Title
The Evolution of Beauty

Journal
Berkeley Scientific Journal, 25(2)

ISSN
1097-0967

Author
Eloyan, Lilian

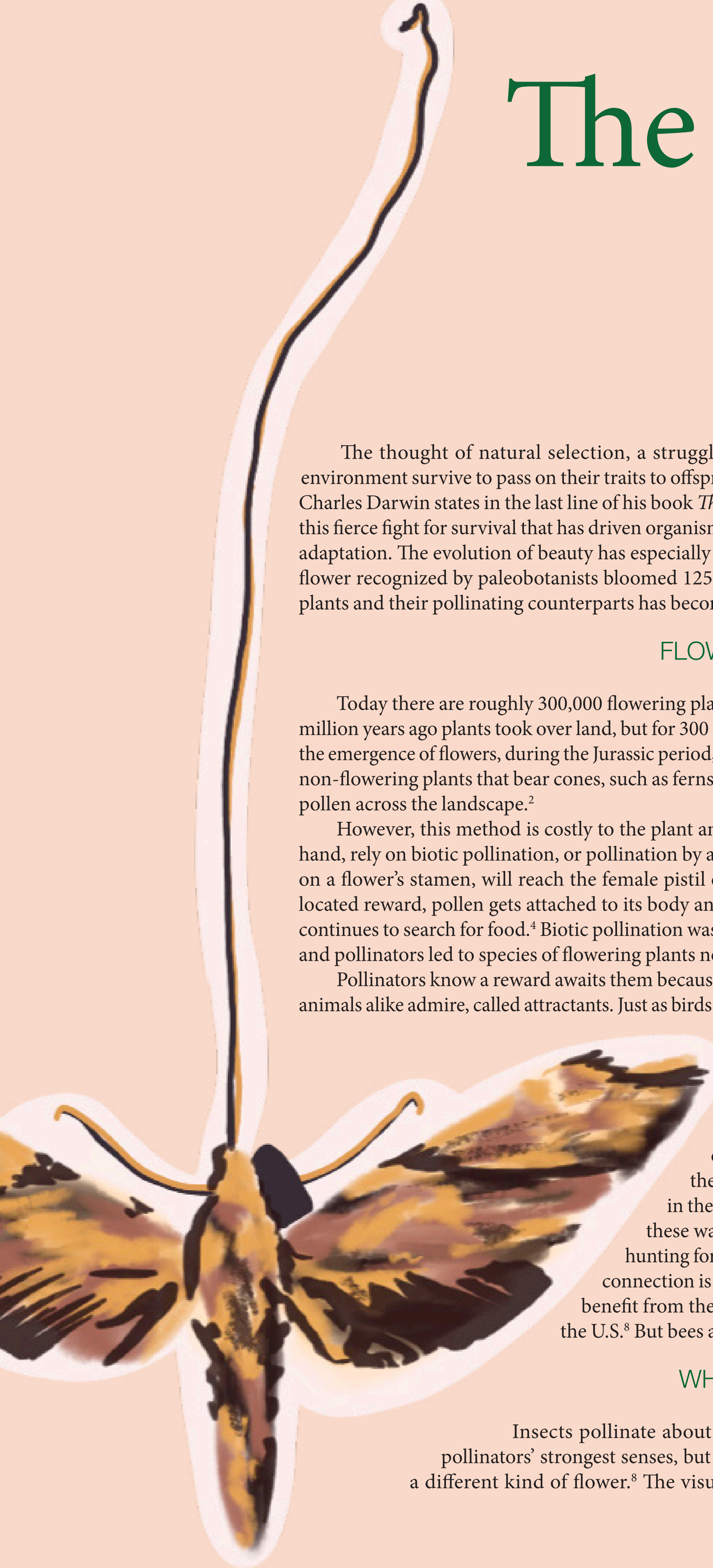
Publication Date
2021

DOI
10.5070/BS325254485

Undergraduate

The Evolution of Beauty

BY LILIAN ELOYAN



The thought of natural selection, a struggle for existence whereby organisms better adapted to their environment survive to pass on their traits to offspring and less fit organisms die out, may seem grim. However, as Charles Darwin states in the last line of his book *The Origin of Species*, "There is grandeur in this view of life."[1] It is this fierce fight for survival that has driven organisms to incredibly complex and oftentimes beautiful evolutionary adaptation. The evolution of beauty has especially blossomed in flowering plants, or angiosperms, since the first flower recognized by paleobotanists bloomed 125 million years ago.[2] From that moment on, the coevolution of plants and their pollinating counterparts has become one of the most intimate symbiotic relationships.

