

TPO 42 – 1 Geographic Isolation of Species

物种的地理隔离

Biologist Ernst Mayr defined a species as "an actually or potentially interbreeding population that does not interbreed with other such populations when there is opportunity to do so. A key event in the origin of many species is the separation of a population with its gene pool (all of the genes in a population at any one time) from other populations of the same species, thereby preventing population interbreeding. With its gene pool isolated, a separate population can follow its own evolutionary course. In the formation of many species, the initial isolation of a population seems to have been a geographic barrier. This mode of evolving new species is called allopatric speciation.

生物学家厄恩斯特·迈尔将物种定义为“一个可以互相交配或可能互相交配的群体，但这个群体不能与其它生物交配，即便有交配的机会”。许多物种起源时的一个关键事件是拥有自己的基因库的种群（任何时候这个种群的所有基因）与该物种其他种群分离，因此阻止了种群间交配。由于基因库被隔离，各自的种群可以按照自身的进程来进化。在许多物种的形成过程中，最初的种群隔离似乎来自一种地理上的屏障。这种进化新物种的模式被称为异域物种形成。

Many factors can isolate a population geographically. A mountain range may emerge and gradually split a population of organisms that can inhabit only lowland lakes; certain fish populations might become isolated in this way. Similarly, a creeping glacier may gradually divide a population, or a land bridge such as the Isthmus of Panama may form and separate the marine life in the ocean waters on either side.

许多因素可以在地域上隔离一个种群。某些山脉的出现会逐渐分离出一个只能在低洼的湖泊中生活的物种，某些鱼类可能就这样被隔离出来了。类似地，慢慢移动的冰川可能会逐渐将一个种群分开，或者形成像巴拿马地峡这样的大陆桥，将海洋生物隔离在大陆桥的两边水域。

How formidable must a geographic barrier be to keep populations apart? It depends on the ability of the organisms to move across barriers. Birds and coyotes can easily cross mountains and rivers. The passage of wind-blown tree pollen is also not hindered by such barriers, and the seeds of many plants may be carried back and forth on animals. In contrast, small rodents may find a deep canyon or a wide river an effective barrier. For example, the Grand Canyon, in the southwestern United States, separates the range of the white-tailed antelope squirrel from that of the closely related Harris' antelope squirrel. Smaller, with a shorter tail that is white underneath, the white-tailed antelope squirrel inhabits deserts north of the canyon and west of the Colorado River in southern California. Harris' antelope squirrel has a more limited range in deserts south of the Grand Canyon.

多么强大的地理屏障才能将种群分开呢？它取决于生物跨越障碍的能力。鸟类和狼可以轻易越过山川河流。那些通过风来传播花粉的树木也不会受到这些壁垒的阻碍，并且很多植物的种子会被动物搬来搬去。相对来说，一个很深的峡谷或一条宽阔的河流可能是小型啮齿类动物的有效屏障。例如，美国西南部的大峡谷将白尾羚羊松鼠的生活范围以及与其密切相关的哈里斯羚羊松鼠的生活范围隔开。白尾羚羊松鼠体型较小，尾巴很短且下面是白色的，栖息于大峡谷以北、科罗拉多河以西的南加利福尼亚沙漠地区。哈里斯羚羊松鼠的生活范围更为有限，位于大峡谷以南的沙漠地区。

Geographic isolation creates opportunities for new species to develop, but it does not necessarily lead to new species because speciation occurs only when the gene pool

批注 [1]: geographic

英 [ˌdʒiəˈɡræfɪk]

美 [ˌdʒiəˈɡræfɪk]

adj. 地理的；地理学的

undergoes enough changes to establish reproductive barriers between the isolated population and its parent population. The likelihood of allopatric speciation increases when a population is small as well as isolated, making it more likely than a large population to have its gene pool changed substantially. For example, in less than two million years, small populations of stray animals and plants from the South American mainland that managed to colonize the Galapagos Islands gave rise to all the species that now inhabit the islands.

