Official 01

Passage 01

Evidence of the Earliest Writing

Although literacy appeared independently in several parts of the prehistoric world, the earliest evidence of writing is the cuneiform Sumerian script on the clay tablets of ancient Mesopotamia, which, archaeological detective work has revealed, had its origins in the accounting practices of commercial activity. Researchers demonstrated that preliterate people, to keep track of the goods they produced and exchanged, created a system of accounting using clay tokens as symbolic representations of their products. Over many thousands of years, the symbols evolved through several stages of abstraction until they became wedge-shaped (cuneiform) signs on clay tablets, recognizable as writing.

虽然读写能力在史前世界几个区域独立出现，最早的文字证据是在古代美索不达米亚黏土碑发现的楔形苏美尔笔迹，地质勘探结果表明文字来源于商业活动的计数实践。研究者证实，没有读写能力的人为了记录他们生产和交换的货物用黏土符号创造了一个计数系统作为他们产品的象征性代表。经历了几千年，这些符号经历几个抽象阶段的进化，直到他们成为在黏土碑上楔形的符号，即可辨认的文字。

The original tokens (circa 8500 B.C.E.) were three-dimensional solid shapes-tiny spheres, cones, disks, and cylinders. A debt of six units of grain and eight head of livestock, for example, might have been represented by six conical and eight cylindrical tokens. To keep batches of tokens together, an innovation was introduced (circa 3250 B.C.E.) whereby they were sealed inside clay envelopes that could be broken open and counted when it came time for a debt to be repaid. But because the contents of the envelopes could easily be forgotten, two-dimensional

representations of the three-dimensional tokens were impressed into the surface of the envelopes before they were sealed. Eventually, having two sets of equivalent symbols-the internal tokens and external markings-came to seem redundant, so the tokens were eliminated (circa 3250–3100 B.C.E.), and only solid clay tablets with two-dimensional symbols were retained. Over time, the symbols became more numerous, varied, and abstract and came to represent more than trade commodities, evolving eventually into cuneiform writing.

原始的符号（大约公元前 8500 年）是三维的固定的形状-小球形，圆锥形，圆盘形和圆柱形。例如，六个单位的谷物和八头牲畜的账可能是被六个圆锥形符号和八个圆柱形符号代表。为了把一堆符号聚集在一起，有所创新（大约公元前 3250 年），这里符号被封存在黏土信封中，当还债的时候可以敲碎打开并且计数。但是因为信封的内容可以轻易被遗忘，在他们被封存之前，三维符号的二维代表被刻在信封的表面。最终，有两套对等的符号-内部符号和外部痕迹-这看起来累赘，所以符号被消除（大约公元前 3250-3100 年），只有带有二维符号的黏土碑被保留。随着时间的推移，符号变得越来越多，丰富，抽象，并且代表了除贸易货物以外更多的含义，最终进化成楔形文字。

The evolution of the symbolism is reflected in the archaeological record first of all by the increasing complexity of the tokens themselves. The earliest tokens, dating from about 10,000 to 6,000 years ago, were of only the simplest geometric shapes. But about 3500 B.C.E., more complex tokens came into common usage, including many naturalistic forms shaped like miniature tools, furniture, fruit, and humans. The earlier, plain tokens were counters for agricultural products, whereas the complex ones stood for finished products, such as bread, oil, perfume, wool, and rope, and for items produced in workshops, such as metal, bracelets, types of cloth, garments, mats, pieces of furniture, tools, and a variety of stone and pottery vessels. The signs marked on clay tablets likewise evolved from simple wedges, circles, ovals, and triangles based on the plain tokens to pictographs derived from the complex tokens.

符号的进化在地质记录里有所反映，首先是因为符号本身越来越复杂的性质。最早的符号要追溯到大约 10，000 到 6000 年前，仅仅是最简单的几何形状。但是大约公元前 3500 年，更复杂的符号开始广泛使用，包括许多自然的形状如小型工具，家具，水果和人类。更早的简单的符号是农产品的计数，然而复杂的符号代表成品，像面包，油，香水，羊毛和绳子，还有在车间生产的产品，比如金属，手镯，布料的种类，衣服，垫子，家具，工具和多种石制与陶制的容器。类似的，在黏土碑上刻的记号同样由简单的楔形，圆形，椭圆形和三角形演化而来，基于从简单符号到来源于复杂符号的图片文字的变化。

Before this evidence came to light, the inventors of writing were assumed by researchers to have been an intellectual elite. Some , for example, hypothesized that writing emerged when members of the priestly caste agreed among themselves on written signs. But the association of the plain tokens with the first farmers and of the complex tokens with the first artisans-and the fact that the token-and-envelope accounting system invariably represented only small-scale transactions-testifies to the relatively modest social status of the creators of writing.