FLOWERING PLANTS

Today there are roughly 300,000 flowering plants, yet they are a relatively new addition to life on Earth.[2] 450 million years ago plants took over land, but for 300 million years flowers did not have a place in the sun. Just before the emergence of flowers, during the Jurassic period, dinosaurs lived alongside a world dominated by gymnosperms, non-flowering plants that bear cones, such as ferns, which used the natural movement of the wind to spread their pollen across the landscape.[2]

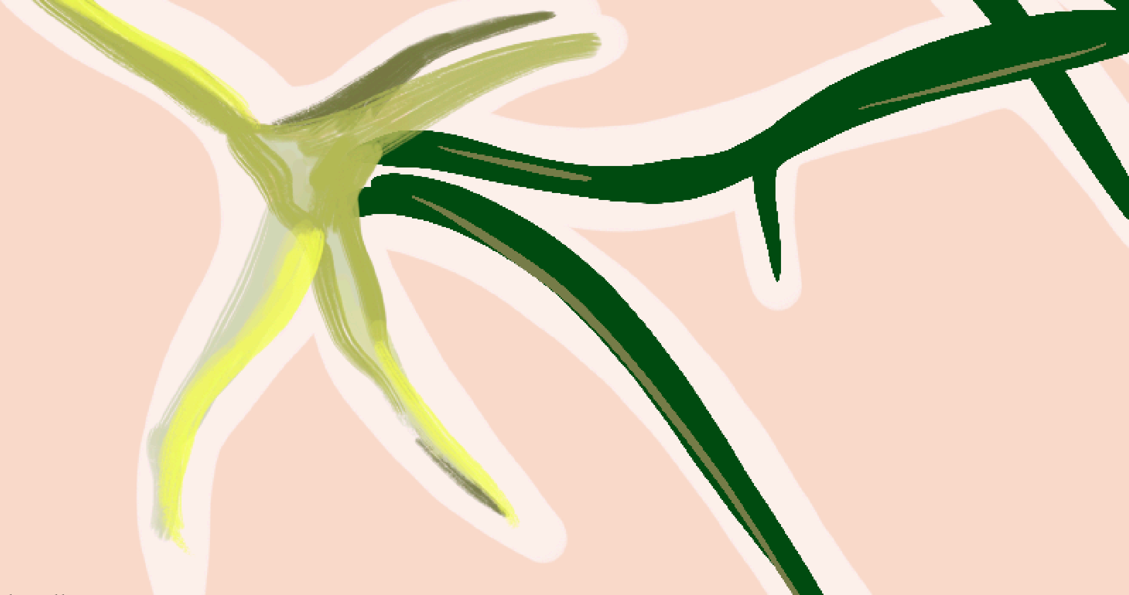
However, this method is costly to the plant and does not guarantee pollination. Angiosperms, on the other hand, rely on biotic pollination, or pollination by animals which oftentimes ensures that the male pollen, located on a flower's stamen, will reach the female pistil of another flower.[3] As a pollinator searches for a strategically located reward, pollen gets attached to its body and is conveniently transported to the next flower as the animal continues to search for food.[4] Biotic pollination was a game changer, as the simultaneous evolution of floral beauty and pollinators led to species of flowering plants now making up 80% of the plant kingdom.[5]

Pollinators know a reward awaits them because of the appealing features of flowering plants that humans and animals alike admire, called attractants. Just as birds of paradise flaunt their decorative feathers in hopes of attracting a mate, flowers that stand out in the green backdrops of their environments and release enticing fragrances are not only easier to find and to pollinate, but also signal to animals that they have more to offer than beauty. These rewards come most commonly in the form of either nutritious pollen or sweet nectar.[6] One of the earliest insects to reap the benefits of these rewards were carnivorous wasps who swapped out the meat in their diets for nutrient-rich pollen from magnolia trees.[7] Over time these wasps found that pollen foraging was more energy efficient than hunting for a meal and eventually evolved into what we now call bees.[7] This connection is now called a mutualistic relationship, meaning both organisms benefit from the interaction as bees pollinate two-thirds of the crops grown in the U.S.[8] But bees aren't attracted to just any flower.

WHAT MAKES A FLOWER BEAUTIFUL

Insects pollinate about 65% of flowering plant species so attractants play to their pollinators' strongest senses, but beauty is in the eye of the beholder, as each organism prefers a different kind of flower.[8] The visual spectrum of bees, for example, is shifted toward shorter

