**Lighting**

**闪电**

Lightning is a brilliant flash of light produced by an electrical discharge from a storm cloud. The electrical discharge takes place when the attractive tension between a region of negatively charged particles and a region of positively charged particles becomes so great that the charged particles suddenly rush together. The coming together of the oppositely charged particles neutralizes the electrical tension and releases a tremendous amount of energy, which we see as lightning. The separation of positively and negatively charged particles takes place during the development of the storm cloud.

闪电是由雷雨云放电产生的一道明亮夺目的闪光。当带正电荷粒子区域与带负电荷粒子区域之间的吸引力大到使带电粒子瞬间碰撞到一起就会发生放电现象。相反的带电粒子的结合中和了电压并释放出巨大的能量，这就是我们看到的闪电。在雷雨云形成的过程中正负带电粒子相互分离。

The separation of charged particles that forms in a storm cloud has a sandwich-like structure. Concentrations of positively charged particles develop at the top and bottom of the cloud, but the middle region becomes negatively charged. Recent measurements made in the field together with laboratory simulations offer a promising explanation of how this structure of charged particles forms. What happens is that small (millimeter-to centimeter-size) pellets of ice form in the cold upper regions of the cloud. When these ice pellets fall, some of them strike much smaller ice crystals in the center of the cloud. The temperature at the center of the cloud is about -15℃ or lower. At such temperatures, the collision between the ice pellets and the ice crystals causes electrical charges to shift so that the ice pellets acquire a negative charge and the ice crystals become positively charged. Then updraft wind currents carry the light, positively charged ice crystals up to the top of the cloud. The heavier negatively charged ice pellets are left to concentrate in the center. This process explains why the top of the cloud becomes positively charged, while the center becomes negatively charged. The negatively charged region is large: several hundred meters thick and several kilometers in diameter. Below this large, cold, negatively charged region, the cloud is warmer than -15℃, and at these temperatures, collisions between ice crystals and falling ice pellets produce positively charged ice pellets that then populate a small region at the base of the cloud.

形成雷雨云的带电粒子的分离具有一种三明治结构。带正电的粒子聚集在云的顶部和底部，但是中间区域形成的是带负电的粒子。近期的野外测量以及实验室模拟为这种带电粒子的排列结构提供了可能的解释。实际上在此过程中在云层较冷的上部区域形成了细小的(毫米到厘米大小)冰丸。当这些冰丸飘落时，一部分会与云层中心比冰丸小得多的冰晶相撞。云层中心的温度大约在零下15摄氏度或者更低。在此温度下，冰丸和冰晶的撞击会使电荷发生转移，冰丸由此获得了负电而冰晶获得了正电。随后上升气流会将较轻的正电冰晶带到云的顶部。较重的负电冰丸会留在云层中部并积累起来。这个过程解释了为什么云的顶部带正电而中部带负电。带负电的区域非常大：厚度达数百米，直径达几千米。位于这片又大又冷的带负电区域之下的云层的温度要高于零下15摄氏度，在此温度下，冰晶和降落的冰丸的碰撞会产生带正电荷的冰丸，于是在云层的底部聚集成一小片区域。

Most lightning takes place within a cloud when the charge separation within the cloud collapses. However, as the storm cloud develops, the ground beneath the cloud becomes positively charged and lightning can take place in the form of an electrical discharge between the negative charge of the cloud and the positively charged ground. Lightning that strikes the ground is the most likely to be destructive, so even though it represents only 20 percent of all lightning, it has received a lot of scientific attention.

大部分的闪电发生在云层塌陷电荷分离的云层内部。但是，随着雷雨云的发展，云层下方的地面会带上正电，闪电就能够在带负电的云和带正电的陆地之间以放电的形式发生。击中地面的闪电是最有可能带有破坏性的，所以即使它只占所有闪电的20%，还是受到了很大的科学关注。

Using high-speed photography, scientists have determined that there are two steps to the occurrence of lightning from a cloud to the ground. First, a channel, or path, is formed that connects the cloud and the ground. Then a strong current of electrons follows that path from the cloud to the ground, and it is that current that illuminates the channel as the lightning we see.

通过高速摄影，科学家已经确定从云层到地面发生闪电的过程有两步。首先，要建立连接云层和地面的通道或者路径。然后强电流会沿着这条通道从云层传向地面，这股照亮通道的电流就是我们看到的闪电。

The formation of the channel is initiated when electrons surge from the cloud base toward the ground. When a stream of these negatively charged electrons comes within 100 meters of the ground it is met by a stream of positively charged particles that comes up from the ground. When the negatively and positively charged streams meet, a complete channel connecting the cloud and the ground is formed. The channel is only a few centimeters in diameter, but that is wide enough for electrons to follow the channel to the ground in the visible form of a flash of lightning. The stream of positive particles that meets the surge of electrons from the cloud often arises from a tall pointed structure such as a metal flagpole or a tower. That is why the subsequent lightning that follows the completed channel often strikes a tall structure.

电子从云层基部涌向地面就会开始形成通道。当这些负电荷距离地面不到100米的时候，会遇到来自地面的带正电的粒子流。一旦正负带电粒子流相遇，一条连接云层和地面的完整的通道便形成了。这个通道直径仅有几厘米，但是已经足以使电子以一道闪电这种可见的形式通过通道到达地面。那些与从云层涌来的电子相遇的带正电的粒子流通常来自于高大的带尖顶的建筑物，例如金属旗杆或塔。这就是为什么接下来通过完整通道的闪电往往会击中高层建筑的原因。

Once a channel has been formed, it is usually used by several lightning discharges, each of them consisting of a stream of electrons from the cloud meeting a stream of positive particles along the established path. Sometimes, however, a stream of electrons following an established channel is met by a positive stream making a new path up from the ground. The result is a forked lightning that strikes the ground in two places.

一旦通道形成，同一条通道可以发生多次闪电放电，每一次都是来自云层的电子流在已有通道上遇到带正电的粒子。但是有时候，通过已有通道的电子流会遇到从地面新路径来的带正电的电子流。结果就是形成在两处击中地面的叉状闪电。