在证据为人所知之前，研究者认为文字发明者是有智慧的精英。比如，有些人假设文字出现于神职人员阶层内部约定的文字符号。但是简单的符号和最早的农民的联系，复杂符号和最早的工匠的联系，还有符号信封计数系统总是仅代表小规模交易的事实-证实了文字创造者相对卑微的社会地位。

And not only of literacy, but numeracy (the representation of quantitative concepts) as well. The evidence of the tokens provides further confirmation that mathematics originated in people`s desire to keep records of flocks and other goods. Another immensely significant step occurred around 3100 B.C. E., when Sumerian accountants extended the token-based signs to include the first real numerals. Previously, units of grain had been represented by direct one-to-one correspondence-by repeating the token or symbol for a unit of grain the required number of times. The accountants, however, devised numeral signs distinct from commodity signs, so that eighteen units of grain could be indicated by preceding a single grain symbol with a symbol denoting "18." Their

invention of abstract numerals and abstract counting was one of the most revolutionary advances in the history of mathematics.

不仅仅是读写能力，还有计算能力（量概念的表示）。符号证据进一步证实数学来源于人们记录家禽和其他商品数目的愿望。另一个具有重大意义的进展发生在大约公元前 3100 年，这时苏美尔人扩展基于符号的标记直到第一个真正的数字。以前，谷物单位被一对一对应-表现为需要的谷物单位的重复符号或标志。然而，会计们设计出与货物标记不一样的数字标记，这样十八个谷物单位都可以通过一个谷物标志和一个表示十八的符号表示。抽象数字的发明和抽象计数是数学史上最具有革命性的进步。

What was the social status of the anonymous accountants who produced this breakthrough? The immense volume of clay tablets unearthed in the ruins of the Sumerian temples where the accounts were kept suggests a social differentiation within the scribal class, with a virtual army of lower-ranking tabulators performing the monotonous job of tallying commodities. We can only speculate as to how high or low the inventors of true numerals were in the scribal hierarchy, but it stands to reason that this laborsaving innovation would have been the brainchild of the lower-ranking types whose drudgery it eased.

这些创造出重大突破的匿名会计们的社会地位怎么样？在苏美尔庙宇遗迹中出土的大量黏土碑上保存的记录表明抄写阶层的社会分级，有大批低阶层的制表人都在做单调的计数商品工作。我们只能推测数字发明者在抄写阶级的地位高低，但是我们有理由推测这种节省劳动力的创新可能是低等级阶层为缓解劳苦的点子。

Passage 02

Rain Forest Soils

On viewing the lush plant growth of a tropical rain forest, most people would conclude that the soil beneath it is rich in nutrients. However, although rain forest soils are highly variable, they have in common the fact that abundant rainfall washes mineral nutrients out of them and into streams. This process is known as leaching. Because of rain leaching, most tropical rain forest soils have low to very low mineral nutrient content, in dramatic contrast to mineral-rich grassland soils. Tropical forest soils also often contain particular types of clays that, unlike the mineral-binding clays of temperate forest soils, do not bind mineral ions well. Aluminum is the dominant cation (positively charged ion) present in tropical soils; but plants do not require this element, and it is moderately toxic to a wide range of plants. Aluminum also reduces the availability of phosphorus, an element in high demand by plants.

