

# Flowers and Flight ... Blossoms and Bees

It's hard to believe, but the first flowering plants (angiosperms) appeared on earth just 130,000,000 years ago (130 Mya). The first *vascular* plants - which had established themselves on land nearly 400,000,000 years ago (400 Mya) - made do without flowers, depending instead on water - during their sexual phase - to spread eggs and sperm, requiring mating plants to be in close proximity.

There is a human tendency to view the current biological world and assume that how things are must be pretty much how they've always been ... but change is an integral part of the weave of reality. Of course, we can see small changes occurring all the time, but *dramatic* changes - that alter the entire landscape are *extremely infrequent* or else occur *incredibly slowly over extremely long periods of time*. Our human vision is totally blind to this and we do not see it.



Here's a bit of information: **all green plants** go through an *alternating cycle* in which one generation reproduces sexually and the next generation asexually. To see this, you need to look closely *and* to know what you're looking at. The most primitive plants, such as green mosses, exhibit the *gametophyte -  $n$  - sexually reproducing generation* as the larger of the two - *sporophytes* of mosses are seen as the slender yellow or orange stalks that extend above the green carpet. In all later plants, such as ferns, the *sporophyte -  $2n$  - asexual generation* is the large plant or tree we know. Giant tree ferns and the like dominated the forests of the Carboniferous age, 320 Mya. Fern spores, when they land in a moist area, develop into much smaller gametophyte plants, quite different in size and appearance from their (single) parent. These small plants, mating by watery sexual union, give rise to progeny which again grow into large sporophytes - ferns.

Ginkgoes and gymnosperms (think *conifers, pines, etc.*) follow an even more interesting path, in which the male gametophyte is truly minuscule, *several cells in size*, small enough for the *entire plant* to fit inside a protective pollen capsule, shielded from the dry land environment. Meanwhile, a slightly larger, but still tiny, multicellular female gametophyte is held on the scale of a cone. A pollen grain traveling through the air might land on the receptive part of a faraway cone. Then, the male plant, splitting open its pollen capsule, can extend its pollen tube and generate (by *mitosis*) a few sperm cells -  $n$  - to fuse with a waiting egg. The resulting zygote -  $2n$  - becomes an embryo and its development suspended in a seed.



In the middle of the Cretaceous, 130 Mya - when dinosaurs ruled (and the only mammals even alive on the planet were small rodent-like animals) - another change came about in the reproductive lifestyle of certain plants. *For the first time ever, flowers opened on the planet.* By 100 Mya, these plants had become widespread and began to dominate the landscape. There arose an advantage for flowering plants to use winged insects - already plentiful by then - to pick up the male plants (in pollen grains) and provide airborne delivery directly to the flowers where females were waiting. Flowers provided food: protein-rich pollen and sweet nectar as a reward for this behavior ... and success in attracting pollinators meant reproductive success for the plant.

When we read about the coevolution of honeybees and flowers of angiosperm plants, we are faced head-on with the great difficulty of accepting or believing that such a concept is even worth considering. *Bees and flowers just go together and it must have been that way right from the start,* we might think ... certainly that's just how it's always been. This was obvious, right, and widely accepted thinking two hundred years ago, in that well-ordered world that we humans once inhabited. Geologists, however, have changed our comprehension of the true depth of time. In 1830, Charles Lyell published *Principles of Geology*, which explained how the record *written in rock* showed that a combination of incredibly slow processes over an immensity of time were responsible for the total transformation of landscapes - as mountains rise from ocean depths and then are carved by glaciers and rivers. This book was carried on the *HMS Beagle* and changed the thinking of a certain young naturalist on board during its five-year voyage from 1831-36. Charles Darwin saw the patterns and relationships in *living systems* that - given the enormity of time that he now recognized had been available - could be explained by incredibly small changes during inheritance over many, many generations.



It was late in the Cretaceous, 80 Mya, that flowers and honey bees began their long and storied dance together ... a dance whose partners survived the big impactor near the Yucatan (Chicxulub) 65 Mya (the dinosaurs weren't so lucky, though mammals saw a silver lining). Flowering plants and honey bees have gone through subtle changes together ever since, one adjusting to the other in the slow but constant dance of genetic variation and natural selection that has always occurred over the vastness of time.