**The Arrival of Plant Life in Hawaii**

**夏威夷植物的到来**

When the Hawaiian islands emerged from the sea as volcanoes, starting about five million years ago, they were far removed from other landmasses. Then, as blazing sunshine alternated with drenching rains, the harsh, barren surfaces of the black rocks slowly began to soften. Winds brought a variety of life-forms.

大约500万年以前，当夏威夷群岛作为火山从海洋中出现的时候，它们与其他陆块相距甚远。然后，经过了炙热阳光和湿润雨水的交替作用之后，那严酷贫瘠的黑色岩石表面开始渐渐变软。最后，大风就携带来了各种各样的生命体。

Spores light enough to float on the breezes were carried thousands of miles from more ancient lands and deposited at random across the bare mountain flanks. A few of these spores found a toehold on the dark, forbidding rocks and grew and began to work their transformation upon the land. Lichens were probably the first successful flora. These are not single individual plants; each one is a symbiotic combination of an alga and a fungus. The algae capture the Sun's energy by photosynthesis and store it in organic molecules. The fungi absorb moisture and mineral salts from the rocks, passing these on in waste products that nourish algae. It is significant that the earliest living things that built communities on these islands are examples of symbiosis, a phenomenon that depends upon the close cooperation of two or more forms of life and a principle that is very important in island communities.

孢子很轻，可以被微风携带着从更古老的陆地飘过几千英里并随机地降落在荒芜的山腰上。一些孢子在漆黑坚硬的岩石中扎根并生长，开始改造土地。地衣可能就是第一批成功安家的植物。它们不是单一的一种植物，每一个都是海藻和真菌的共生体。海藻通过光合作用获取太阳的能量，并将它储存在有机分子中。真菌从岩石中吸收水分和矿物盐，并将这些作为代谢废物为海藻施肥。岛屿上最早的生物群落以共生的方式存在是非常重要的，共生是一种依靠两种或两种以上的生物紧密合作而生存的现象，也是岛屿上生物群落非常重要的一项原则。

Lichens helped to speed the decomposition of the hard rock surfaces, preparing a soft bed of soil that was abundantly supplied with minerals that had been carried in the molten rock from the bowels of Earth. Now, other forms of life could take hold: ferns and mosses (two of the most ancient types of land plants) that flourish even in rock crevices. ■These plants propagate by producing spores — tiny fertilized cells that contain all the instructions for making a new plant — but the spores are unprotected by any outer coating and carry no supply of nutrient. ■Vast numbers of them fall on the ground beneath the mother plants. ■ Sometimes they are carried farther afield by water or by wind. ■But only those few spores that settle down in very favorable locations can start new life; the vast majority fall on barren ground. By force of sheer numbers, however, the mosses and ferns reached Hawaii, survived, and multiplied. Some species developed great size, becoming tree ferns that even now grow in the Hawaiian forests.

地衣有利于加速坚硬岩石表面的分解，并产生了一层柔软的土壤，这些土壤被提供了大量的来自地下深处的熔岩中含有的矿物质。现在，其他形式的生命就可以安家了：蕨类植物和苔藓（两种最古老的陆地植物品种）甚至可以在岩石缝隙里繁衍。这些植物通过产生孢子来繁殖，孢子是一些微小的有营养的细胞，它们携带了所有的可繁衍一株新的植物所需的遗传物质，但是它没有任何外部表皮的保护，也不携带营养物质。大量的孢子飘落在母体植物下面的土壤里，有时候它们被流水或风带到了更远的地方。但是只有少量的飘落在绝佳位置的孢子可以开始新的生命，绝大部分的孢子会落在贫瘠的土地上。尽管如此，靠着绝对数量上的优势，地衣和蕨类植物到达了夏威夷群岛存活了下来，并繁衍开去。其中一些物种体型巨大，成为了即使到现在还生长在夏威夷森林中的桫椤。

Many millions of years after ferns evolved (but long before the Hawaiian Island were born from the sea), another kind of flora evolved on Earth: the seed-bearing plants. This was a wonderful biological invention. The seed has an outer coating that surrounds the genetic material of the new plant, and inside this covering is a concentrated supply of nutrients. Thus, the seed’s chances of survival are greatly enhanced over those of the naked spore. One type of seed-bearing plant, the angiosperm, includes all forms of blooming vegetation. In the angiosperm, the seeds are wrapped in an additional layer of covering. Some of these coats are hard — like the shell of a nut — for extra protection. Some are soft and tempting, like a peach or a cherry. In some angiosperm the seeds are equipped with gossamer wings, like the dandelion and milkweed seeds. These new characteristics offered better ways for the seeds to move to new habitats. They could travel through the air, float in water, and lie dormant for many months.

在蕨类植物进化了好几百万年之后（不过，还是远在夏威夷群岛从海洋中出现之前），另一种植物开始在地球上进化：种子植物。这是一次惊人的生物进化。种子有一层裹在新植物遗传物质外面的表皮，在表皮里面是一种浓缩了的营养物质。因此，种子物种的成活率相对于那些裸露的孢子大大地提高了。其中一种种子植物——被子植物，包含了所有的开花植物。在被子植物中，种子被另外的一层外皮包裹着。其中的一些表皮很坚硬——就像坚果的外壳——可以提供额外的保护。还有一些被子的表皮则很软、很诱人，比如桃子或樱桃。还有一些被子植物的种子携带有薄纱一样的翅膀，比如说蒲公英和马利筋的种子。这种特征为种子转移到新的栖息地提供了更好的途径，它们可以通过空气、流水传播并可以保存好几个月。

Plants with large, buoyant seeds — like coconuts — drift on ocean currents and are washed up on the shores. Remarkably resistant to the vicissitudes of ocean travel, they can survive prolonged immersion in saltwater. When they come to rest on warm beaches and the conditions are favorable, the seed coats softer. Nourished by their imported supply of nutrients, the young plants push out their roots and establish their place in the sun.

一些拥有硕大的、可以浮于水面的种子的植物，像椰子，随洋流飘荡，被冲上海岸。对洋流变动抵抗的耐久性使得它们可以在海水的长期浸泡中生存下来。当它们停歇在温暖的海滩上，一旦条件合适，种子的外皮就开始变得更软。由于受到内部携带的营养物质的滋养，幼小的植物开始发芽并在阳光下成长。

By means of these seeds, plants spread more widely to new locations, even to isolated islands like the Hawaiian archipelago, which lies more than 2,000 miles west of California and 3,500 miles east of Japan. The seeds of grasses, flowers, and blooming trees made the long trips to these islands. (Grasses are simple forms of angiosperms that bear their encapsulated seeds on long stalks.) In a surprisingly short time, angiosperms filed many of the land areas on Hawaii that had been bare.

借助这些种子，植物传播到更远的新地方，甚至到了像夏威夷群岛（位于加利福利亚以西2,000英里和日本以东3,500英里）这样孤立的岛屿上。草、花和开花植物的种子经过长途跋涉到达这些岛屿上。（草类是一类将其种子孕育在长长的秸秆中的简单被子植物。）在短得惊人的时间内，被子植物覆盖了夏威夷群岛上曾经大面积荒芜的地面。