FEATURES



wavelengths of light relative to human sight, allowing them to see ultraviolet light.[9] For this reason bees are unable to see the color red which appears black to them.[9] Consequently, bees are attracted to flowers that are often blue, yellow, or ultraviolet, even though humans might not be able to appreciate their beauty.[9] Moths also pollinate several flower species but are most active at dusk. Therefore, plants that have co-evolved with moths tend to have lighter-colored, or white, flowers that are visible under low-light conditions and produce strong, easily detectable, scents.[9] Unlike flowers pollinated by bees or bee flowers, moth flowers generally do not have a landing platform as moths remain in flight as they feed on nectar, and nectar tubes are generally narrow, in keeping with the narrow proboscis of moths.[9] Butterflies, on the other hand, prefer brighter colors and sweeter scents as they have exceptional color vision and powerful olfactory capabilities, making them the most successful of the biotic pollinators.[9] Birds also have outstanding visual abilities and can better sense warmer shades of the color spectrum, but they have poor olfactory sense, so bird-pollinated flowers are typically red and odorless.[9] In addition, birds have high metabolic demands compared to insect pollinators, so bird flowers produce relatively large amounts of nectar as a reward and must have thick, rigid parts to withstand probing by strong beaks.[9] These mutualisms are sometimes so specialized that they function as a lock and key, with only one pollinator able to access a flower's unique reward.

COEVOLUTION

Darwin used symbiotic relationships between organisms as evidence for evolution as they exemplified a key component of evolutionary theory; predictability. In Madagascar, Darwin and his colleagues were perplexed by a species of star orchid that has a narrow 16-inch long nectar tube.[4] Darwin predicted that the star orchid must have a complementary counterpart that would be able to reach its nectar.[4] Sure enough, 20 years later, the hawk moth, with a 16-inch long proboscis, was spotted on the island and named *Xanthopan morganii praedicta*, which translates from Latin to "predicted moth."[4]

> "Attractants play to their pollinators' strongest senses, but beauty is in the eye of the beholder, as each organism prefers a different kind of flower."

Other flowering plants have evolved more deceptive modes of pollination. Their relationships with their pollinators are sometimes commensal, meaning only one member of the partnership benefits, while the other is largely unaffected. *Ophrys apifera*, also known as the bee orchid, has striking yellow and black colored petals that are shaped like a female bee.[10] As male bees attempt copulation, they inadvertently gather pollen on their backs and carry them to the next flower in a futile mating attempt.[10] Other examples of deceit pollination, however, aren't as pretty. The largest flowering plant in the world, *Rafflesia*, mimics the look and scent of rotting flesh to encourage flies to lay their eggs on the plant and unwittingly carry pollen between flowers whereas the larvae, upon hatching, starve as they need animal flesh to survive.[11]

Beyond these floral oddities, the necessity of floral beauty to attract pollinators is a happy side effect of evolution when viewed through a human lens. Although the world around us can be a hostile and competitive place, we're lucky that beauty has evolved to become a dominant element in the natural world and that we humans are not immune to these charming adaptations. With all the selective pressures that exist to define beauty in the natural world, it is important to realize that as humans, our definition of beauty remains similarly in a perpetual state of evolution; while one person smells the roses, another may see nothing but thorns. The coevolution between flowering plants and their pollinators has designed a world of incredible diversity that makes life on Earth so beautiful today.

Acknowledgements: *I would like to acknowledge my wonderful editors, Shivali Baveja and Nicholas Nolan, of the Berkeley Scientific Journal features department, for their indispensable contribution to the writing process.*

