人快速传播而灭绝的情况下，例如猿的灭绝，新西兰大型不能飞行的鸟类的灭绝——以遗骸形式出现的考古证据非常丰富。格雷森还表明，更新世时期末期美洲的所有甚至大部分大型食草动物在克洛维斯出现后都灭绝了的证据不是很清楚。在 35 个已灭绝的属中，只有 8 个可以确切地指定其是在 12,000 至 10,000 年前灭绝的。格雷森认为，许多更老的属可能在 12,000 年前就已经灭绝了，至少在克洛维斯出现在美国西部之前半个世纪就已经灭绝了。