地理隔离为新物种的进化创造了机会，但这并不一定会形成新物种，因为物种形成只有在基因库发生足够大的变化，被隔离的种群与亲本种群之间出现繁殖障碍（即不能交配繁殖）时才发生。数量小的种群被隔离开来时，比数量大的种群更容易发生基因库的实质变化，也就增加了异域物种形成的可能性。例如，从南美大陆流浪而来，成功移居到加拉帕戈斯群岛的动物和植物小种群，在不到二百万年的时间就进化出了现在岛上存在的所有物种。

When oceanic islands are far enough apart to permit populations to evolve in isolation, but close enough to allow occasional dispersions to occur, they are effectively outdoor laboratories of evolution. The Galapagos island chain is one of the world's greatest showcases of evolution. Each island was born from underwater volcanoes and was gradually covered by organisms derived from strays that rode the ocean currents and winds from other islands and continents. Organisms can also be carried to islands by other organisms, such as sea birds that travel long distances with seeds clinging to their feathers.

当海洋岛屿互相之间的距离比较远，使得种群得以独立进化，但又不至于太远从而使得物种可以在偶然的条件下传播过去时，它们就是有效的野外进化实验室。加拉帕戈斯群岛是世界上最伟大的进化展示窗之一。它的每个岛屿都来自海底火山喷发，岛上逐渐住满了通过洋流和从其他岛屿和陆地迁来的生物。这些生物也可能是被其他生物带到岛屿上来的，如长途飞来的海鸟羽毛上可能沾有其他植物的种子。

The species on the Galapagos Islands today, most of which occur nowhere else, descended from organisms that floated, flew, or were blown over the sea from the South American mainland. For instance, the Galapagos island chain has a total of thirteen species of closely related birds called Galapagos finches. These birds have many similarities but differ in their feeding habits and their beak type, which is correlated with what they eat. Accumulated evidence indicates that all thirteen finch species evolved from a single small population of ancestral birds that colonized one of the islands. Completely isolated on the island after migrating from the mainland, the founder population may have undergone significant changes in its gene pool and become a new species. Later, a few individuals of this new species may have been blown by storms to a neighboring island. Isolated on this second island, the second founder population could have evolved into a second new species, which could later recolonize the island from which its founding population emigrated. Today each Galapagos island has multiple species of finches, with as many as ten on some islands.

今天生活在加拉帕戈斯群岛的物种，是那些由从南美大陆飘过来、飞过来、或者被风吹过来的物种演变而来的，其中大多数物种是岛上独有的，在其他地方见不到。例如，加拉帕戈斯群岛有十三种联系紧密的鸟都叫加拉帕戈斯雀类。这些鸟类有许多相似之处，但他们的饮食习惯和嘴型（与它们所吃的东西有关）存在不同。已经收集到的证据表明，这十三种雀鸟都是从小种群中的鸟类祖先进化而来的，这个鸟类的祖先在其中的一个岛栖息繁殖。从大陆迁移来后，它们在岛上完全被隔离开来，最初的种群基因库发生了很大的变化，成为一个新的物

种。后来,新物种的小部分可能被风暴吹到了邻近的岛屿。它们在这个岛上再次被隔离开来,这第二个初始种群可能又进化出另一个新物种,而这个新物种之后又可能重新回到它的初始种群来自的那个岛。今天每个加拉帕戈斯岛都有多种雀鸟,有些岛上多达十种。

TPO 42 – 2 Explaining Dinosaur Extinction 解释恐龙灭绝

Dinosaurs rapidly became extinct about 65 million years ago as part of a **mass extinction** known as the K–T event, because it is associated with a **geological** signature known as the K–T boundary, usually a thin band of **sedimentation** found in various parts of the world (**K** is the traditional abbreviation for the Cretaceous, derived from the German name **Kreidezeit**). Many explanations have been proposed for why dinosaurs became extinct. For example, some have **blamed dinosaur extinction on** the development of flowering plants, which were **supposedly** more difficult to digest and could have caused **constipation** or indigestion **except that** flowering plants first evolved in the Early Cretaceous, about 60 million years before the dinosaurs died out. In fact, several scientists have suggested that the duckbill dinosaurs and horned dinosaurs, **with their complex battery of grinding teeth**, evolved to exploit this new resource of rapidly growing flowering plants. Others have **blamed** extinction **on** competition from the mammals, which **allegedly** ate all the dinosaur eggs **except that** mammals and dinosaurs appeared at the same time in the **Late Triassic**, about 190 million years ago, and there is no reason to believe that mammals suddenly **acquired a taste for** dinosaur eggs after 120 million years of coexistence. Some explanations (such as the one stating that dinosaurs all **died of** diseases) fail because **there is no way to scientifically test them**, and they **cannot move beyond the realm of** speculation and guesswork.

