

BOOK REVIEW

Time's Arrow Time's Cycle—Myth and Metaphor in the Discovery of Geological Time. Stephen Jay Gould. 1987. Harvard University Press, Cambridge, MA \$17.50.

According to the author, this book was written to explore the role of metaphor in the formulation and testing of scientific theories combining the directionality of narrative history (time's arrow) and the unchanging, immanent laws of nature (time's cycle). The discovery and development of the concept of "deep time," together with the misrepresentation ("cardboard history") of the contributions of three historical figures to it, form the bulk of the story.

Thomas Burnet's *The Sacred Theory of the Earth* (1680-1690), particularly its frontispiece delineating time's cycle (an eternal divine presence) and time's arrow (historical progression), is identified by Gould as anything but "biblical idolatry that reined the progress of science," according to textbook accounts. It is, rather, a rational explanation employing narrative history and immanent laws.

By comparison, James Hutton's *Theory of the Earth* (1795) and Charles Lyell's *Principles of Geology* (1830-1833) restrict their observations to geology and omit the essential metaphorical value of theological, linguistic, archeological, and historical contributions.

Gould rejects the supposed dichotomy of time's arrow *versus* time's cycle and refers to the evolution-creation and science-religion antitheses as parallel misreadings of history. Burnet's derivation of earth history and deep time from scriptural metaphor and natural history is preferred to Hutton's truncated concept of the earth as a machine without history having "no vestige of a beginning, — no prospect of an end" and being its own Aristotelian efficient cause. Gould also rejects the traditional portrayal of Hutton as a purely inductive scientist and claims that his methodology centers on arguments from final causality (perfection) and not from historical progression. Although Hutton had discovered deep time, he did not appreciate its historical dimension, time's arrow.

It remained for Charles Darwin to discover time's arrow as contingent history, the undercurrent of biological evolution. Gould's reflections on natural history in his

Ever Since Darwin, 'The Panda's Thumb, Hen's Teeth and Horse's Toes, and The Flamingo's Smile provide abundant examples of oddities and imperfections in historical descent that cross the grain of Hutton's final causality and raise the hackles of many scriptural literalists who wish to see nothing but immediate perfection in the earth's biota. In this context, Gould identifies concepts of biologists who "... classify organisms by computer without judging the different historical value of characters..." with Hutton's myopic view of earth history. Gould thus dedicates his book to "... a different view of this discrepancy: time's cycle cannot, in principle, encompass a complex history that bears irreducible signs of time's arrow."

Lyell's image in "cardboard history," according to Gould, is also false. Viewing all geological phenomena as based upon uniformitarianism, Lyell used verbal skills, not empirical evidence, to support his contentions and make caricatures of catastrophists such as Cuvier, who was really a product of the Enlightenment, not a dogmatic theologian. Since Lyell emphasized uniformity of law, process, rate (gradualism), and state (non-progressionism), he actually emphasized time's cycle at the expense of time's arrow. It was Darwin's later influence on Lyell that led him to abandon time's exclusive cycle for life's history. Lyell then became an evolutionist, albeit without accepting the concept of natural selection.

If Gould seems to be eccentrically harsh in his criticisms of historians of Hutton and Lyell, his purpose is reflected in *The Mismeasure of Man*: "Scientists do not debunk only to cleanse and purge. They refute older ideas *in the light of* a different view about the nature of things." Gould does an admirable job of integrating concepts from different intellectual streams and pointing out errors of interpretation in history. For him "... time's arrow is the intelligibility of distinct and irreversible events, while time's cycle is the intelligibility of timeless order and lawlike structure. We must have both." Let us hope that time's arrow will permit Gould to continue writing such intellectually stimulating and thoroughly enjoyable essays.

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BOOK REVIEW

The International Encyclopedia of Astronomy. Edited by Patrick Moore. October 1987. Orion Books, 225 Park Avenue South, New York, New York. 464 p. \$40 cloth.