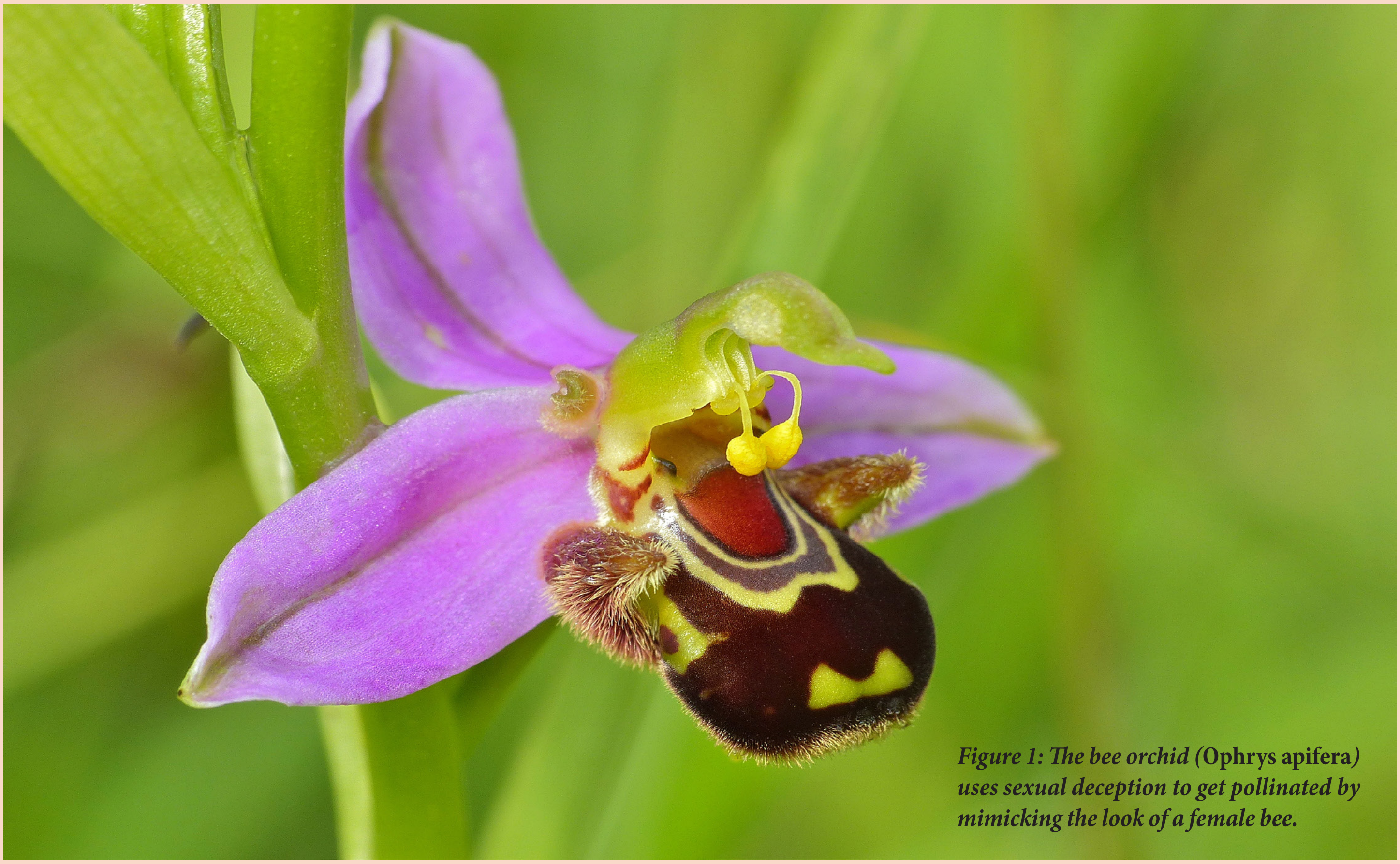


*Figure 1: The bee orchid (**Ophrys apifera**) uses sexual deception to get pollinated by mimicking the look of a female bee.*

"The necessity of floral beauty to attract pollinators is a happy side effect of evolution when looking at the phenomenon through a human lens."

REFERENCES

1. Darwin, C. (1859). *The origin of species*. Vintage.
2. Pennisi, E. (2009). On the origin of flowering plants. *Science*, *324*(5923), 28–31. https://doi.org/10.1126/science.324.5923.28
3. Walker, T. (2020). Animals. In *Pollination: The Enduring Relationship between Plant and Pollinator* (pp. 66–95). Princeton University Press. https://doi.org/10.2307/j.ctv10tq6j3.6
4. Zimmer, C. (2006). *Evolution: the triumph of an idea*. Harperperennial.
5. Barras, C. (2014, October 10). *The abominable mystery: How flowers conquered the world*. BBC Earth. http://www.bbc.com/earth/story/20141017-how-flowers-conquered-the-world
6. Walker, T. (2020). Rewards. In *Pollination: The Enduring Relationship between Plant and Pollinator* (pp. 126–153). Princeton University Press. https://doi.org/10.2307/j.ctv10tq6j3.8
7. Goulson, D. (2014, April 25). The Beguiling History of Bees [Excerpt]. *Scientific American*. https://www.scientificamerican.com/article/the-beguiling-history-of-bees-excerpt/
8. Kearns, C., & Inouye, D. (1997). Pollinators, flowering plants, and conservation biology. *BioScience*, *47*(5), 297–307. https://doi.org/10.2307/1313191
9. Walker, T. (2020). Attraction. In *Pollination: The Enduring Relationship between Plant and Pollinator* (pp. 96-125). Princeton University Press. https://doi.org/10.2307/j.ctv10tq6j3.7
10. Fenster, C. B., & Martén-Rodríguez, S. (2007). Reproductive assurance and the evolution of pollination specialization. *International Journal of Plant Sciences*, *168*(2), 215–228. https://doi.org/10.1086/509647
11. Beaman, R., Decker, P., & Beaman, J. (1988). Pollination of Rafflesia (Rafflesiaceae). *American Journal of Botany*, *75*(8), 1148–1162. https://doi.org/10.2307/2444098

IMAGE REFERENCES

1. *Banner*: Image made by BSJ.
2. *Figure 1*: Dupont, B. (2014). *Bee Orchid (Ophrys apifera) (14374841786) - cropped* [Photograph]. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Bee_Orchid_(Ophrys_apifera)_(14374841786)_-_cropped.jpg