geological adj. 地质的, 地质学的	sedimentation n. 沉积 (作用)
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大约在 6500 万年前, 恐龙迅速地灭绝, 成为 K-T 大规模灭绝事件的一部分, 之所以称作 K-T 是因为它与地质学上的标签 K-T 边界有关。K-T 边界通常是一个薄薄的沉积带, 在世界各处都有存在 (K 在惯例上是白垩纪 Cretaceous 的缩写, 源自德国名字 kreidezeit)。关于恐龙为何绝种有很多解释。例如, 有些将恐龙的灭绝归咎于开花植物的发展, 这种植物据称更难消化, 可引起便秘和消化不良——但是开花植物最初是在早白垩世纪进化的, 也就是在恐龙灭绝前约 6000 万年就出现了。实际上, 一些科学家提出, 鸭嘴恐龙和有角恐龙已经进化出一口复杂的磨牙, 能够消化吸收这些迅速增长的开花植物。也有科学家将恐龙的灭绝归咎于哺乳动物的竞争, 据说是它们吃掉了所有的恐龙蛋——但是, 哺乳动物和恐龙都生活在在约 1.9 亿万年前的晚三叠世, 没理由说哺乳动物在和恐龙共同生活了 1.2 亿年之后, 忽然爱吃恐龙蛋了。还有些解释 (比如有一种解释认为恐龙死于疾病) 也说不通, 因为没有办法进行科学验证, 而且这些解释也无非都是臆想和猜测。

This focus on explaining dinosaur extinction misses an important point: the extinction at the end of the Cretaceous was a global event that **killed off** organisms **up and down** the food chain. It wiped out many kinds of plankton in the ocean and many marine organisms that **lived on** the plankton at the base of the food chain. These included a variety of clams and snails, and especially the ammonites, a group of shelled **squidlike** creatures that dominated the **Mesozoic** seas and had survived many previous mass extinctions. The K–T event marked the end of the marine **reptiles**, such as the mosasaurs and the plesiosaurs, which were the largest creatures that had ever lived in the seas and which ruled the seas long before whales evolved. On land, there was also a **crisis** among the land plants, **in addition to**

批注 | 2: blame on

把责任推给…; 怪到…头上; 把责任推给; 责怪…; 把…归咎于; 怪到

批注 | 3: supposedly

adv. 可能; 按照推测; 恐怕

批注 | 4: constipation

n. [临床] 便秘; 受限制

批注 | 5: except that

conj(连词). 除了…之外, 只可惜除了; **只是**; 之外; 只可惜

批注 | 6: allegedly

adv. 依其申述; 据说, 据称

批注 | 7: kill off

•消灭

批注 | 8: up and down

•上上下下; 到处; 前前后后; 来来往往

批注 | 9: live on

•vi. 以…为食; 靠…生活

批注 | 10: squid

n. 鱿鱼; 乌贼; 枪乌贼

批注 | 11: reptile

n. 爬行动物; (非正式) 卑鄙的人

adj. 爬行动物的; 卑鄙的

批注 | 12: crisis

•n. 危机; 危险期; 决定性时刻
•adj. 危机的; 用于处理危机的

the disappearance of dinosaurs. So any event that can explain the destruction of the base of the food chain (plankton in the ocean, plants on land) can better explain what happened to organisms at the top of the food chain, such as the dinosaurs. **By contrast, any explanation that focuses strictly on the dinosaurs completely misses the point.** The Cretaceous extinctions were a global phenomenon, and dinosaurs were just a part of a bigger picture.