This book, like any encyclopedia, is a collection of facts, definitions, and descriptions of subjects related to astronomy. It contains more than 2,500 entries and is lavishly illustrated with photographs and drawings, many of which are in color. In addition, Patrick Moore has seen fit to include seven essays by noted astronomers on some of the more controversial subjects in astronomy. Slightly over a hundred astronomers were asked to contribute to the entries in this volume and presumably the accuracy rests with the contributor insofar as they are identified. Presumably, the book is to serve as a "first look" at a subject, whetting the reader's appetite in the hope that he will go on to learn more about the subject. This it does well. Unfortunately, there is no bibliography that would enable readers to satisfy their hunger for additional knowledge or serve to verify the accuracy of the necessarily abbreviated account.

By and large the essays are well written, but rather uneven in the amount of information they convey. However, they are strewn throughout the book, often inserted in the middle of some other discussion to the detriment of both. I found the essay on Superclusters by de Vaucouleurs to be informative and beautifully illustrated, but destined to become obsolete quickly due to the activity in the field. On the other hand, the essay on Pulsars by Hewish is chatty and somewhat self-serving and rather thin on content. The quality of the entries is uneven and collectively tends to provide an English view of astronomy. For example, Henry Norris Russell, who is arguably the greatest American astronomer of the twentieth century, is accorded a short paragraph wherein he is noted for his incorrect speculation on the evolution of the stars. Nothing is said about his landmark contribution to the understanding of eclipsing binary stars upon which most of the quantitative knowledge of contemporary astrophysics rests. On the other hand, the Seventh Astronomer royal, Sir George Biddle Airy, is accorded a full column where we learn of his biography and personality, but little of his contribution to either astronomy or mathematics. This is by no means an isolated incident. Under "Struve" we learn something about Fredrich

Georg Wihelm whose contributions to astronomy are of historical interest only, but Otto Struve, who had a tremendous influence on twentieth century stellar astronomy, is not even mentioned. To include (with picture) such relative astronomical nonentities as Sir William Henry Mahoney Christie (eighth Astronomer Royal) and leave out Otto Struve clearly shows that the primary purpose of this book is not to catalogue the major topics of astronomy.

A more general perusal of the book supports this view when one notices the heavy emphasis on space exploration. Certainly the space programs of the Soviet Union and the United States have provided the world with a plethora of beautiful pictures and satellite astronomy has advanced our knowledge of the solar system immeasurably. But the manned programs of both countries have contributed little to the development of astronomy and to find entries (again with pictures) of Alan Shepard and Valentina Tereshkova in a book purporting to be about astronomy boggles the mind. Such a lack of focus does a disservice to both the astronauts, the cosmonauts, and astronomy by not distinguishing among them.

It is irresistible when encountering a book like this to look up some topic where one has some expertise to see what a contributor has done to it. I have spent some time studying a baffling object known as SS433. This, along with "SS Cygni" stars, is to be found right after "Sputnik" and before "Stadius." The entry is rather long for this book, but the numbers on the artist's conception disagree with those in the text (the text is roughly correct). However, the entry is rather unenlightening and really does little to inform the reader why this is considered such a remarkable and puzzling object.

The editor gives a disclaimer in the beginning of the book that there has been no attempt to reconcile different views from different contributors. While this may be understandable, it leads to some confusion where apparently factual information will be different in different sections of the book. If one is looking for a splashy book for one's coffee table that will beguile and impress the casual guest, this is the book for you. However, if you want a true encyclopedia of astronomy, I suggest you look elsewhere.

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Due to recent numbers of *The Ohio Journal of Science* being special issues (Symposium on Biotechnology-Vol. 87 No. 5 and Field Guides and Related Papers for the North-Central Section, Geological Society of America-Vol. 88, No. 1), we accumulated a large number of accepted papers. We thank those authors for their patience. We are now able to once again assure publication of accepted manuscripts within seven to eight months.

The Editor