

TPO 19 – 1 The Roman Army's Impact on Britain 罗马军队对不列颠的影响

In the wake of the Roman Empire's conquest of Britain in the first century A.D., a large number of **troops** stayed in the new province, and these troops had a considerable impact on Britain with their **camp**s, **fortifications**, and **participation** in the local economy. Assessing the **impact** of the army on the civilian population **starts from** the **realization** that the soldiers were always unevenly distributed across the country. Areas rapidly **incorporated into** the empire were not long affected by the military. Where the army remained stationed, its presence was much more influential. The **imposition** of a **military base** involved the **requisition** of native lands for both the fort and the territory needed to feed and exercise the soldiers' animals. The **imposition** of **military rule** also robbed local leaders of opportunities to participate in local government, so social development was stunted and the **seeds of disaffection** sown. This then meant that the military had to remain to suppress rebellion and organize government.

在公元 1 世纪罗马帝国成功征服不列颠**之后**，有大量军队驻守在这片新省区，这些军队的**军营**和**城防**以及他们**参与**当地经济都对英国产生了重要的影响。评估军队对人口数量的影响要从士兵在国家内不均匀的分布开始讲起。那些很快就**并入**帝国的地区并未长期受到军队的影响。而那些保留军队的地区，军队的影响更大。**建立**军事基地需要征用当地的土地建造要塞，喂养并训练士兵的牲口。**实行**军事统治也强行剥夺了本地领导参与政府事务的机会，因而社会的发展受到了阻碍，由此播下了**不满的种子**。这就意味着军队不得不维持对反叛的高压政策以及承担组织政府的责任。

Economic exchange was clearly very important **as** the Roman army **brought with it** very substantial spending power. Locally a fort had two kinds of impact. Its large population needed food and other supplies. Some of these were certainly brought from long distances, but demands were inevitably placed on the local area. Although goods could be **requisitioned**, they were usually paid for, and this probably stimulated changes in the local economy. When not campaigning, soldiers needed to be occupied; otherwise they represented a potentially dangerous source of friction and disloyalty. Hence a **writing tablet dated 25 April** tells of 343 men at one fort engaged on tasks like shoemaking, building a bathhouse, operating kilns, digging clay, and working lead. Such activities had a major effect on the local area, **in particular with** the construction of infrastructure such as roads, which improved access to remote areas.

因为罗马军队有着强大的消费潜力，经济交流就显得非常重要。在当地，一个军事基地有两种影响。大量的人口需要食物和其他供给。有些食物和供给确实是从远方带来的，但是需求不可避免地由本地承担。尽管这些商品可以**强征**，但是军队通常会给予报酬，这些都会刺激当地经济的发展。另一方面当没有战争时，士兵们需要有事可做，否则他们就会成为摩擦和叛变的潜在根源。因此 4 月 25 日的一块**写字板**说一个基地内 343 名士兵干着诸如做鞋，造浴室，操作炉子，挖泥土和铸铅之类的工作。这样的活动对当地有着显著的影响，**特别是**基础设施（如道路）的建设使得偏远地区的交通更加便利。

批注 [1]: **in the wake of**

• 紧紧跟随；随着...而来；作为...的结果；仿效

批注 [2]: **troop**

英 [tru:p] 美 [tru:p]

- n. 军队；组；群；多数
- vi. 群集；成群而行；结队
- vt. 把（骑兵）编成骑兵连

批注 [3]: **fortification**

英 [fɔ:tɪfɪ'keɪʃn] 美 [fɔ:rtɪfɪ'keɪʃn]

- n. [军] 设防；[军] 防御工事；加强；配方

批注 [4]: **realization**

英 [ri:əlaɪ'zeɪʃn; rɪəlaɪ'zeɪʃn] 美 [ri:ələ'zeɪʃn]

- n. 实现；领悟

批注 [5]: **incorporate**

英 [ɪn'kɔ:pəreɪt] 美 [ɪn'kɔ:rpəreɪt]

- vt. 包含，吸收；体现；把.....合并
- vi. 合并；混合；组成公司
- adj. 合并的；一体化的；组成公司的

批注 [6]: **imposition**

英 [ɪmpə'zɪʃn] 美 [ɪmpə'zɪʃn]

- n. 征收；强加；欺骗；不公平的负担

批注 [7]: **requisition**

英 [rekwi'zɪʃn] 美 [rekwi'zɪʃn]

批注 [8]: **sown**

英 [saʊn] 美 [saʊn]

- v. 播种；布满；埋雷；传播（sow 的过去分词）

批注 [9]: **brought with it**

带来了

Each soldier received his pay, but in regions without a developed economy there was initially little on which it could be spent. **The pool of** excess cash rapidly stimulated a thriving economy **outside fort gates**. Some of the demand for the services and goods was no doubt fulfilled by people drawn from far **afield**, but some local people certainly became **entwined** in this new economy. There was informal marriage with soldiers, who until A.D. 197 were not legally **entitled to** wed, and whole new communities grew up near the forts. These settlements acted like small towns, becoming centers for the artisan and trading populations.