对恐龙灭绝的解释都错过了一个重要信息：白垩纪末的灭绝是一个全球性的事件，这次事件杀死的生物来自整个食物链。有许多海洋中的浮游生物都灭绝了，而以这些处于食物链的底端的浮游生物为食的许多海洋生物也都灭绝了。这些生物包括各种蛤蜊和蜗牛，尤其是菊石，一种类似鱿鱼的带壳生物，它曾经在中生代海洋中大规模存在，并且在以前的很多大规模灭绝中幸存了下来。K-T 事件标志着海洋爬行动物（如沧龙类与蛇颈龙，曾经生活在海洋，并且早在鲸鱼出现之前统治海洋很久的最大生物）的结束。在陆地上，除了恐龙灭绝以外，陆地植物也面临着生存危机。因此，任何能解释食物链底端生物（海洋中的浮游生物、陆地上的植物）毁灭的原因，都能更好地解释在食物链顶端的生物发生了什么，如恐龙的灭绝。相比之下，那些只关注恐龙本身的解释就没有解释到点子上。白垩纪灭绝是一个全球性的现象，恐龙的灭绝只是其中的一部分。

According to one theory, the Age of Dinosaurs ended suddenly 65 million years ago when a giant rock from space **plummeted to Earth**. Estimated to be ten to fifteen kilometers in diameter, this bolide (either a comet or an asteroid) was traveling at cosmic speeds of 20–70 kilometers per second, or 45,000–156,000 miles per hour. Such a huge mass traveling at such tremendous speeds carries an enormous amount of energy. When the bolide struck, this energy was released and generated a huge shock wave that leveled everything for thousands of kilometers around the impact and caused most of the landscape to burst into flames. The bolide struck an area of the Yucatán Peninsula of Mexico known as Chicxulub, excavating a crater 15–20 kilometers deep and at least 170 kilometers in diameter. The impact displaced huge volumes of seawater, causing much flood damage in the Caribbean. Meanwhile, the bolide itself excavated 100 cubic kilometers of rock and debris from the site, which rose to an altitude of 100 kilometers. Most of it fell back immediately, but some of it remained as dust in the atmosphere for months. This material, along with the smoke from the fires, shrouded Earth, creating a form of nuclear winter. According to computerized climate models, global temperatures fell to near the freezing point, photosynthesis 名词 halted, and most plants on land and in the sea died. With the bottom of the food chain destroyed, dinosaurs could not survive.

根据某一个理论，恐龙时代在 6500 万年前突然结束，是因为当时一个巨大的星体从太空撞到了地球上。这颗火流星（彗星或小行星）的直径估计在 10000~15000 米左右，以 20~70 千米每秒或 45000~156000 英里每小时的宇宙速度飞行。这个体积庞大、速度飞快的星体带着大量的能量。当星体撞击地球时，这些能量被释放，产生了巨大的冲击波，受到影响的数千公里的土地被夷为平地，大部分景观突然起火。星体击中了墨西哥尤卡坦半岛的希克苏鲁伯地区，凿出一个深 15~20 千米、直径至少有 170 千米的大坑。撞击造成大量海水移位，在加勒比海地区引起了很多洪灾。与此同时，火球自身也在撞击地凿出了 100 立方公里的岩石和碎片，这些岩石和碎片飞到 100 千米的高度。大部分的碎片立刻就掉下来了，但有一些变成了灰尘在大气中漂浮了数月之久。这些灰尘与火灾产生的烟雾一起笼罩着地球，创造出一种

批注 [13]: 翻译的时候先翻译主句。

批注 [14]: picture
 •n. 照片，图画；影片；景色；化身
 •vt. 画；想像；描写

批注 [15]: plummet
 v. 陡直落下，快速落下；（价值、数量等）骤然下跌
 n. 骤降；铅垂，铅垂线
 plump
 •adj. 饱满的；胖乎乎的
 •v. （使）饱满而柔软；变圆，长胖；重重地放下
 •adv. 突然（或重重）坠地；直接地
 •n. 突然前冲；重重坠落

批注 [16]: level
 •n. 水平；标准；水平面
 •adj. 水平的；平坦的；同高的
 •vi. 瞄准；拉平；变得平坦
 •vt. 使同等；对准；弄平