在观赏热带雨林郁郁葱葱的植物生长时，大多数人会认为它下面的土壤营养丰富。然而，虽然雨林土壤成分多变，但它们的共同之处在于丰富的降雨将矿物质营养物质从其中冲刷出并流入溪流。这个过程被称为浸出。由于雨水浸出，大多数热带雨林土壤的矿物质含量都很低，与富含矿物质的草地土壤形成鲜明对比。热带森林土壤通常也含有特殊的粘土，与温带森林土壤的矿物结合粘土不同，它们不能很好地结合矿物离子。铝是热带土壤中主要的阳离子（带正电的离子），但植物不需要这种元素，并且对很多植物都有中等毒性。铝也降低了磷的可用性，但磷是植物极其需要的元素。

High moisture and temperatures speed the growth of soil microbes that decompose organic compounds, so tropical soils typically contain far lower amounts of organic materials (humus) than do other forest or grassland soils. Because organic compounds help loosen compact clay soils, hold water, and bind mineral nutrients, the relative lack of organic materials in tropical soils is deleterious to plants. Plant roots cannot penetrate far into hard clay soils, and during dry periods, the soil cannot

hold enough water to supply plant needs. Because the concentration of dark-colored organic materials is low in tropical soils, they are often colored red or yellow by the presence of iron, aluminum, and manganese oxides; when dry, these soils become rock hard. The famous Cambodian temples of Angkor Wat , which have survived for many centuries, were constructed from blocks of such hard rain forest soils.

高湿度和高温加速了分解有机化合物的土壤微生物的生长，因此热带土壤的有机物质（腐殖质）的含量通常比其他森林或草地土壤低得多。由于有机化合物有助于松散粘土土壤，保持水分，结合矿物质营养，热带土壤中有机物质的相对缺乏对植物是有害的。植物的根部不能穿透到坚硬的粘土土壤中，在干旱的时候，土壤不能容纳足够的水来满足植物的需要。由于热带土壤中深色有机物质的浓度较低，因此在铁、铝和锰氧化物的存在下，它们通常呈现红色或黄色; 干燥时，这些土壤变硬。著名的柬埔寨庙宇吴哥窟已经屹立了好几个世纪，它就是用这种坚硬的雨林土块砌成的。

Given such poor soils, how can lush tropical forests exist? The answer is that the forest`s minerals are held in its living biomass-the trees and other plants and the animals. In contrast to grasslands, where a large proportion of plant biomass is produced underground, that of tropical forests is nearly all aboveground. Dead leaves, branches, and other plant parts, as well as the wastes and bodies of rain forest animals, barely reach the forest floor before they are rapidly decayed by abundant decomposers-bacterial and fungal. Minerals released by decay are quickly absorbed by multitudinous shallow, fine tree feeder roots and stored in plant tissues. Many tropical rain forest plants (like those in other forests) have mycorrhizal (fungus-root) partners whose delicate hyphae spread through great volumes of soil, from which they release and absorb minerals and ferry them back to the host plant in exchange for needed organic compounds. The fungal hyphae are able to absorb phosphorus that plant roots could not themselves obtain from the very dilute soil solutions, and fungal hyphae can transfer mineral nutrients from one forest plant to another. Consequently , tropical rain forests typically have

what are known as closed nutrient systems, in which minerals are handed off from one organism to another with little leaking through to the soil. When mineral nutrients do not spend much time in the soil, they cannot be leached into streams. Closed nutrient systems have evolved in response to the leaching effects of heavy tropical rainfall. Evidence for this conclusion is that nutrient systems are more open in the richest tropical soils and tightest in the poorest soils.

鉴于土壤如此贫瘠，那郁郁葱葱的热带森林是如何存在的？答案是，森林的矿物质被保存在其生物的体内——树木、其他植物和动物身体中。与地下生产大量植物生物的草地相比，热带森林几乎全部在地上。死叶、树枝等植物部分，以及热带雨林动物的废物和尸体，几乎还没有到达森林的地面，就被大量的细菌和真菌腐生物迅速分解。腐烂释放出来的矿物很快被众多浅而细的植物根系吸收并储存在植物组织中。许多热带雨林植物（像其他森林中的那些植物一样）具有菌根（真菌根）伴侣，其精细菌丝通过大量土壤扩散，从中释放和吸收矿物质并将它们运送回宿主植物以换取所需的有机物化合物。真菌菌丝能够吸收植物根本不能从极稀土壤溶液中获得的磷，而且可以将矿物营养物从一种森林植物转移到另一种。因此，热带雨林通常具有所谓的封闭营养系统，其中矿物质从一个生物体转移到另一个生物体，几乎没有渗漏到土壤中。当矿物质营养素在土壤中消耗的时间不多时，它们不会被浸出进入溪流。封闭的营养系统发展，以应对热带降雨的严重浸出效应。这一结论的证据是，营养系统在热带土壤最丰富的地区更为开放，在最贫瘠的土壤中更为紧密。