每一个士兵都会有报酬，但是在那些经济欠发达地区花不了那么多的钱。所以这些**多余的钱**迅速刺激了基地外的经济。一些服务和商品的需求毫无疑问是由外地的人来完成的，但是本地人当然也会卷入到这个新的经济体系中。士兵中出现了非正式婚姻，这种婚姻直到公元 197 年才得到了法律的承认，从而在这些军事基地周围发展出一些全新的社会群体。这些定居地就像城镇一样，成为了工匠和生意人的聚集地。

The army also provided a means of personal advancement for auxiliary soldiers recruited from the native peoples, **as** a man obtained hereditary Roman citizenship on retirement after service in an auxiliary regiment. Such units **recruited** on an **ad hoc** (as needed) basis from the area in which they were stationed, and there was evidently large-scale recruitment within Britain. The total numbers were at least 12,500 men up to the reign of the emperor Hadrian (A.D. 117--138), with a peak around A.D. 80. **Although** a small proportion of the total population, this perhaps had a massive local impact when a large proportion of the young men were removed from an area. **Newly raised regiments** were normally transferred to another province from **whence** it was unlikely that individual recruits would ever return. Most units raised in Britain went elsewhere on the European continent, although one is recorded in Morocco. The reverse process brought young men to Britain, where many continued to live after their 20 to 25 years of service, and this added to the cosmopolitan Roman character of the **frontier** population. By the later Roman period, frontier garrisons (groups of soldiers) were only rarely transferred, service in units became effectively hereditary, and forts were no longer populated or maintained at full strength.

军队还为当地征召的后备兵提供了个人升迁途径，一个人从后备队退役之后就可以成为世袭罗马公民。这样的人就是从这些驻地中特别招募而来，并且不列颠的招募规模特别的大。在哈德良皇帝(A.D. 117-138)统治时期总人数至少是 12 500 人，在公元 80 年时达到顶峰。**尽管**这只占总人口的一小部分，但当有大量年轻人离开一个地方时，这可能对当地有非常大的影响。**新建立起来的军团**通常会被转移到一个不可能回到原籍的省区。大多数不列颠的军团都去了欧洲大陆别的地方，尽管记载下来的只有摩洛哥一个地方。逆向过程把年轻人带回英国，很多士兵持续服务 20 到 25 年继续生活在当地，这又给**驻守地**的人口增添了兼容并蓄的罗马特征。在后罗马时期，前线卫戍部队很少调动，军团中的服务得到了有效的延续，而军事基地也不再**全员驻守**或者全力去维持。

This process of settling in as a community over several generations, combined with local recruitment, **presumably** accounts for the apparent stability of the British northern frontier in the later Roman period. It **also** explains why some of the forts continued in occupation long after Rome ceased to have any formal authority in Britain, at the beginning of the fifth century

批注 [10]: **afield**

英 [ə'fi:lɪd] 美 [ə'fi:lɪd]

- adv. 在远方地；遥远地；远离家乡地；在田野，在野外
- adj. 远方的；遥远的；远离家乡的

far afield

- 远离；广泛地（的）；闻所未闻（的）

批注 [11]: **entwine**

英 [ɪn'twaɪn] 美 [ɪn'twaɪn]

- v. 缠住，盘绕；使缠绕；与……密切相关

批注 [12]: **entitled to**

- 有权享有；有…的资格

entitle

英 [ɪn'taɪtl] 美 [ɪn'taɪtl]

批注 [13]: **as**

英 [əz; æz] 美 [əz; æz]

- adv. 如同，像……一样
- prep. 作为；以……身份；当作；像，如同；当……时

批注 [14]: **ad hoc**

英 [æd'hɒk] 美

- adj. 特别的；临时；专设
- adv. 特别地

批注 [15]: **whence**

英 [wens] 美 [wens]

- adv. 从何处；由此；到原来的地方
- conj. 从何处；由此

批注 [16]: **populated**

英 ['pɔ:pjuleɪtɪd] 美 ['pɑ:pjuleɪtɪd]

批注 [17]: **presumably**

英 [prɪ'zju:məbli] 美 [prɪ'zu:məbli]

- adv. 大概；推测起来；可假定

A.D. The circumstances *that had allowed natives to become Romanized* also led the **self-sustaining** military community *of the frontier area* to become effectively British.

