



Did Popper Refute Evolution?

The neo-Darwinian theory of evolution is the currently accepted paradigm to explain the history and diversity of life on Earth. Yet ever since the publication of Darwin's *Origin of Species* in 1859, the theory has been under attack on a variety of grounds. Readers of *SI* are familiar with standard creationist nonsense, as well as with the slightly more sophisticated sophistry of "intelligent design" proponents. Some of the criticisms of evolutionary theory have been put forth in the professional philosophical arena, where serious scholars have often accused it of being incoherent or logically fallacious.

Perhaps the best-known philosophical criticism of evolution was put forth by Karl Popper, who once claimed that "Darwinism is not a testable scientific theory, but a metaphysical research program" (*Unended Quest*, 1976). Popper famously retracted his comments once it was explained to him that there was quite a bit more to the theory than he had understood from a cursory examination of the subject: "I have changed my mind about the testability and logical status of the theory of natural selection; and I am

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glad to have an opportunity to make a recantation" (*Dialectica* 32:344–346).

Besides being an impressive example of a famous scholar admitting in public that he was wrong (when was the last time a creationist has done that?), the episode is important for two reasons. First, it is interesting to understand where Popper's original criticism came from; second, it is crucial to realize exactly why he recanted. One of Popper's chief interests in philosophy of science was the so-called demarcation problem, something very dear to skeptics. The problem consists of identifying the criteria that separate science from pseudoscience. Popper took, not surprisingly, physics and astronomy to be quintessential examples of good science. On the other hand, he considered Marxist history, Freudian psychoanalysis, and astrology as examples of pseudoscience. The task, then, could be rephrased in terms of pinning down what distinguishes these two groups of theories. As it turns out, Popper's approach was vitiated by his failure to appreciate the heterogeneity intrinsic in both the categories of "science" and "pseudoscience," i.e., in the fact that not all science (or pseudoscience) is created equal, operates by the same criteria, and can therefore be defined in similar manner. But I will return to that topic in a future column.

As far as we are concerned here, Popper proposed his famous criterion of falsification to solve the demarcation

problem: good science is done when hypotheses can be shown to be false (if they indeed are). That's where the philosopher's criticism of evolutionary theory originated from. Popper understood evolutionary biologists to say that their theory predicts that natural selection allows only the fittest organisms to survive; but, he countered, the "fittest" organisms are *defined* as those who survive, which makes the statement tautological. Now, in philosophy being a tautology isn't necessarily a bad thing; after all, tautologies are the bread and butter of logic and mathematics—in the sense that one logically deduces consequences from premises that are taken as given, like definitions—and consider how many interesting things have come out of both logic and mathematics. That is why Popper initially concluded that, though tautological, evolutionary theory was a useful "metaphysical" (in the philosophical, not religious, sense) program, i.e., an overarching idea that could provide a powerful framework to interpret the biological world. But, as in the case of Freudian psychoanalysis or Marxist history, it wasn't good science.

Why, then, did the Austrian philosopher change his mind? Because it turns out that while it is true that evolutionary biologists predict (i.e., deduce) the

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Unfortunately, the infrared sensor's recoded output is in a standard commercial video format (e.g., NTSC or PAL). These were the accepted video standards when the equipment was designed. The infrared focal planes have dynamic ranges of thirteen or fourteen bits, but the image-forming electronics compresses this wide range in a nonlinear fashion to make cosmetically appealing images on a six or eight bit capable display, a low-dynamic range for video recording. In other words, a lot of information gets lost. Unfortunately, just like your camcorder, the compression is adaptive based on scene statistics and details, and the settings are not recorded. This, along with other factors such as atmospheric, eliminates such airborne infrared system from recording any precise data, unlike common handheld thermographic and scientific cameras. From a videotape, one cannot glean any radiometric data, as it is all processed in an unknown manner with nonlinear and adaptive algorithms to make a clearly displayed image on conventional television. Also every copy degrades the tape, and every format (DVC, SVHS, VHS, etc.) imposes its own proprietary scaling and changes on the data, making reliable scientific measurement impossible.

