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In *Observing Evolution*, population geneticist Bruce Grant chronicles a nearly twenty-year span of his career dedicated to an instance of adaptive evolution *par excellence*: industrial melanism in peppered moths (*Biston betularia*). This paradigmatic example of evolution by natural selection was famously popularized by the work of Bernard Kettlewell in the mid-twentieth century. The story is familiar to anyone who has taken an undergraduate biology course: the Industrial Revolution was accompanied by a dense smog that polluted the forests of Birmingham, England. The light-colored trees that once offered sanctuary from predators to similarly colored moths were now covered in black soot. And while light moths are conspicuous against sooty trees, dark moths go unnoticed. The light moths perish, and the dark moths survive and reproduce. Thus, the phenomenon of "industrial melanism" evolved by natural selection. However, certain features of Kettlewell's account, such as the hypothesized mechanism by which moths choose to rest on surfaces that match the color of their wings, had—as of 1983—gone untested. It was the challenge of this untested hypothesis that would draw Grant away from his *Drosophila* laboratory, send him on a transcontinental tour of the birch forests of the world,

and ultimately lead him to discover the parallel rise and fall of industrial melanism in evolutionary biology's beloved geometers.

Prospective readers should note, however, that Grant's book functions more as a memoir than a monograph. If one is solely interested in reading a scientific text on Kettlewell's hypothesis and Grant's subsequent tests of that hypothesis, then perhaps one might be better suited by reading the primary literature. In *Observing Evolution*, Grant's research program serves as the thread that weaves his globetrotting episodes together. This is not by any means to imply that the book lacks empirical science. Of course, Grant provides his readers with summaries of his research—the hypotheses he tested and the experiments he and his colleagues designed to test them. But this story is less about the *results* of the experiments themselves, and far more about the people and places that Grant would encounter as he performed them. In an apt description, Grant calls his book "an adventure story, offering a firsthand account of this research" (p. ix).

It is for this reason that *Observing Evolution* may be of special interest to historians and philosophers of science—especially those who work in "philosophy of experiment," *sensu* Ian Hacking. Grant brings us along as he makes the awkward and frustrating transition from laboratory science to field work. He describes his pitfalls in detail as he develops a "feeling for the organism." (His admiration for Barbara McClintock, and his aspiration to achieve with the peppered moth the kind of intimate knowledge that she had of maize, is a running motif.) And while it is interesting to read of the inevitable hiccups in experimental design, it is even more interesting—and, at times, highly entertaining—to learn of Grant's solutions.

For example, in an early episode, Grant attempts to resolve a dispute between Kettlewell and T. D. Sargent "regarding the *mechanism* by which moths choose their daytime hiding places" (p. 23). Kettlewell proposed a "contrast/conflict" mechanism of background selection,

whereby peppered moths compare the pigment of their own scales with the color of the background. If the moth inspects itself and sees white scales, then it will prefer light backgrounds. Sargent, on the other hand, suggested that background preferences are genetically fixed—no self-inspection necessary. To adjudicate the dispute, Grant would need to deceive the moths about their own color. If a white moth inspected itself, found black scales, and continued to demonstrate a preference for light backgrounds, then this would support Sargent's hypothesis over Kettlewell's. If, however, the background preference of the moths varied with the color it saw upon self-inspection, then this would support Kettlewell's "contrast/conflict" hypothesis. Simple enough. However, Grant soon discovered that creating phony phenotypes is not as easy as it sounds: "Moths don't like being painted" (p. 33). He arrives at a solution to this problem completely by accident. After many failed attempts to find the right kind of paint, Grant heads to the office at the University of Virginia's Mountain Lake Biological Station—where he was conducting his summer research—to inquire about paint suppliers. While in the office, he spots a handheld hole punch, and a desk littered with paper discs discarded from the punch. Instead of painting the moths, Grant decides to outfit them with the paper discs—white collars for black moths, and black collars for white moths. When the moths inspect themselves, they see the color of their collar and (hopefully) mistake it for their own pigment. As an added bonus, the collared moths look quite fancy in their "Elizabethan garb" (p. 36). We see in this episode, as in many others, how Grant ultimately achieved the feeling for the organism that he was seeking.

During his travels, hijinks abound. Over the span of several chapters, Grant recounts the time he joined a bagpipe band in Liverpool, England, where he was conducting experiments with Sir Cyril Clarke. (Grant is an avid "piper.") Later, in Japan, we follow Grant and his colleagues as they furtively scale the roof of a guardhouse on top of a hydroelectric dam—all so they can

swing their nets at the moths circling the mercury vapor lamps. (Such precarious situations are familiar to entomologists, of course; collectors will go to great lengths for good specimens.)

Because his adventure story is meant to appeal to a wide audience, Grant aims to write in a way that is accessible to biologists and non-biologists alike. This is always a worthy pursuit, no matter whether one is writing a monograph or memoir. To ensure that his language is not prohibitive, Grant follows each bit of biological jargon with an ordinary translation in parentheses. Unfortunately, however, this stylistic convention can occasionally result in awkward prose. For example, when discussing the color variation in *Biston betularia*, Grant writes that the "various forms (called phenotypes by geneticists) have been given names by lepidopterists (who study moths and butterflies), as is their custom for polymorphic (having more than one known form) species" (p. 7). In other places, one wonders if the translations are necessary, such as Grant's explanation that a source of female moths can "attract (assemble) males by pheromones (a scent triggering a behavioral response in members of the same species)" (p. 49). This is, of course, a very minor point, but it serves to demonstrate a major challenge of science writing—to communicate the science in a way that is informative, elegant, and unassuming, all at the same time. It is a challenge that Grant frequently meets.

Perhaps what is most special about Grant's chronicle is the passion with which he writes about scientific practice. His love of biology shines through, and it is quite contagious. The same can be said for the enormous affection with which he writes of lepidopterans in general. This affection is never more obvious than the moment when Grant sees his very first peppered moth—the first of thousands. In his description of this moment, he writes: "This moth species was so famous, and I had looked forward to this day with such great anticipation, that I felt as though organ music should be playing, or trumpets sounding" (p. 17). Of course, learning of the

major empirical results that have punctuated Grant's career—including his refutation of Kettlewell's contrast/conflict hypothesis and his discovery of the parallel rise and fall of industrial melanism in Britain and North America—is an important feature of the book. But it is Grant's reminder of just how fun scientific collaboration can be—even, and perhaps especially, when the experiment goes wrong—that makes *Observing Evolution* a book worth reading.