LETTERS

Evolution and Prediction

In his recent News and Comment article (20 Mar., p. 1331) on the outcome of "Scopes II" in California, William J. Broad brings up the charge that somehow evolutionary theory is less "scientific" than, say, quantum mechanics. Seemingly a good piece of ammunition for creationists, the charge stems from Sir Karl Popper's characterization of "Darwinism" as a "metaphysical research program"—not a theory with falsifiable components. To assume, however, that "evolutionary theory . . . does not behave like a good theory" because "it is unable . . . to make predictions about future events" is to misconstrue the true nature of predictivity and hypothesis testing in science.

One must distinguish between the general notion that life has evolved and specific theories on *how* life evolves. Only the latter is conventionally called "evolutionary theory." If some evolutionary biologists have been less than rigorous in their adherence to the hypothetico-deductive approach to the study of evolutionary mechanisms, it is nonetheless true that the experimental procedures of geneticists and developmental biologists, and the field and laboratory procedures of ecologists, systematists, and paleontologists generally are firmly cast within the hypothetico-deductive mold (*1*). There is no problem with the study of evolutionary mechanics being "scientific" by Popper's or any other serious philosopher's conception of that term. The very "squabbles" among evolutionists said to show how weak the theory is actually show that rival hypotheses are once again being evaluated in evolutionary biology—an activity that is supposed to be normal in science.

But Popper's by now famous remark pertains as well to the very notion of evolution. How do we falsify the historical proposition that life has evolved? If evolution is "descent with modification," as Darwin so elegantly phrased it, a hierarchical array of organisms defined by nested sets of evolutionary novelties (modifications) *must* result. This is evolution's grand prediction: that all organisms descended from a common ancestor will display one coherent pattern of nested sets of resemblances. All forms of life have RNA, all eukaryotes discrete nuclei, all vertebrates backbones, and all mammals three inner ear bones. In addition to the properties unique to *Homo sapiens*, we also have general primate, mammalian, vertebrate, and eukaryotic features. Follow any other branch of life and you find the same pattern: nested sets of biochemical, anatomical, and behavioral characteristics. Thus the basic prediction of evolution is confirmed, though this is not the point. In principle, were we to find no order, we would have to reject the notion of genealogical relationships among organisms: the notion of evolution.

Of course, creationists see the same order in the biotic world and simply claim that the Creator made it that way. But this "what you see is what you get" notion makes no predictions about the structure of similarities interlinking the biota. The reason why the pages of *Science* are open to those who look at the effects of caffeine on rats is that the efforts of systematists (who have been among Popper's more ardent admirers in the realm of biology) hinge on predictivity: the closer the phylogenetic relationship of an experimental animal to man, the more similar its physiology is *likely* to be, and hence the more forceful the implications of the results will be to human medicine. By all criteria, both aspects of evolutionary study—pattern and process—are as scientific as any activity I can think of. The creationists will not win in court on the trumped-up charge that evolution is "secular humanism" and not science. But they *may* win in the more important arena of public opinion if they succeed (as they have to a remarkable degree thus far) in convincing our fellow citizens that science is just another authoritarian belief system, and that Americans, in the traditional sense of "fair play," should be allowed to "hear both sides."

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References and Notes

1. A more detailed consideration of the hypothetico-deductive method in evolutionary research can be found in N. Eldredge and J. Cracraft, *Phylogenetic Patterns and the Evolutionary Process* (Columbia Univ. Press, New York, 1980).

I give my compliments to William J. Broad for his recent News and Comment article on the evolutionist-creationist confrontation. His is the first article I have seen to point out that the principal issue at stake is one not of facts, but of philosophy. I believe, as Broad seems to suggest, that the philosophical question is how to distinguish between scientific and nonscientific methods of explanation. The creationists seem to under-

stand this when they assert that evolutionary theory is religious or that creationist theory is scientific. With all due respect for biologist Arthur Kornberg, astronomer Carl Sagan, and biophysicist Thomas H. Jukes, the successful defense of science will probably depend on philosophers of science, as Broad proposes, and possibly also on historians of science.

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. . . If methodological problems and doctrinal disputes add up to an undercutting of evolutionary facts, as creationist attorney Richard K. Turner claims, what about the creationists? Leaving aside the progressive creationists, the day-age creationists, the gap-theory creationists, the pre-Genesis gap-theory creationists, and others (*1*), the 6-day creationists by themselves encompass a spectrum of views, some departing considerably from the literal Genesis account. Some of these have been summarized by Morris (*2*). One of the disagreements concerns the number and kind of miracles in the creation model, a topic discussed further by Lammerts (*3*). While Morris is in favor of playing down the role of miracles, Lammerts insists there are a great many. Certainly incorporating miracles into explanatory hypotheses qualifies as a methodological oddity in a discipline that calls itself scientific creationism!

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References

1. H. M. Morris, Ed., *Scientific Creationism* (Creation-Life, San Diego, Calif., 1974), pp. 220–243.
2. ———, *Creation Res. Soc. Q.* **11**, 173 (1974).
3. W. E. Lammerts, *ibid.* **12**, 75 (1975).

. . . The evolutionists seem to be allowing themselves to be boxed in by accepting definitions stipulated by the creationists. One might dispute these definitions by making the following four points:

1) The minimum necessary to make a doctrine religious is that it asserts the existence of at least one supernatural deity. Evolution is thus no religious doctrine and the establishment clause remains inviolate when schools mandate its teaching.

2) It is impossible to teach all the different views that may be held on any point by different persons or groups. In any science it is appropriate to teach those views held by general consensus in the relevant competent scientific community, always provided that the views can be put in manageable form for students, and that the open-ended character of science is stressed.

3) There is no reason to hold that all theories properly described as scientific are predictive. A theory might well be oriented in one temporal direction for explanatory purposes, in this case the past, and still provide a scientific explanation in its domain. And if falsifiability were held to be the criterion for distinguishing scientific from nonscientific theories, it would not be too hard to devise tests for such a theory.

4) In any case, evolution can be considered a complex fact rather than a theory (*1*). What is in dispute among scientists is not the existence of the fact, but the mechanism through which evolution works.

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References

1. A. Montagu, *New York Times*, 17 March 1981, p. A16.

Same Name, Different Spelling

The 23 January issue of *Science* contains an article by R. Jeffrey Smith (News and Comment, p. 364) discussing the illegal transfer of sophisticated technology to the Eastern Bloc. On page 366 the author describes the activities of a certain Bryan Williamson, who is referred to as "a consulting engineer" "now with an electronics firm in England."

My name is Brian Williamson. Like the man in the article, I used to live in America and now live in England. I, also, am "a consulting engineer," and my company, Williamson Interface Ltd., is "an electronics firm in England." I earn my living consulting in the area of electrical and electronic engineering and have clients all over the world, especially in the United States. . . .

I know nothing of Bryan Williamson, and neither I nor any member of my firm has ever been engaged in the activities described in the article. . . .

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