Book Reviews

Lovell's Gregynog Lectures and Project Ozma

The Exploration of Outer Space. Sir Bernard Lovell. Harper and Row, New York, 1962. viii + 87 pp. Illus. $3.

Sir Bernard Lovell, director of the Jodrell Bank Experimental Station (Manchester, England), which operates the world's largest radio telescope (a paraboloid antenna with an aperture of 250 feet), was invited to give the four Gregynog lectures at the University of Wales in October 1961.

This book, which is largely based on the lectures, is extremely well written, and its first four chapters contain much useful information on optical and radio astronomy. These chapters are: "The techniques of investigation," "The solar system," "The structure of the universe," and "The origin and evolution of the universe." However, much of the information duplicates what can be found in many other books and articles. Is it really necessary or desirable to glut the market with so much essentially identical material?

The fifth chapter, entitled "Some reflections on ethics in the cosmos," was not one of the lectures, but had appeared previously, in a modified form, in the *Sunday Times* (London) and in the New York *Times*. In this chapter Lovell states that during the summer of 1961 he had become "increasingly obsessed with the dangers of certain developments in space research" and perhaps also with the danger of "the big bomb." At the present time Lovell feels more optimistic about the world situation. His reason seems to be this—"the tremendous accomplishment of man in science" has induced mankind to pour so much money into activities like the "man on the moon" project, the Venus probe and the Mars shot that virtually no nation can now afford the expense of waging nuclear war."

But his argument is only partly convincing (man *may* become more ethical as a result of those activities). The power to order a nuclear holocaust now rests with the top statesmen of various nations. Some of them are highly educated persons whose ethics would prevent them, except in an emergency, from causing a world disaster. But I have never heard of either the education or the ethics of Stalin. And, although Hitler caused a *Götterdämmerung* of his friends under the flagstones of Berlin, that was not what he wanted. What he really wanted, and his wish was often expressed in his speeches, was to take with him to the grave all that remained of Germany in defeat together with as many of his enemies as possible!

In this connection Lovell also discusses the possibility of life on other worlds, and he reproduces Cocconi's letter to him, which contained Morrison and Cocconi's suggestion that the Jodrell radio telescope be used to search for intelligent radio messages from space. Lovell, as director of Jodrell, decided against undertaking the experiment—and I agree with every word he says about it.

But when I was director of the American National Radio Astronomy Observatory (Green Bank, West Virginia) and had the power to stop what has become known as Project Ozma, I did not do so. Since I have recently retired it is appropriate to explain why I decided to let the project continue. There were essentially four reasons: (i) The project was in progress when I went to Green Bank. (ii) To discourage Frank Drake, the exceptionally able scientist who made the observations, would have been a tragedy. (iii) The project created tremendous popular interest and induced the Nobel prizewinner Melvin Calvin and many other competent scientists to work on problems of life. (iv) I hoped that the search for intelligent radio messages might lead to the discovery of real "radio stars" known as flare stars. On the surface of the sun, radio flares and optical flares occur coincidentally. The sun and other solar type stars are really flare stars, and the radio flares might be observable.

Lovell had a much larger telescope and would have used a longer wave length—both to his advantage. But he had no optical observatory nearby. And if the flares exist, they should be observed in both ways for positive identification. My computations showed that the Green Bank instrument was only marginal, but luck, perhaps great luck, might have led to a very important discovery. Actually Lovell has also observed several flare stars. But, because he could not obtain optical confirmations, he has published next to nothing about this work. In the February 1963 issue of *Sky and Telescope* several Australian radio and optical astronomers report that radio flares lasting only a few minutes have probably been found. It will be interesting to see whether these results are confirmed.

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Russian Translation

Theory of Ground Water Movement. P. Ya. Polubarinova-Kochina. Translated from the Russian edition by J. M. Roger de Wiest. Princeton University Press, Princeton, N.J., 1962. xix + 613 pp. Illus. $10.

The mathematical description of various ground-water flow patterns created in response to different boundary conditions is this book's chief purpose. Some space, however, is given to such topics as soil structure, porosity, capillary phenomena, and the construction of laboratory models. Although practical examples are chosen from civil engineering rather than petroleum engineering, the general orientation and level of the mathematics used are similar to those in M. Muskat's book, *Flow of Homogeneous Fluids through Porous Media.* Unlike Muskat's book, however, considerable emphasis is given to problems of unsteady flow.

A current fad among scientists in the United States is to decry our ignorance of Russian research. This is certainly justified in the case of ground-water hydraulics. Nevertheless, it is interesting to note that Polubarinova-Kochina's book also reflects some provincialism. Of more than 300 literature citations, less than 10 percent are of non-Russian origin, and most of these are such well-known classics as Prandl's work on fluid mechanics and Carslaw and Jaeger's work on heat conduction. There are no references to current literature published in non-Russian journals. Despite this limitation, the book is a highly important reference work in which the different approaches used in familiar problems together with a number of unique solutions to new problems will be of great interest to ground-water specialists in this country.