批注 [17]: displaced
 •adj. 无家可归的；位移的；被取代的
 •n. 无家可归者
 •v. 取代（displace 的过去分词）；移动...的位置；撤换

批注 [18]: shroud
 •n. 寿衣；覆盖物；船的横桅索；[电] 护罩
 •vt. 覆盖；包以尸衣

批注 [19]: computerized
 •adj. 电脑的；电脑化的；用电脑处理的
 •v. 用电子计算机控制（computerize 的过去分词）

“核冬天”的感觉。根据计算机模拟的气候模型，全球气温下降到接近冰点，光合作用停止，陆地和海洋中的大部分植物都死掉了。随着食物链的底端被破坏，恐龙也就无法生存了。

TPO 42 – 3 Callisto and Ganymede 木星的卫星

From 1996 to 1999, the Galileo spacecraft passed through the Jovian system, providing much information about Jupiter's satellites. Callisto, the outermost of Jupiter's four largest satellites, orbits the planet in seventeen days at a distance from Jupiter of two million kilometers. Like our own Moon, Callisto rotates in the same period as it revolves, so it always keeps the same face toward Jupiter. Its noontime surface temperature is only about -140°C , so water ice is stable on its surface year-round. Callisto has a diameter of 4,820 kilometers, almost the same as that of Mercury. Its mass is only one-third as great, which means its density must be only one-third as great as well. This tells us that Callisto has far less of the rocky metallic materials found in the inner planets and must instead be an icy body through much of its interior.

从 1996 年到 1999 年，伽利略号宇宙飞船围绕木星飞行，提供了很多关于木星的卫星的信息。木卫四，木星的四个最大的卫星中最外层的一个，围绕木星转一圈需要 17 天，轨道半径 200 万公里。像地球的卫星月球一样，木卫四在同一周期公转和自转，所以它总是以固定的面朝向木星。它中午的表面温度大约只有零下 140°C ，所以表面常年都是冰。木卫四的直径为 4820 千米，几乎与水星（的直径）相同。但它的质量仅为水星的三分之一，这也意味着它的密度应该也只有水星的三分之一。这就告诉我们，木卫四内核的岩石金属材料比较少，内核的大部分应该是冰。

Callisto has not fully differentiated, meaning separated into layers of different density materials. Astronomers can tell that it lacks a dense core from the details of its gravitational pull on the Galileo spacecraft during several very close flybys. This fact surprised scientists, who expected that all the big icy moons would be differentiated. It is much easier for an icy body to differentiate than for a rocky one, since the melting temperature of ice is so low. Only a little heating will soften the ice and get the process started, allowing the rock and metal to sink to the center and the slushy ice to float to the surface. Yet Callisto seems to have frozen solid before the process of differentiation was complete.

木卫四还没有完全分化，也就意味着还没分离成几层不同密度的材料。在几次近距离的飞行中，通过伽利略号宇宙飞船的重力探测，天文学家可以知道木卫四缺乏一个高密度的内核。这使科学家们感到吃惊，因为他们认为所有大的冰卫星都会有分层现象。一个冰质天体要比一个岩石天体更容易分层，因为冰的融化温度很低。只要有一点热量，冰就开始软化，分化便开始了，这使得岩石和金属向中心下沉，融化的冰会浮到表面。然而木卫四似乎在分化过程完成之前就已经冻成固体了。

Like our Moon's highlands, the surface of Callisto is covered with impact craters. The survival of these craters tells us that an icy object can form and retain impact craters in its surface. In thinking of ice so far from the Sun, it is important not to judge its behavior from that of the much warmer ice we know on Earth; at the temperatures of the outer solar system, ice on the surface is nearly as hard as rock, and behaves similarly. Ice on Callisto does not deform or flow like ice in glaciers on Earth. Callisto is unique among the planet-sized objects of the solar system in its absence of interior forces to drive geological evolution. The satellite was born dead and has remained geologically dead for more than four billion years.