这种像群落一样的持续好几代的定居过程，再结合当地的士兵招募，大概就是罗马帝国后期英国北部边境比较稳定的原因。这也解释了为什么五世纪初时这些军事基地在罗马已经不再统治英国之后依然存在。这种情况使得本地人罗马化的同时也使得在边境自给自足的军事组织英国化了。

批注 [18]: **self-sustaining**

英 [ˌself səˈsteɪnɪŋ] 美 [ˌself səˈsteɪnɪŋ]

•adj. 自立的；自谋生活的；自撑的

TPO 19 – 2 Succession, Climax, and Ecosystems 演替、顶峰和生态系统

In the late nineteenth century, **ecology** began to grow **into** an independent science from its roots in natural history and plant **geography**. The **emphasis** of this new "**community ecology**" was on the composition and structure of communities consisting of different species. In the early twentieth century, the American ecologist Frederic Clements pointed out that a succession of plant communities would develop after a disturbance such as a volcanic eruption, heavy flood, or forest fire. An abandoned field, for instance, will be invaded successively by **herbaceous** plants (plants with little or no **woody** tissue), shrubs, and trees, eventually becoming a forest. **Light-loving** species are always among the first invaders, while **shade-tolerant** species appear later in the succession.

在 19 世纪末期, **生态学**开始从它的源头——自然历史学和植物**地理学**中脱离出来成为一门独立的学科。这种新的概念“**群落生态**”强调的是不同物种构成的群落中的组成和结构。在 20 世纪早期,美国生态学家弗雷德里克·克莱门茨指出植物群落会在一个大变动(比如火山爆发、泥石流或者森林大火)之后发生演变。比如一块废弃的土地,就会接连受到**草类**植物(那些没有或只有很少**木质**结构的植物)、灌木和树木的入侵,最终形成一片森林。喜阳植物总是第一批入侵者,而那些耐阴植物随后出现。

Clements and other early ecologists saw almost lawlike regularity in the order of succession, but that has not been substantiated. A general trend can be recognized, but the details are usually unpredictable. Succession is influenced by many factors: the nature of the soil, exposure to sun and wind, regularity of precipitation, **chance** colonizations, and many other random processes.

克莱门茨和其他早期的生态学家从演变的顺序中看到了类似定律的规律性,但这个规律性还没有得到证实。我们可以看出大概的趋势,但是细节通常无法预见。演变受很多因素影响:土壤状况,曝光和曝风,降水规律,意外殖民和其他随机过程。

The final stage of a succession, called the climax by Clements and early ecologists, is likewise **not** predictable or of **uniform** composition. There is usually a good deal of turnover in species composition, even in a mature community. The nature of the climax is influenced by the same factors that influenced succession. **Nevertheless**, mature natural environments are usually in equilibrium. They change relatively little through time unless the environment itself changes.

演变的最后阶段被克莱门茨和早期生态学家称为顶级群落,它同样不可预测,组成也不单一。通常会发生大量的物种组成的更替,即使是在成熟的群落也同样如此。顶级群落本质上同样受到那些影响演变的因素的影响。**尽管如此**,成熟的自然环境通常处于平衡状态。它们随时间改变相对较少,除非环境本身发生变化。

For Clements, the climax was a "superorganism," an organic entity. Even some authors who accepted the climax concept rejected Clements' characterization of it as a superorganism, and it is indeed a misleading metaphor. An ant colony may be **legitimately** called a

批注 [19]: chance

英 [tʃɑːns] 美 [tʃæns]

- n. 机会, 际遇; 运气, 侥幸; 可能性
- vt. 偶然发生; 冒……的险
- vi. 碰巧; 偶然被发现
- adj. 意外的, 偶然的, 碰巧的

批注 [20]: uniform

英 [ˈjuːnɪfɔːm] 美 [ˈjuːnɪfɔːr m]

- adj. 统一的; 一致的; 相同的; 均衡的; 始终如一的
- n. 制服
- vt. 使穿制服; 使成一样

批注 [21]: legitimately

英 [lɪˈdʒɪtɪmətli] 美 [lɪˈdʒɪtɪmətli]

- adv. 合理地; 正当地

superorganism because its communication system is so highly organized that the colony always works as a whole and appropriately according to the circumstances. But there is no evidence for such an interacting communicative network in a climax plant formation. Many authors prefer the term "association" to the term "community" in order to **stress** the **looseness** of the interaction.