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Dana's System

The System of Mineralogy of James Dwight Dana and Edward Salisbury Dana. Yale University, 1837–1892. vol. 3, *Silica Materials.* Revised and enlarged by Clifford Frondel. Wiley, New York, ed. 7, 1962. xii + 334 pp. Illus. $7.95.

The System of Mineralogy of James Dwight Dana, first published in 1837, has had a long and deservedly illustrious career. The volume, a foremost authoritative reference source throughout its long history, was one of the more famous products of American science during the 19th century. Clifford Frondel of Harvard, co-author of volumes 1 and 2 of the seventh edition (with the late Charles Palache and Henry Berman), renders a further service to mineralogy as the sole author of volume 3.

The great proliferation of mineralogical studies after the appearance of the fifth edition (1868), which were precipitated by the introduction of sophisticated optical measurements to mineralogy, led to the rigorous and critical system of condensation and abbreviation devised by Edward Salisbury Dana, the author of the sixth edition (1892). The format of that justly famous edition had, necessarily, to be changed somewhat for this edition, because the intervening years witnessed an even more striking period of discovery and understanding that resulted from the increasingly widespread use of x-ray diffraction. The volume of data on minerals had grown so large by the time work commenced on the seventh edition that it was decided to publish the system in three volumes. Volume 1, *Elements, Sulfides, Sulfosalts, Oxides*, appeared in 1944, and volume 2, *Halides, Nitrates, Borates, Carbonates, Sulfates, Phosphates, Arsenates, Tungstates, Molybdates*, in 1951. The initial plan was to cover both silica and silicate minerals in volume 3, but the volume was restricted to the silica minerals alone. Two additional volumes are now proposed to cover the silicates, thus bringing this edition to a total of five volumes.

Despite the crystal chemical classification that, in this edition, replaces the older chemical system of the sixth edition, the sixth edition's critical selection of referable topics and its convenient condensation of data were retained as guiding principles in volumes 1 and 2. With the advantage of a more restricted range of compounds to discuss, Frondel has followed a stated intent to produce an "entirely rewritten and greatly enlarged" volume 3 by rejecting the brevity of the previous volumes. He has produced an interesting but somewhat unbalanced volume that retains the necessary dictionary arrangement of information but which also provides extensive discussions of the vast amount of work done on morphological variations, twinning, crystal physics, compositional variations, and varietal forms of quartz. Two hundred and fifty pages are devoted to quartz alone, a remarkable increase from the ten pages of the sixth edition; this reflects not only a great expansion of the topics selected for discussion, but also the vast amount of work done on quartz, much of it stemming from the widespread use of quartz oscillator plates.

The vital role of x-ray diffraction in mineralogy is emphasized more strongly than in volumes 1 and 2, and complete x-ray powder diffraction tables are included for the first time. A complete list of the interplanar spacings for quartz, and of their diffraction angles for Cu, Co, Fe, and Cr radiations, indicates the widespread use of quartz as an internal measurement standard in x-ray diffraction studies. It is unfortunate that the necessary thermal expansion data were not included so that this valuable table could be equally useful at temperatures other than 25°C.

Volume 3 is easy and interesting reading that will appeal to many scientists as well as to professional mineralogists. Although the extreme emphasis given to quartz results in imbalance and its length reduces its usefulness as a ready reference source, volume 3 is an extensive and impressive compilation that must be on the bookshelf of every serious mineralogist.

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British Scientists

Charles Lyell (*British Men of Science*, vol. 1. Sir Gavin de Beer, General Editor). Sir Edward Bailey. Doubleday, Garden City, N.Y., 1963. x + 214 pp. Illus. $3.95.

Sir Charles Lyell wrote the best and still the most rewarding of geological textbooks, *Principles of Geology* (3 vols., 1830 to 1833). Now Sir Edward Bailey, one of the best known of British geologists, has written a thoughtful and entertaining biography of Lyell that puts the great man in context, with respect to Lamarck, Hutton, Darwin, Chambers, Agassiz, and others.

Lyell also wrote *Travels in North America* (1845), *A Second Visit to the United States of North America* (1849), and *The Geological Evidences of the Antiquity of Man* (1863), but the eleven editions of *Principles*, the final one in 1872, were his glory. Darwin took the first edition with him on the "Beagle" and became one of the thousands caught by its spell and educated by its thoroughness and clarity.

Lyell's marshalling of the evidence for the enormous length of geologic time profoundly affected Darwin, but Lyell himself was a reluctant organic evolutionist. Bailey makes clear Lyell's early coolness toward Lamarck and the slowness with which he accepted Darwin's evidence for evolution. Lyell, who was born near the Highland Border, was one of the first to acclaim Agassiz's recognition, in 1840, of the effects of Pleistocene glaciers and glacier-dammed lakes in and near the Highlands. His fellow members of the Geological Society of London were violently hostile and so shook his first confidence that he became a partial doubter himself and helped hold back for 20 years the recognition by Britons