就像地球的卫星月球的高地一样，木卫四表面到处都是撞击坑。这些撞击坑的存在告诉我们，一个冰体可以形成并保留其表面的撞击坑。在考虑距离太阳如此之远的冰体时，不要根据我

们在地球上所了解的温度更高的冰体来判断其行为是很重要的；在外太阳系的温度下，表面的冰几乎就像岩石一样坚硬，且性质也相似。木卫四上的冰不像地球上的冰川那样会变形或流动。作为太阳系一个行星大小的天体，木卫四是唯一一个无法依靠内部力量推动地质演变的星体。卫星一形成就是死的，它保持地质不变的时间超过了 40 亿年。

Ganymede, another of Jupiter's satellites and the largest in our solar system, is also cratered, but less so than Callisto. About one-quarter of its surface seems to be as old and heavily cratered; the rest formed more recently, as we can tell by the sparse covering of impact craters as well as the relative freshness of the craters. Ganymede is a differentiated world, like the terrestrial planets. Measurements of its gravity field tell us that the rock and metal sank to form a core about the size of our Moon, with a mantle and crust of ice floating above it. In addition, the Galileo spacecraft discovered that Ganymede has a magnetic field, the signature of a partially molten interior. Ganymede is not a dead world, but rather a place of continuing geological activity powered by an internal heat source. Much of its surface may be as young as half a billion years.

木卫三是木星的另一个卫星，也是太阳系中最大的卫星，其表面也是坑坑洼洼的，但不如木卫四那么多坑。木卫三有大约四分之一的表面似乎是很老了，布满了坑洞；其余的四分之三形成的时间更近一些，这一点我们可以从稀疏分布的撞击坑和相对较新的坑判断出来。像类地行星一样，木卫三已经分化了。通过测量它的引力场，我们可以知道下沉的岩石和金属形成了一个月球大小般的核，而冰形成地幔和地壳浮在其上面。此外，伽利略号宇宙飞船发现木卫三有一个磁场，意味着它的内部已经部分熔融了。木卫三并非一个死的星体，其内部的热能会持续地引发地质活动。它的表面大部分的年龄可能是五亿年左右。

The younger terrain is the result of tectonic and volcanic forces. Some features formed when the crust cracked, flooding many of the craters with water from the interior. Extensive mountain ranges were formed from compression of the crust, forming long ridges with parallel valleys spaced one to two kilometers apart. In some places older impact craters were split and pulled apart. There are even indications of large-scale crustal movements that are similar to the plate tectonics of Earth.

较年轻的地形是地质和火山活动形成的。当地壳破裂时，一些地理特征便形成了，内部涌出的洪水淹没了大部分的外壳。巨大的山脉是由外壳挤压形成的，形成了长长的山脊和间隔一到两公里的平行山谷。在一些地方，更早的撞击坑被拉扯开来。甚至有迹象表明木卫三存在类似于地球板块构造的大型外壳运动。

Why is Ganymede different from Callisto? Possibly the small difference in size and internal **heating** 名词 between **the two** 指代刚提的两个 the+adj led to this **divergence** in their evolution. But more likely the gravity of Jupiter **is to blame for** Ganymede's continuing geological activity. Ganymede is close enough to Jupiter that **tidal** forces from the giant planet may have **episodically** heated its interior and **triggered** major **convulsions** on its **crust**.

为什么木卫三和木卫四有这么多不同？可能体积上和内部热量上的小差异导致了他们在进化中的差距。但更可能的原因是，木星的引力造成了木卫三持续的地质活动。木卫三离木星较近，这个巨行星的潮汐力**偶尔**会使得木卫三的内部温度升高，**引发**重大的外壳运动。

批注 [20]: **divergence**

- n. 差异；分歧；分散，发散；（气流或海洋的）分开处

批注 [21]: **is to blame for**

- 对...应负责任；应该为某事负责任

批注 [22]: **tidal**

- adj. 潮汐的；潮的，有关潮水的；定时涨落的

批注 [23]: **episodically**

- 插曲式地
- 偶然发生地

批注 [24]: **trigger**

- n. 扳机；起因，引起反应的事；触发器，引爆装置
- v. 触发，引起；开动（装置）

批注 [25]: **convulsion**

英 [kən'vʌlʃn] 美 [kən'vʌlʃn]

- n. [医] 惊厥；动乱；震撼；震动