The growth of organisms is dependent on the availability of nutrients, none of which is more important than nitrogen. Although there is an abundant supply of nitrogen in Earth`s atmosphere, it cannot be absorbed by plants unless it is "fixed," or combined chemically with other elements to form nitrogen compounds. Nitrogen-fixing bacteria help tropical rain forest plants cope with the poor soils there by supplying them with needed nitrogen. Many species of tropical rain forest trees belong to the legume family, which is known for associations of nitrogen-fixing bacteria within root nodules. Also, cycads (a type of tropical plant that resembles a palm tree) produce special aboveground roots that harbor nitrogen-fixing cyanobacteria. By growing above the ground, the

roots are exposed to sunlight, which the cyanobacteria require for growth. Nitrogen fixation by free-living bacteria in tropical soils is also beneficial.

有机体的生长取决于营养素的可获得性，其中没有一种比氮更重要。虽然地球大气中氮气供应充足，但除非固定，否则不能被植物吸收，或与其他元素化学结合形成含氮化合物。固氮菌帮助热带雨林植物通过向它们提供所需的氮来应对那里的贫瘠土壤。许多热带雨林树种属于豆科植物，这种植物以根瘤中固氮细菌的联合而闻名。而且，铁树（一种类似于棕榈树的热带植物）长出特殊的地上根，其中含有固氮藻青菌。通过在地面上生长，根暴露于藻青菌生长所需的阳光下。热带土壤中自由活菌的固氮作用也是有益的。

Passage 03

Paleolithic Cave Painting

In any investigation of the origins of art, attention focuses on the cave paintings created in Europe during the Paleolithic era (C. 40,000-10,000 years ago) such as those depicting bulls and other animals in the Lascaux cave in France. Accepting that they are the best preserved and most visible signs of what was a global creative explosion, how do we start to explain their appearance? Instinctively, we may want to update the earliest human artists by assuming that they painted for the sheer joy of painting. The philosophers of Classical Greece recognized it as a defining trait of humans to "delight in works of imitation"-to enjoy the very act and triumph of representation. If we were close to a real lion or snake, we might feel frightened. But a well-executed picture of a lion or snake will give us pleasure. Why suppose that our Paleolithic ancestors were any different?

在任何艺术起源的调查研究中，注意力都聚焦在旧石器时代（约 4 万-1 万年前）产生于欧洲的洞穴壁画上，比如法国拉斯科洞穴的那些描绘公牛和其他动物的壁画。 在承认它们是保存最好的以及是全球艺术爆发最显著的标志时，我们如何开始解释他们的出现呢？直觉上，我们或许会以现代的思想来揣度最早人类艺术家的看法，认为他们是为了绘画的纯粹快乐而作画。古典希腊时期的哲学家认为这是人类的典型特征--“模仿的快乐”，享受描绘行为本身及成就。如果我们靠近一头真狮子或者蛇，我们或许会感到害怕。但是一副画得很好的狮子和蛇却能给我们带来快乐。何以会以为我们旧石器时代的祖先会有什么不同呢？

This simple acceptance of art for art`s sake has a certain appeal. To think of Lascaux as a gallery allows it to be a sort of special viewing place where the handiwork of accomplished artists might be displayed.Plausibly , daily existence in parts of Paleolithic Europe may not have been so hard, with an abundance of ready food and therefore the leisure time for art. The problems with this explanation, however, are various. In the first place,

the proliferation of archaeological discoveries-and this includes some of the world`s innumerable rock art sites that cannot be dated-has served to emphasize a remarkably limited repertoire of subjects. The images that recur are those of animals. Human figures are unusual, and when they do make an appearance, they are rarely done with the same attention to form accorded to the animals. If Paleolithic artists were simply seeking to represent the beauty of the world around them, would they not have left a far greater range of pictures-of trees, flowers, of the Sun and the stars?

为了艺术而创作艺术的这种简单认可具有一定的吸引力。把拉斯科洞穴看做画廊，它是某种特殊的观赏地，展示着杰出艺术家们的作品。或许，在旧石器时代欧洲的有些地方，日常生活或许没有那么艰难，有充足的现成食物，因此有闲暇时间来创作艺术。但是，这个解释的问题有很多。首先，大量的考古发现，包括一些无法追溯日期的世界上数不清的岩画遗址，都足以强调极其有限的题材。重现的形象是那些动物的。人物形象不常见，并且当人物出现的时候，绘制的精力和投入在动物身上的精力无法相比。如果旧石器时代的艺术家们只是仅仅寻求象征他们周围世界的美好事物，难道他们不会留下更大范围的、如树木、鲜花、太阳和星星的绘画作品吗?