对于克莱门茨来讲，顶级群落是一个“超级有机体”，一个有机的整体。即使那些接受顶级群落概念的作者也拒绝接受克莱门茨关于超级有机体的描述，它的确是一个误导人的隐喻。一个蚁群被称作超级有机体还比较**合理**，因为它的通信系统组织非常严密，在某些情形下这些群落能够像一个整体一样巧妙运作。但是没有证据表明在顶级群落植物系统中有这样一种相互影响的交流系统。相比“群落”，很多作者更喜欢用“联系”用以**强调**交互的**松散性**。

Even less fortunate was the extension of this type of thinking to include animals as well as plants. This resulted in the "biome," a combination of coexisting flora and fauna. Though it is true that many animals are strictly associated with certain plants, it is misleading to speak of a "spruce-moose biome," for example, because there is no internal cohesion to their association as **in an organism**. The spruce community is not **substantially** affected by either the presence or absence of moose. **Indeed**, there are vast areas of spruce forest without moose. The opposition to the Clementsian concept of plant ecology was initiated by Herbert Gleason, soon joined by various other ecologists. Their major point was that the distribution of a given species was controlled by the habitat requirements of that species and that therefore the vegetation types were a simple consequence of the ecologies of individual plant species.

更不幸的是这种思考方式从植物扩展到了动物。于是就产生了生物群落的概念——一种动物群落和植物群落共存的结合体。尽管很多动物确实和一些植物紧密联系，但诸如“云杉麋鹿生态系统”的说法仍然具有误导性，因为云杉和麋鹿之间并没有**像一个有机体那样**有内在联系。云杉群落并没有**极大地**受到麋鹿存在或者不存在的影响。**实际上**有很多云杉林并没有麋鹿。对克莱门茨关于植物群落概念的反对意见最早是由赫伯特·格里森提出来的，并且获得了很多其他生态学家的支持。他们的主要观点是给定物种的分布是由该物种所需求的栖息地决定的，因此植被类型是简单的单个植物类型生态的结果。

With "climax," "biome," "superorganism," and various other **technical** terms for the association of animals and plants **at a given locality** being criticized, the term "ecosystem" was more and more widely adopted for the whole system of associated organisms together with the physical factors of their environment. **Eventually**, the energy-transforming role of such a system was emphasized. Ecosystems thus involve the circulation, transformation, and accumulation of energy and matter through the medium of living things and their activities. The ecologist is concerned primarily with the **quantities of matter and energy** that **pass through** a given ecosystem, and with the rates **at which** they **do so**.

尽管顶级群落，生态群落，超级有机体和许多对**给定区域**动植物联系描述的专业术语都被批评，但“生态系统”越来越被广泛接受，它用以描述相互联系的有机体以及生态环境物理因素的系统。**最终**，这个系统强调的是能量转变模式。因此生态系统包括通过生物媒介和活动而产生的循环、转换和能量及物质的积累。生态学家主要关注的是在给定系统下流过系统的物质和能

批注 | 22]: substantially

英 [səb'stænjəli] 美 [səb'stæ
njəli]

•adv. 实质上；大体上；充分地

量的量以及它们流过的速率。

Although the ecosystem concept was very popular in the 1950s and 1960s, it is no longer the dominant paradigm. Gleason's arguments against climax and biome are largely valid against ecosystems as well. Furthermore, the number of interactions is so great that they are difficult to analyze, even with the help of large computers. Finally, younger ecologists have **found ecological problems involving behavior and life-history adaptations more attractive than measuring physical constants. Nevertheless**, one still speaks of the ecosystem when referring to a local association of animals and plants, usually without paying much attention to the energy aspects.

