BOOK REVIEWS

Ascent by Natural Selection

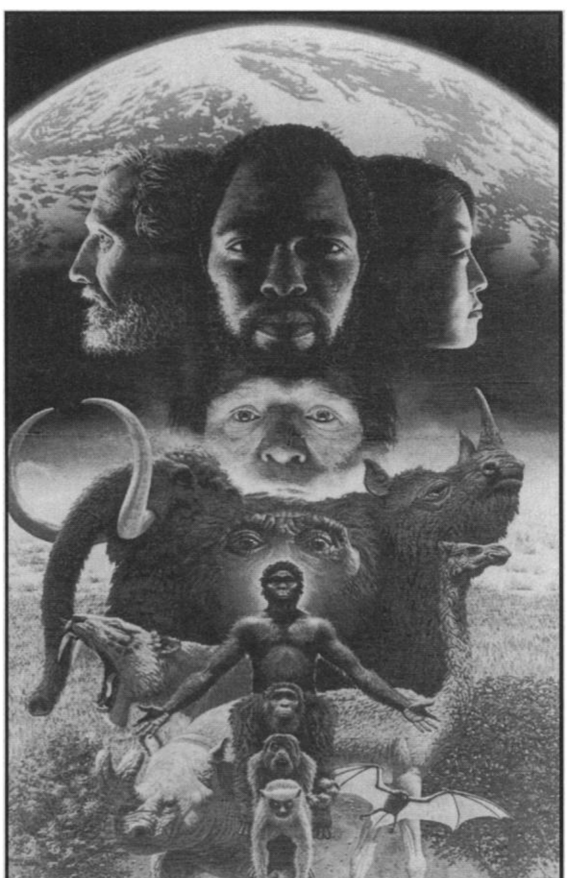
Monad to Man. The Concept of Progress in Evolutionary Biology. MICHAEL RUSE. Harvard University Press, Cambridge, MA, 1996. xii, 628 pp., illus. $49.95 or £33.50. ISBN 0-674-58220-9.

The process of evolution appears to be progressive. The earliest organisms were no more complex than today's bacteria; now their descendants include orchids, honeybees, dolphins, and human beings. But upon reflection the matter of progress becomes murky. Bacteria are simpler, but they surpass dolphins in their ability to synthesize all their components and obtain the energy they need from inorganic compounds. Some evolutionary lineages do not seem progressive at all: living bacteria are similar to their ancestors of three billion years ago. Moreover, many evolutionary lineages and more than 99.9% of all species that lived in the past have become extinct, which could hardly be considered progressive for those lineages and species.

The notion that living organisms can be classified in a hierarchy from lower to higher forms goes back to Aristotle and earlier. The creation of the world described in Genesis contains the explicit notion that some organisms are superior to others, with man at the climax. The image of a *scala naturae* or "ladder of life" rising from amoeba to man is present, implicitly or explicitly, in all preevolutionary biology. The theory of evolution added the dimension of time, or history. The ascendance from amoeba to man could now be seen as the result of a natural, progressive development through time from simple to gradually more complex and more diverse organisms.

But why should greater complexity or diversity be considered progress? One might favor longer persistence of kind, or greater number of individuals, or lesser dependence on other organisms as criteria of progressiveness. By any of these three criteria, bacteria are among the most progressive organisms. The point I am leading to is that in order to decide which organisms are more or less progressive, we need first to settle the matter of what we mean by the term. And I fail to see how this could be done by studying organisms or analyzing the evolutionary process. It seems rather to me that deciding upon a criterion of progress is a matter of personal preference; or, to put it more formally, the concept of "progress" implies value judgments and thus transcends the standard modes of scientific discourse. I do not mean to deny that we can use scientific discourse to decide whether or not one organism is more complex than another or to ascertain whether a certain species is more numerous or more widespread than another. But investigation of these matters will in no way settle the issue of which organism is more progressive, unless we have first decided by which standard we will measure progress; for this decision science is hopelessly incompetent.