The UFO believers who participate in the online UFO Updates forum, which includes many "leaders" of the UFO movement, laughed off the valid explanation of oil well fires as flippantly as they did the absurd ones. UFO author Ray Stanford scoffed at "oil rig flares tracked on radar at near the aircraft's altitude," of which neither statement was true: the radar targets were in a different direction entirely, and distant objects near the horizon may well be on the ground. Roswell champion David Rudiak scoffed at "invisible, flying oil wells," while Alfred Lehberg suggested that skeptics might as well propose "soar-

ing lighthouses and gassy pelicans." Others raised the specter of elves, angels, flaming seagulls, etc. Jaime Maussan argued that the flaming oil wells would not have been visible, because they were 125 to 200 km or more distant. He neglected to calculate that from an altitude of 3,500 meters, the horizon is nominally 211 km distant, and that atmospheric refraction typically extends this distance somewhat, depending on meteorological conditions, as also does the height above the water of the flames themselves.⁷

By their reaction, the "leaders" of UFOlogy have shown themselves incapable of distinguishing logical from illogical thought, and science from pseudoscience. The lesson of the Mexican Infrared UFO video illustrates once again the inability of the UFO movement to perform critical thinking.

Notes

1. Miller is the author of the textbook *Principles of Infrared Technology: A Practical Guide to the State of the Art* (Kluwer Academic Publishers, 1994) and *Photonics Rules of Thumb* (McGraw-Hill, 2004), as well as two ancillary versions of *Photonics Rules of Thumb* (McGraw-Hill 1994 and 2003).
2. Information provided by Jaime Maussan. See www.virtuallystrange.net/ufo/updates/2004/may/m26-003.shtml.
3. See www.virtuallystrange.net/ufo/updates/2004/jun/m01-002.shtml.
4. At the Bay Area UFO Expo, San Jose, California, September, 2000. See "Reptoids and Martians Invade Silicon Valley" by Robert Sheaffer, SKEPTICAL INQUIRER, January 2001.
5. See Maussan's Web site about the videos at www.ovnistv.tv/noti_mayo/n_11mayo_reporte.htm.
6. See Franz's original posting at www.virtuallystrange.net/ufo/updates/2004/may/m27011.shtml. Alcione's Web site is at www.alcione.org.
7. See www.istp.gsfc.nasa.gov/stargaze/Shorizon.htm for an explanation of how to calculate the distance to the horizon as a function of elevation. □

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survival of the fittest (and the much more important fact that s/he is going to have the most offspring) by means of natural selection, they have independent ways to assess which members of a population of organisms actually are the "fittest." For example, biologists employ optimization analyses to predict which combinations of morphological, behavioral, or physiological traits are more likely to be advantageous (i.e., to increase "fitness") in the range of environments actually encountered by a given living form. They then sample natural populations of organisms, determine in which environments they actually live, measure those traits they hypothesize are more likely to make a difference, and obtain statistical predic-

tions on where natural selection should push the population next. Finally, biologists wait until the next generation of organisms comes out and measure their characteristics again.

If the theory were correct (and given some other verifiable conditions, such as the presence of adequate genetic variation for the traits in question), the population's mean for the characters under selection should have shifted in the predicted direction. This is an eminently falsifiable hypothesis, in the same sense in which predictions made by astronomers or physicists are falsifiable, and very much unlike the explanations of human behavior put forth by psychoanalysts, which are notoriously so flexible that they can fit (*a posteriori*) virtually any observed pattern.

The tautological circle thus broken, evolutionary biology can be fully admitted among the sciences even by the

Popperian criterion of falsification. Much more than a useful metaphysical research program, the modern theory of evolution is as scientific as Newtonian mechanics, though by all means not as precise as, say, quantum mechanics. The distressing part of this story is how many creationists, and occasionally even professional philosophers, keep bringing up Popper's alleged refutation of evolution as if it were the last word on the subject. They often imply that evolutionary biologists are either dupes or, worse, consciously misleading the public into thinking that they are doing good science at the expense of that same public's generosity. For this, however, we cannot blame Popper, who demonstrated in his retraction a much higher intellectual standard than the people who attempt to exploit one of his mistakes in order to serve their parochial ideological agendas. □