Extinction of the Dinosaurs

**恐龙的灭绝**

Paleontologists have argued for a long time that the demise of the dinosaurs was caused by climatic alterations associated with slow changes in the positions of continents and seas resulting from plate tectonics. Off and on throughout the Cretaceous (the last period of the Mesozoic era, during which dinosaurs flourished), large shallow seas covered extensive areas of the continents. Data from diverse sources, including geochemical evidence preserved in seafloor sediments, indicate that the Late Cretaceous climate was milder than today’s. The days were not too hot, nor the nights too cold. The summers were not too warm, nor the winters too frigid. The shallow seas on the continents probably buffered the temperature of the nearby air, keeping it relatively constant.

很长时间以来，古生物学家们认为恐龙的灭亡是与因地质构造而引起的海洋和大陆位置变迁相关的气候变化所致。在整个白垩纪（中生代的最后的一段时间，这时恐龙正值繁盛），广阔的浅海覆盖了大量的陆地。各方面的数据，包括海床沉积中的地理化学证据，都表明白垩纪后期的气候比现在的气候要温和得多。白天不是很热，夜间也不是很寒冷。夏天不是太炎热，而冬天也不是太寒冷。大陆上的浅海可能使其附近的空气少受影响，以保持相对稳定的温度。

At the end of the Cretaceous, the geological record shows that these seaways retreated from the continents back into the major ocean basins. No one knows why. Over a period of about 100,000 years, while the seas pulled back, climates around the world became dramatically more extreme: warmer days, cooler nights; hotter summers, colder winters. Perhaps dinosaurs could not tolerate these extreme temperature changes and became extinct.

在白垩纪后期，地质资料表明这些浅海都从大陆退回到主要的海洋盆地内了，没有人明白为什么。大约在100 000年内，海洋收缩了，世界的气候也随之变得更极端：白天更热，夜间更冷，夏天更炎热，冬天更寒冷。恐龙或许就是因为无法忍受这种严峻的气温变化因而灭绝。

If true, though, why did cold-blooded animals such as snakes, lizards, turtles, and crocodiles survive the freezing winters and torrid summers? These animals are at the mercy of the climate to maintain a livable body temperature. It’s hard to understand why they would not be affected, whereas dinosaurs were left too crippled to cope, especially if, as some scientists believe, dinosaurs were warm-blooded. Critics also point out that the shallow seaways had retreated from and advanced on the continents numerous times during the Mesozoic, so why did the dinosaurs survive the climatic changes associated with the earlier fluctuations but not with this one? Although initially appealing, the hypothesis of a simple climatic change related to sea levels is insufficient to explain all the data.

如果真是这样，那么为什么冷血动物，比如蛇类、蜥蜴、乌龟和鳄鱼却能够幸免于寒冬和酷夏呢？这些动物都是依赖于气温以使其身体保持适合生存的温度。很难理解它们为什么毫不受影响，然而恐龙却如此的无能以至于无法适应，尤其是有些科学家认为恐龙是热血动物。批评者们也指出浅海在中生代曾有过无数次的进入大陆而又退回盆地的过程，所以为什么恐龙在前面的海洋起伏中能幸免于难，而在这一次中却不能呢？尽管最初人们这样认为，但是简单的与海平面高度有关的气候变化假设是不足以解释所有数据的。

Dissatisfaction with conventional explanations for dinosaur extinctions led to a surprising observation that, in turn, has suggested a new hypothesis. Many plants and animals disappear abruptly from the fossil record as one moves from layers of rock documenting the end of the Cretaceous up into rocks representing the beginning of the Cenozoic (the era after the Mesozoic). Between the last layer of Cretaceous rock and the first layer of Cenozoic rock, there is often a thin layer of clay. Scientists felt that they could get an idea of how long the extinctions took by determining how long it took to deposit this one centimeter of clay and they thought they could determine the time it took to deposit the clay by determining the amount of the element iridium (Ir) it contained.

对传统的关于恐龙灭绝解释的不满使得人们反过来惊奇的发现，从而产生了新的假设。当人们对比白垩纪后期的岩层资料和新生代（中生代后面的一个时期）早期的资料时发现很多植物和动物都突然地消失了。在白垩纪最后的一层岩石和新生代的第一层岩石之间，常有一层很薄的粘土。科学家们感觉到他们可以通过确定这层一厘米厚的粘土层中元素铱的含量来推测其的沉积时间，进而推测大灭绝所用的时间。

Ir has not been common at Earth’s since the very beginning of the planet’s history. Because it usually exists in a metallic state, it was preferentially incorporated in Earth’s core as the planet cooled and consolidated. Ir is found in high concentrations in some meteorites, in which the solar system’s original chemical composition is preserved. Even today, microscopic meteorites continually bombard Earth, falling on both land and sea. By measuring how many of these meteorites fall to Earth over a given period of time, scientists can estimate how long it might have taken to deposit the observed amount of Ir in the boundary clay. ■These calculations suggest that a period of about one million years would have been required. ■However, other reliable evidence suggests that the deposition of the boundary clay could not have taken one million years. ■So the unusually high concentration of Ir seems to require a special explanation. ■

自从地球形成之初，铱元素在地球的表面上就不常见。因为它通常是以金属状态存在，并随着地球的冷却和固结而优先地合并到地核中了。在一些陨石中，铱可能会高度富集，而这里常保存着太阳系内原始的化学组成。直到今天，小型的陨石也在连续不断地撞击地球，并掉落在陆地和海洋中。通过确定在一段给定时间内掉落在地球上的这种陨石的数量，科学家们就可以确定沉积隔层粘土的形成时间。这种计算表明形成这种沉积可能需要一百万年。然而其他可靠的证据则表明沉积这层粘土不可能花费了一百万年。所以这种不正常的铱的富集可能需要一种特殊的解释。

In view of these facts, scientists hypothesized that a single large asteroid, about 10 to 15 kilometers across, collided with Earth, and the resulting fallout created the boundary clay. Their calculations show that the impact kicked up a dust cloud that cut off sunlight for several months, inhibiting photosynthesis in plants; decreased surface temperatures on continents to below freezing; caused extreme episodes of acid rain; and significantly raised long-term global temperatures through the greenhouse effect. This disruption of food chain and climate would have eradicated the dinosaurs and other organisms in less than fifty years.

考虑到这些事实，科学家们就假设有一个较大的小行星，直径差不多有10到15公里，曾与地球相撞，碰撞扬起的灰尘等就形成了这层粘土层。他们的计算表明撞击扬起的灰尘遮挡了阳光达几个月之久，阻止了植物的光合作用，将陆地上的气温降到了零点之下；导致了酸雨这种极端事件；通过温室效应造成了长期的、严重的全球升温。这种对食物链和气候的极大扰乱将可使恐龙和其他生物在不到50年的时间内绝迹。