"Progress," writes Michael Ruse in *Monad to Man*, "is a modern (that is, post-medieval) notion." As he recounts it, "belief in the possibility of ongoing moral and social improvement—in short, a belief in Progress—arose in the eighteenth and nineteenth centuries" (p. 23). Ruse tells us of Condorcet, Voltaire, and other Enlightenment French *philosophes*, who propounded that knowledge acquired by the powers of human reason would dispel superstition and bring about material benefits, as well as moral and social progress. In Britain, Adam Smith proclaimed that the doctrine of self-interest would usher in universal economic and social benefits. The German idealist philosophers, from Kant to Hegel, believed in the unstoppable forward thrust generated by the powers of reason. Omitted by Ruse is that the Founding Fathers of the United States, from Benjamin Franklin to Thomas Jefferson, saw the birth of the American Republic as the beginning of a new era of material prosperity, equality, and justice for all.



"Humans at the top of the 'Tower of Time' " as displayed in the Smithsonian Institution, a representation "touchingly politically correct in the careful depiction of the evolutionary triumph of a black man, an oriental woman, and an aged white male." [From *Monad to Man*; Smithsonian Press]

Ruse does not long delve into the Enlightenment's belief in human progress, nor does he pretend that he has much to say that is new or profound about the matter. The point that engages his sustained effort is that the Enlightenment's philosophy of progress was transferred wholesale into the biology of the time, so that emerging ideas about biological evolution became permeated from the start by a belief in progress. The attributes of knowledge, economic sucess, social welfare, and the like used for assessing human progress were translated into biological attributes such as complexity of organization, adaptation to the environment, and specialization. The connection between belief in progress and biological theorizing is, for Ruse, fundamental for understanding the history of evolutionary theory. He seeks to prove this connection by means of a three-pronged test that he repeats at key historical points. What needs to be demonstrated in each case, he says, is that (i) "biological theorizing has in fact been influenced by the idea of Progress"; (ii) the biologists "consciously or unconsciously leaned on the idea of Progress, or, conversely, hoped to support the idea indirectly through the organic world"; and (iii) "the biology outstrips the evidence" (pp. 39–40). With this resolve, Ruse proceeds to probe evolutionary biology's history starting in mid-18th century.

Ruse's first set of biological worthies includes the Swiss naturalist Charles Bonnet (1720–1793); the French Jean-Baptiste

Robinet (1735–1820), Buffon (1707–1788), and, at great extent, Lamarck (1744–1829); the British James Burnett (1714–1799) and Erasmus Darwin (1731–1806), Charles's redoubtable grandfather; and the German Lorenz Oken (1779–1851). Then he proceeds to biologists who dominate the first half of the 19th century: Cuvier (1769–1832) and Etienne Geoffroy Saint-Hilaire (1772–1844) in France; Robert Grant (1793–1874), Robert Chambers (1802–1871), and Richard Owen (1804–1892) in Britain; von Baer (1792–1876) in Germany; and the Swiss-American Louis Agassiz (1807–1873). Owen and Agassiz were ardent anti-evolutionists. Ruse skillfully shows how the temper of the times, most particularly optimism about cultural progress, pervaded these early biologists' highly speculative theorizing. Whether his application of the three-pronged test amounts to a "proof" of the case, as he would have it, is for me uncertain and of little consequence.

The study of biological evolution becomes seriously scientific with Charles Darwin's (1809–1882) publication of *The Origin of Species* (1859). Darwin systematically accumulated evidence (bringing in artificial selection, biogeography, and other considerations that previously had received scant or no attention) making a strong case for the evolutionary origin of organisms; and, of greatest import, he discovered natural selection, the causal process accounting for evolutionary change and diversification. The evolution of organisms became accepted by professional biologists and the subject of much public discussion.

Yet, as Ruse sagaciously discerns, the study of evolution remained a matter for amateur, rather than professional, investigations; it was not until well into the 20th century that it became accepted as a proper subject for academic research and was incorporated into the curriculum. The journal *Evolution*, the first periodical dedicated to the subject, first appeared in 1947. It would be the 1960s before courses dedicated to evolution became common at academic institutions and departments of "evolutionary biology" or "ecology and evolution" started to proliferate. "Nothing in biology makes sense except in the light of evolution," wrote in 1973 the great evolutionist Theodosius Dobzhansky. Yes, would say Ruse, but it has taken a full century and more for biologists to notice it.