尽管生态系统的概念在二十世纪五六十年代特别流行，但它也不是最权威的范例。格里森反对顶级群落和生物群系的论点用来反驳生态系统同样很有效。进一步讲，交互的数量如此之大以至于即使借助计算机也很难去分析它们。最后，年轻一代的生态学家发现关于行为和生命历史进化的问题比测试物理常量更有趣。**尽管如此**，当谈到某地的动植物联系的时候还是会使用生态系统，通常也就不关注能量的方面了。

批注 [23]: adaptation

英 [ˌædæp'teɪʃn] 美 [ˌædæp'teɪʃn]

•n. 适应；改编；改编本，改写本

TPO 19 – 3 Discovering the Ice Ages 发现冰川期

In the middle of the nineteenth century, Louis Agassiz, one of the first scientists to study glaciers, immigrated to the United States from Switzerland and became a professor at Harvard University, where he continued his studies in geology and other sciences. **For his research**, Agassiz visited many places in the northern parts of Europe and North America, from the mountains of Scandinavia and New England to the rolling hills of the American Midwest. In all these diverse regions, Agassiz saw signs of glacial erosion and sedimentation. In flat plains country, he saw moraines (accumulations of earth and loose rock that form at the edges of glaciers) that reminded him of the terminal moraines found at the end of valley glaciers in the Alps. The **heterogeneous** material of the drift (sand, clay, and rocks deposited there) convinced him of its glacial origin.

在 19 世纪中期，路易斯·阿加西是第一批研究冰川的科学家中的一个，他从瑞士移民到美国成为哈佛大学的一位教授，在那里继续研究地质和其他科学。**从他的研究看**，他访问了欧洲北部和北美的很多地方，从斯堪的纳维亚和新英格兰到美国中西部的波状丘陵地带。在所有这些不同的地区里，阿加西看到了冰川侵蚀和沉积的迹象。在平原国家，他看见了冰碛石（冰川边缘泥土和松散岩石的聚集体），这些东西让他想起了在阿尔卑斯山谷冰川里发现的终碛石。漂流物（沉积的沙子和粘土和岩石）的**混杂异质**物使他相信这都是冰川造成的。

The areas covered by this material were **so vast that** the ice that deposited it must have been a continental glacier larger than Greenland or Antarctica. Eventually, **Agassiz and others convinced** geologists and the general public **that** a great continental glaciation had extended the polar ice caps far into regions that now enjoy temperate climates. For the first time, people began to talk about ice ages. It was also apparent that the glaciation occurred in the relatively recent past because the drift was soft, like freshly deposited sediment. We now know the age of the glaciation accurately from **radiometric dating** of the carbon-14 in logs buried in the drift. The drift of the last glaciation was deposited during one of the most recent **epochs** of geologic time, the Pleistocene, which lasted from 2.6 million to 11,700 years ago. Along the east coast of the United States, **the southernmost advance** of this ice is recorded by the enormous sand and drift deposits of the terminal moraines that form Long Island and Cape Cod.

这些碛石覆盖的区域是如此之大以至于那些使它们沉积下来的冰川肯定比格林兰或者南极洲还要大的大陆冰川。最终，**阿加西和他的支持者**说服了地质学家和公众相信大型的大陆冰川曾经把极地冰盖延伸到如今的温带气候地区。人们第一次开始讨论冰河时代。很明显冰川作用就发生在相对不远的过去，因为漂流物很软，像新鲜的沉积物。我们现在通过测量掩埋在漂流物中木头**放射性的碳-14**来精确**确定**冰川作用的**时期**。上次冰川作用的漂流物在最近的一个地质时期——更新世，从 180 万年持续到 1 万年前——被沉淀下来。沿着美国东海岸，**最南边的冰川运动**被来自长岛和科德角的大量的沙子和终碛石的漂流沉积物所记录下来。

It soon became clear that there were multiple glacial ages **during** the Pleistocene, with warmer interglacial intervals between them. As geologists mapped glacial deposits in the late nineteenth century, they became aware that there were several layers of drift, the lower ones

批注 | 24|: **heterogeneous**

英 [ˌhetərəˈdʒiːniəs] 美 [ˌhɛtəˈrɑːdʒiːniəs]

•adj. 由很多种类组成的，混杂的；各种各样的；（化学）不均匀的，多相的；（数学）不纯一的，参差的

homogeneous

英 [ˌhɒməˈdʒiːniəs] 美 [ˌhoʊməˈdʒiːniəs]

•adj. 均匀的；[数] 齐次的；同种的；同类的，同质的

批注 | 25|: **advance**

英 [ədˈvɑːns] 美 [ədˈvæns]

n. 发展；**前进**；增长；预付款

•vt. 提出；预付；使……前进；将……提前

•vi. 前进；进展；上涨

•adj. 预先的；先行的

批注 | 26|: **During** 表明这段整个都在说 **Pleistocene** 这一个 **epoch**。

corresponding to earlier ice ages. **Between** the older layers of glacial material were well-developed soils *containing fossils of warm-climate plants*. These soils were evidence that the glaciers retreated as the climate warmed. By the early part of the twentieth century, scientists believed that four distinct glaciations had affected North America and Europe **during** the **Pleistocene epoch**.

