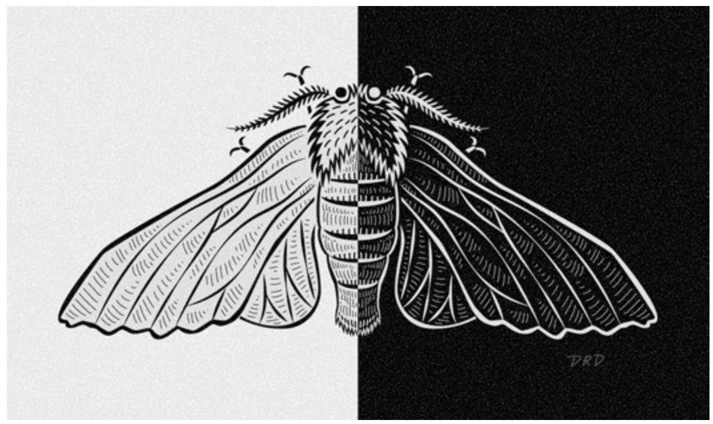
Teacher Tune-up

Quick Content Refresher for Busy Professionals

Why is the story of the peppered moth so famous and important?



The story of *Biston betularia,* the peppered moth, is a staple of many textbooks on evolution. Briefly stated, some mostly light-colored moths got mostly dark colored over many generations; then they got light-colored again. So what's the big deal? Why is the peppered moth such an evolutionary celebrity?

Before 1800, most peppered moths were white, with a sprinkling of dark spots that give the moth its name. They were well camouflaged against lichens that grew on trees with light bark, which helped them avoid predatory birds.

Throughout the nineteenth century, England's industrial revolution saw the rise of steam power. Trains and steam-powered factories (the "dark Satanic Mills" of an 1808 poem by William Blake) burned coal and belched tons of soot into the environment. The black soot killed lichen and settled on the trees where the peppered moths rested. And generation by generation, the moths began to change.

In 1811, someone found the first dark, nearly black, peppered moth. By the middle of the century, the frequency of melanism (dark coloration) in the peppered moths had risen dramatically. And by the end of the century, in large areas of England that were coated in dark industrial filth, nearly all peppered moths were dark.

Along with changing landscapes and moths, another change was afoot. Naturalists had begun to speculate about something called evolution, based largely on evidence of ancient events: sequences in the fossil record, similarities among different species, vestigial structures in many organisms—that sort of thing. With the publication of *On the Origin of Species by Natural Selection* in 1859, Charles Darwin became the most famous and convincing exponent of evolutionary theory. He followed that up with *The Descent of Man* in 1871.

In 1896, J. W. Tutt suggested that the changing coloration of the peppered moth might be a case of evolution happening in the present, in a short, observable time span. Later, in the 1950s, Bernard Kettlewell conducted experiments that confirmed that, yes, different colorations produced different selection pressures in different circumstances: light-colored moths were harder for birds to catch in clean environments, while dark-colored moths were harder for birds to catch in polluted environments.

Moths were not the only organisms impacted by industrial pollution. The Great London Smog of 1952 killed thousands of people over a few days. This catastrophe helped motivate the British Parliament to pass the Clean Air Act in 1956, and in the years that followed, the dark pollution from burning coal was dramatically reduced.

Low and behold, as black soot disappeared from the environment and lichen regrew on the light-colored trees, changing what counted as camouflage, the subsequent generations of peppered moths included fewer dark-colored individuals and more light-colored individuals.

The case of the peppered moth was an accidental experiment almost two centuries in the making—a short, observable amount of time by evolutionary standards—and it happened at just the time that Darwinian ideas became available to interpret events. Evolutionary theory illuminated what was happening to the peppered moths, and the peppered moths gave a new kind of immediate, living evidence to evolutionary theory, making the peppered moth an evolutionary superstar.

Other cases of this kind of so-called microevolution have since been observed. Microevolution, or small-scale evolution, involves a change in the relative abundance of different alleles in a population. (Alleles are versions of specific genes; so a gene for coloration might come in two or more alleles, each version coding for a different color.) The genetic allele for melanism was already present in the peppered moth population, but it remained rare before the nineteenth century because it made moths easier prey for birds. The allele for light coloration never entirely disappeared from the population during the coal-coated years, so it was available when light coloration again became a more fitting characteristic for survival.

In contrast to microevolution, large-scale or macroevolution involves more radical reshaping of species through mutation, and even the branching apart of different species from common ancestors.

In addition to being the first case of evolution by natural selection observed in real time, the peppered moth story underscores the fact that evolution is not a matter of progress in one inevitable direction. When selection pressures reversed, so did the genetic make-up and the visible characteristics of the overall moth population.