Thomas H. Huxley (1825–1895), who famously battled Bishop Wilberforce at Oxford, is emblematic of the schism in the split that existed between the subjects he taught to university students or the research he pursued professionally, mostly physiology and anatomy, and the evolutionary theorizing of his popular writings and speeches. Ruse also expounds Alfred Russel Wallace (1823–1913), co-discoverer of natural selection, and other late-19th- and early-20th-century evolutionists. He insightfully scrutinizes at length the mathematical evolutionists R. A. Fisher, J. B. S. Haldane, and Sewall Wright, whose major contributions started in the 1920s, and the great biological theorists Theodosius Dobzhansky, George Simpson, Ernst Mayr, and G. Ledyard Stebbins, who between 1937 and 1950 completed the integration of evolution with genetics, paleontology, systematics, and botany. The exertions of even these greatest of all evolutionists are tainted, Ruse concludes, by a belief in progress, however nuanced. Ruse then brings the story to the present and to those of us still in the trenches pursuing evolutionary research with theory and experiment. He sees that the ideology of progress subtly persists, even as this is explicitly denied by evolutionists. He proclaims that "we should not expect progressionism to disappear from evolutionary theory anytime soon . . . , however professional and mature evolutionary studies become" (p. 539). By this time and on this point, Ruse and I have parted company.

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Comparative Volcanology

Volcanoes of the Solar System. CHARLES FRANKEL. Cambridge University Press, New York, 1996. xiv, 232 pp., illus. $70 or £40, ISBN 0-521-47201-6; paper, $24.95 or £14.95, ISBN 0-521-47770-0.

Volcano Instability on the Earth and Other Planets. W. J. McGUIRE, A. P. JONES, and J. NEUBERG, Eds. Geological Society, Bath, UK, 1996 (U.S. distributor, AAPG Bookstore, Tulsa, OK). viii, 388 pp., illus. $125 or £75; to society members, $58 or £35. ISBN 1-897799-60-8. Geological Society Special Publication no. 110. Based on a conference, May 1994.

Volcanoes and the dynamic processes by which they are formed are inherently intriguing topics in Earth and planetary science, in part because of the many remaining mysteries associated with them. Indeed, recent discoveries suggest that volcanism is manifested in a variety of unique forms throughout the solar system, as well as on the terrestrial ocean floor. Two newly published books on this subject are considered here, the first an introductory survey, the other a collection of state-of-the-art research papers thematically linked by one of the most compelling new paradigms of volcano evolution. Each offers something for the reader interested in volcanoes, whether it be a synopsis of eruptions on the Jovian satellite Io or a treatment of new techniques for monitoring the deformation patterns on historically unstable terrestrial volcanoes.

In his solar-system–wide survey of volcanoes and the processes by which they are formed Charles Frankel addresses a broad range of readers without many of the esoteric details that lie behind the theories presented. Frankel's treatment is synoptic and includes some captivating images of newly discovered volcanic landforms on Venus as well as from the outer solar system. It is assumed that the reader has a rudimentary knowledge of geological principles. The underlying theme is that of comparative planetary volcanology. The text presents a very understandable case for comparing volcanoes across all of the rocky planets of the solar system by employing several interesting analogies. Indeed, the author captures many of the newly developed paradigms that have emerged as a result of global reconnaissance by spacecraft of bodies such as the moon, Venus, Mars, and Io. While excellent treatments of this subject have been published in the past few years (for example, P. W. Francis's *Volcanoes: A Planetary Perspective*, Oxford Univ. Press, 1993), *Volcanoes of the Solar System* seeks to captivate the reader by providing a high-level review in the form of an inventory. Indeed, the book reads at times rather like a voyager's guide to planetary volcanoes. On this basis, the book succeeds and offers an enticing, albeit uneven, presentation of how volcanism is manifested in the solar system.

It is unfortunate, however, that Frankel's treatment of such an inherently interesting subject is flawed by inattention to detail and other limitations. For example, early in the book a classic image of Earth as viewed by Apollo 17 is incorrectly oriented with north to the left. In addition, Frankel misrepresents one of the most significant remote-sensing discoveries of the past 20 years—the dramatic realization of ocean floor topography from geodetic-precision spaceborne ocean radar altimeters—by attributing these results to laser altimetry, a method only recently employed for the first time in Earth orbit. He also misrepresents the current state of topographic knowledge of the terrestrial seafloor in suggesting that we now have a better global dataset on the physiography of the surface of Venus and Mars than we do for terrestrial ocean basins. Global images of the surfaces of the Moon, Mars, and Venus are available with spatial resolutions that average 100 to 200 meters, but such data are in no way equivalent to global topographic datasets that quantify the relief characteristics of the surfaces of any of the silicate planets. Indeed, global