很快我们就知道了在更新世有多个冰川期，期间夹着温暖的间冰期。当地质学家绘制出 19 世纪后期冰河沉积的地图之后，他们开始意识到有好几层漂流物，底层漂流物对应的是早期冰河时代。在这些年代更久远的冰层里有永冻土，其中包含了温带植物的化石。这些土壤是冰川随气候转暖而消失的证据。到了 20 世纪初期，科学家们相信 4 个不同的冰川作用影响着更新世时期的北美和欧洲。

This idea was **modified** in the late twentieth century, when geologists and oceanographers examining oceanic sediment found fossil evidence of warming and cooling of the oceans. Ocean sediments presented a much more complete geologic record of the Pleistocene than continental glacial deposits did. The fossils buried in Pleistocene and earlier ocean sediments were of foraminifera—small, single-celled marine organisms that secrete shells of calcium carbonate, or calcite. These shells differ in their proportion of ordinary oxygen (oxygen-16) and the heavy oxygen isotope (oxygen-18). The ratio of oxygen-16 to oxygen-18 found in the calcite of a foraminifer's shell depends on the temperature of the water in which the organism lived. Different **ratios** in the shells preserved in various layers of sediment reveal the temperature changes in the oceans **during** the Pleistocene **epoch**.

在 20 世纪末期，当地质学家和海洋学家研究海洋沉积发现海洋变暖和变冷的化石证据时，这种观点得到了修正。相比大陆冰川沉积，海洋沉积呈现出更新世时期更完整的地质记录。埋在更新世时期的化石和更早的海洋沉积物是有孔虫类，它们是一种小的单细胞海洋生物，会分泌碳酸钙壳或者方解石。这些壳的普通氧（氧 16）和重氧同位素（氧 18）的比例不同。有孔虫类壳的方解石中氧 16 与氧 18 的比例取决于生物居住的水域的温度。不同沉积层中保存的壳有不同的含量，这显示出更新代海洋温度的变化。

Isotopic analysis of shells allowed geologists to measure **another glacial effect**. They could trace the growth and shrinkage of continental glaciers, even in parts of the ocean where there may have been no great change in temperature—*around the equator, for example*. The oxygen isotope ratio of the ocean changes **as a great deal of water is** withdrawn from it by evaporation **and is** precipitated as snow to form glacial ice. **During glaciations**, the lighter oxygen-16 has a **greater** tendency to evaporate from the ocean surface than the heavier oxygen-18 does. Thus, more of the heavy isotope is left behind in the ocean and absorbed by marine organisms. From this analysis of marine sediments, geologists have learned that there were many shorter, more regular cycles of glaciation and deglaciation than geologists had recognized from the glacial drift of the continents **alone**.

对壳的同位素分析使得地质学家能够测量**一些其他的冰川影响**。他们能够追踪大型冰川的增长和减小，即使是那些海洋中温度变化不太大的区域，比如说赤道附近。当大量水被蒸发并以雪的形式沉积形成冰川冰时，海洋中氧的同位素比率会发生变化。在冰川作用时期，轻一些的氧 16 比重一些的氧 18 更容易从海洋的表面蒸发。这样，更多的重氧同位素留在了海洋

批注 | 27]: **modified**

英 ['mɒdɪfaɪd] 美 [məˈdɪfaɪd]

•adj. 改进的，修改的；改良的
•v. 修改；缓和（modify 的过去分词）

modify

英 ['mɒdɪfaɪ] 美 ['mɑːdɪfaɪ]

•vt. 修改，修饰；更改
•vi. 修改

批注 | 28]: **ratio**

英 ['reɪʃiəʊ] 美 ['reɪʃiəʊ]

•n. 比率，比例

里并被有机物吸收。从这些海洋沉积物的分析来看，地质学家了解到有很多更短更有规律的冰川作用和去冰川作用的发生，这比之前地质学家**仅仅**从大陆冰川漂流物中识别出的要多。