**Extinction Episodes of the Past**

**过去的灭绝事件**

It was not until the Cambrian period, beginning about 600 million years ago, that a great **proliferation** of macroscopic species occurred on Earth and produced a fossil record that allows us to track the rise and fall of biodiversity. Since the Cambrian period, biodiversity has generally risen, but there have been some notable exceptions. Biodiversity collapsed dramatically during at least five periods because of mass extinctions around the globe. The five major mass extinctions receive most of the attention, but they are only one end of a spectrum of extinction events. Collectively, more species went extinct during smaller events that were less dramatic but more frequent. The best known of the five major extinction events, the one that saw the demise of the dinosaurs, is the Cretaceous-Tertiary extinction.

直到六亿年前的寒武纪，肉眼可看的物种才在地球上兴起。多亏了化石的帮助，我们现在可以了解到物种的兴衰。自从寒武纪，生物开始变得多样化，但是也有些例外。因为在世界范围内的灭绝事件中，至少五次有物种大规模减少的情况。虽然我们最关注这五次大灭绝，但是它们只是一系列灭绝事件中的冰山一角。总体来说，很多较小的灭绝事件虽然不够引人注目，但是它们更为频繁，大部分物种就是因此而灭绝的。在五次大灭绝中，见证恐龙灭绝的是发生在白垩—第三纪的灭绝。

Starting about 280 million years ago, reptiles were the dominant large animals in terrestrial environments. In popular language this was the era “when dinosaurs ruled Earth,” when a wide variety of reptile species occupying many ecological niches. However, no group or species can maintain its dominance indefinitely, and when, after over 200 million years, the age of dinosaurs came to a dramatic end about 65 million years ago, mammals began to flourish, evolving from relatively few types of small terrestrial animals into the myriad of diverse species, including bats and whales, that we know today. Paleontologists label this point in Earth’s history as the end of the Cretaceous period and the beginning of the Tertiary period, often abbreviated as the K-T boundary. This time was also marked by changes in many other types of organisms. Overall, about 38 percent of the families of marine animals were lost, with percentages much higher in some groups. Ammonoid mollusks went from being very diverse and abundant to being extinct. An extremely abundant set of planktonic marine animals called foraminifera largely disappeared, although they rebounded later. Among plants, the K-T boundary saw a sharp but brief rise in the abundance of primitive vascular plants such as ferns, club mosses, horsetails, and conifers and other gymnosperms. The number of flowering plants (angiosperms) was reduced at this time, but they then began to increase dramatically.

二亿八千万年前，爬行动物成为陆上的主宰。通俗来说这是一个“恐龙统治地球”的时代。各类爬行动物占据了不同的生态环境。然而，没有哪一类生物可以永久保持主宰地位，在二亿年后，大约是六千五百万年前恐龙时代最终结束，哺乳动物开始繁盛，从最初的少数几种小型陆生动物逐渐发展到无数的各类物种，包括我们现在所知的蝙蝠和鲸鱼。古生物学家把地球历史上这个时间点作为白垩纪的末期和第三纪的初期，简称为K-T边界。很多K-T边界时期的其他生物也发生了重大变化。总的来说，大约38%的海洋生物消失了，更多的菊石软体动物也濒临灭绝。曾经尤为繁盛的海洋浮游生物-有孔虫也几乎消失了，尽管后来它们的数量有所回升。对植物来说，短时期突然出现了大量的原始维管植物，比如说蕨类植物，石松类植物，木贼类植物，松柏类植物和其他裸子植物。在此期间，开花植物（被子植物）的数量减少，但是接着又显著增加了。

What caused these changes? For many years scientists assumed that a cooling of the climate was responsible, with dinosaurs being particularly vulnerable because, like modern reptiles, they were ectothermic (dependent on environmental heat, or cold-blooded). It is now widely believed that at least some species of dinosaurs had a metabolic rate high enough for them to be endotherms (animals that maintain a relatively consistent body temperature by generating heat internally). Nevertheless, climatic explanations for the K-T extinction are not really challenged by the ideas that dinosaurs may have been endothermic, because even endotherms can be affected by a significant change in the climate.

这些变化的原因是什么呢？很多年来，科学家认为气候变冷是罪魁祸首，因为恐龙，和很多现代爬行动物一样是变温动物（依赖于环境温度，或冷血动物），面对气候变化非常脆弱。现在人们普遍相信至少有些恐龙具有足够高的新陈代谢速度，是恒温动物（动物通过在身体内部产生热量来维持相对不变的体温）。尽管如此，恐龙有可能是恒温动物这一论断未真正挑战K-T灭绝的气候变化原因。这是因为一些恒温动物仍然会受到气候显著变化的影响。

Explanations for the K-T extinction were revolutionized in 1980 when a group of physical scientists led by Luis Alvarez proposed that 65 million years ago Earth was stuck by a 10-kilometer-wide meteorite traveling at 90,000 kilometers per hour. They believed that this impact **generated** a thick cloud of dust that enveloped Earth, shutting out much of the incoming solar radiation and reducing plant photosynthesis to very low levels. Short-term effects might have included huge tidal waves and **extensive** fires. In other words, a series of events arising from a single cataclysmic event caused the massive extinctions. Initially, the meteorite theory was based on a single line of evidence. At locations around the globe, geologists had found an unusually high concentration of iridium in the layer of sedimentary rocks that was formed about 65 million years ago. Iridium is an element that is usually uncommon near Earth’s surface, but it is abundant in some meteorites. Therefore, Alvarez and his colleagues concluded that it was likely that the iridium in sedimentary rocks deposited at the K-T boundary had originated in a giant meteorite or asteroid. Most scientist came to accept the meteorite theory after evidence came to light that a circular formation, 180 kilometers in diameter and centered on the north coast of the Yucatan Peninsula, was created by a meteorite impact about 65 million years ago.

然而，在 1980年，路易斯·阿尔瓦雷茨带领的一组物理学家提出，在六千五百万年前，有一个10公里宽的陨星以每小时九万公里的速度撞击了地球，这使K-T灭绝成因发生革命性变化。他们认为：撞击产生了一层厚厚的灰尘云，笼罩了地球，阻断了太阳辐射，并使光合作用降到最低。短期内还有可能造成了巨大的海啸和广泛的火灾。也就是说，这次灾难性的撞击引发了一系列连锁反应并最终导致了大灭绝。最初，陨石理论是在一系列证据上发展起来的。在世界各地的很多地方，地质学家发现铱元素在六千五百万年前的沉积岩层中含量异常丰富。铱元素在地球表面很不常见，但在陨石中含量丰富。因此，阿尔瓦雷茨和同事推测在K-T边界沉积岩沉淀的铱元素来自于巨型陨星或小行星。科学家们逐渐接受了陨星理论，因为他们看到了六千五百万年前陨星撞击产生的圆形构造的证据。该圆形构造直径为180公里，围绕在尤卡坦半岛的西北岸。