A further question to the theory of art for art`s sake is posed by the high incidence of Paleolithic images that appear not to be imitative of any reality whatsoever. These are geometrical shapes or patterns consisting of dots or lines. Such marks may be found isolated or repeated over a particular surface, but also scattered across more recognizable forms. A good example of this may be seen in the geologically spectacular grotto of Pêche Merle, in the Lot region of France. Here we encounter some favorite animals from the Paleolithic repertoire-a pair of stout-bellied horses. But over and around the horses` outlines are multiple dark spots, daubed in disregard for the otherwise naturalistic representation of animals. What does such patterning imitate? There is also the factor of location. The caves of Lascaux might conceivably qualify as underground galleries, but many other paintings have been found in recesses totally unsuitable for any kind of viewing-tight nooks and crannies that must have been

awkward even for the artists to penetrate, let alone for anyone else wanting to see the art.

关于为了艺术而创作艺术的理论另外一个问题是，大量的旧石器时代图像似乎完全不是任何现实的模仿。这些几何形状或者图案由点或者线组成。这样的符号可以在一个特定的表面单独或重复出现，但也可能散布在更多可以识别的类型中。一个很好的例子出现在法国 Lot 地区 Pêche Merle 的地质学上壮观的洞穴里。 在这里，我们遇到了一些来自旧石器时代常见内容、最受欢迎的动物--两只腹部隆起的马。但是在四周，马的轮廓是许多黑点，胡乱涂抹，完全不顾及原本动物的自然表现。这样的图案模仿的是什么？ 此外，还有地点的因素。拉斯科的洞穴或许可以想象，适合作为秘密的画廊，但是在深处发现的许多其他壁画完全不适合任何形式的观赏--狭窄的角落和裂缝，即使对艺术家来说要穿过去，一定都很奇怪，更别说对于任何想要去观看艺术的人了。

Finally, we may doubt the notion that the Upper Paleolithic period was a paradise in which food came readily, leaving humans ample time to amuse themselves with art. For Europe it was still the Ice Age. An estimate of the basic level of sustenance then necessary for human survival has been judged at 2200 calories per day. This consideration, combined with the stark emphasis upon animals in the cave art, has persuaded some archaeologists that the primary motive behind Paleolithic images must lie with the primary activity of Paleolithic people: hunting.

最后，我们怀疑上旧石器时代是一个食物轻易获取的天堂、让人类有足够的时间用艺术来取悦自己这种看法。对于欧洲，它仍然处于冰川期。用于人类生存所必须的基本生计，估计在每天 2200 卡路里。结合在洞穴艺术中对于动物的鲜明强调，这个考虑使一些考古学家相信，旧石器时代壁画背后的主要动机一定与旧石器时代人们的主要活动有关：打猎。

Hunting is a skill. Tracking, stalking, chasing, and killing the prey are difficult, sometimes dangerous activities. What if the process could be made easier-by art? In the early decades of the twentieth century, Abbé Henri Breuil argued that the cave paintings were all about "sympathetic magic." The artists strived diligently to make their animal images evocative and realistic because they were attempting to capture the spirit

of their prey. What could have prompted their studious attention to making such naturalistic, recognizable images? According to Breuil, the artists may have believed that if a hunter were able to make a true likeness of some animal, then that animal was virtually trapped. Images, therefore, may have had the magical capacity to confer success or luck in the hunt.

打猎是一门技术。追踪、悄悄跟踪、追逐、并猎杀猎物是困难、有时危险的活动。如果这个过程可以通过艺术变得简单，将会如何呢？在二十世纪早期，Abbé Henri Breuil 认为，洞穴壁画全与“共感巫术”有关。艺术家们不断努力使他们的动物画形象和逼真，因为他们试图捕捉猎物的灵魂。是什么促使他们专注于制造这些自然的容易识别的图像呢？据 Breuil 所说，艺术家们可能相信，假如猎人能够画出某些动物的真实写照，那么那只动物几乎已被捕获。因此，图像具有在打猎中赋予成功和好运的魔力。