Cosmology without Tears

The Mystery of the Expanding Universe. William Bonnor. Macmillan, New York, 1964. xii + 212 pp. Illus. $7.50.

It is rare indeed that a publisher's blurb accurately describes the work it advertises. But in this case, "humorous, caustic and illuminating" perfectly characterize William Bonnor's book. One might also add that his exposition is a model of lucidity, is always exact, and is as simple as the complex subject of cosmological theory permits. Though the work is intended for the intelligent layman, there is hardly a chapter which the professional cosmologist will not find instructive.

A sketch of the observational data occupies the first five chapters and, in these, Bonnor's masterly analysis, in simple terms, of the notion of distance, and of the many pitfalls that are contained in this notion, is particularly noteworthy. The next five chapters deal with the models of the universe which are deduced from general relativity. Here a refreshing departure from tradition is made. Instead of concentrating on the Einstein and de Sitter universes, neither of which fits the observations, Bonnor begins with three models that contain both matter and motion. These are the models derived from the assumption that the cosmical constant is zero. He is particularly good on the initial singular state—the Big Bang—from which the expansion in these models begins. He explains how this condition is a result of the oversimplification of the physical situation inherent in the models and how dangerous it is to identify the singular state with an act of creation carried out by God. Models with a positive cosmical constant are also described because Bonnor believes that the presence of such a constant would account for the expansion through a cosmic repulsion. He does not refer to models with a negative cosmical constant which, in my own opinion, would explain the retardation of the expansion suggested by the data obtained in the last ten years. Gödel's "rotating" model of the universe is given a most illuminating chapter to itself. Finally, an analysis of the steady-state theory leads to the conclusion that it is a phenomenological scheme, perhaps capable of describing the expansion phenomenon, but otherwise devoid of a proper theoretical foundation. In the last two chapters Bonnor summarizes the position in the light of Baum's optical data and of the radio astronomical observations made by Ryle and others. Bonnor comes out in favor of some one of the general relativity models, and he thinks that the steady-state theory has a rather doubtful future in front of it.

A reviewer ought to find something to criticize in a book, if only to show that he has read it. I have had some difficulty in finding anything and can only point to one or two matters of detail. Bonnor is a mathematician and, as he says himself, primarily a theoretician. I therefore read with surprise (p. 129) that, with a nonzero cosmical constant, the "problem [of solving Einstein's equations] becomes preposterously difficult." In fact, the increase of difficulty is trifling, at least in the cosmological problem. An elliptic integral of the first kind has to be dealt with instead of elementary integrals that lead to trigonometric or hyperbolic functions. The explanation of Bonnor's statement is not to be found in the supposition that I am a better mathematician than he is. For he implies (p. 170) that he can follow Sciama's mathematical treatment of the formation of galaxies in the steady-state theory, a piece of analysis that has hitherto entirely defeated me.

A theoretician may perhaps be allowed to lay less emphasis on observation than on theory. It is, however, unfortunate that Bonnor writes of Baade's 1952 revision of the cosmical distance scale (p. 33) as the correction of a "mistake" made by previous observers. An error in algebra is suggested, or at least an obvious misinterpretation of the available data. In fact Baade's revision was due to the acquisition of new data that were not available to his predecessors. As I read the story, it was the realization that Cepheids fell into two classes (Populations I and II), rather than the correction of errors in statistical parallaxes, that produced the change. The revision of the distance-scale constitutes an example of the fact that, as knowledge increases, conclusions have to be altered. It is also unfortunate that Bonnor lays so much stress on Baum's observations, compared with Sandage's photographic data, in the velocity-distance problem. Baum has never published a detailed account of his methods or of his data, particularly with respect to the crucial apparent magnitudes he finds. All that has appeared is a small-scale graph or two of his results, accompanied by statements of the conclusions he draws from the unpublished observations. I am said to consider that it is "improper" to assume the existence of unobserved and unobservable matter in the universe (p. 44). The average density quoted on page 203 is, I would say, at least 40 and probably 100 times too high. It would mean that astronomers have so far only identified matter, either luminous or nonluminous, to the extent of between 1 and 3 percent of what is there. The presence of the remainder is needed to force agreement with one of the simple models of the universe. I can see little difference between this procedure and the introduction of God to account for the singular state to which Bonnor objects in chapter 8.

These are, however, criticisms of minor details. Bonnor's book should be, I believe, required reading on the part of all students of cosmology. Relativistic cosmology has long needed a brilliant popularization to serve as an antidote to the equally brilliant popularizations of the supporters of the steady-state theory. Bonnor has now filled that need.

G. C. McVittie
University of Illinois Observatory, Urbana

Geology

Determination des Mineraux des Roches au Microscope Polarisant. Marcel Roubault and others. Editions Lamarre-Poinat, Paris, 1963. 365 pp. Illus. Plates. F. 48.50.

Twenty-five years ago Roubault, the senior author, collaborated with Leon Bertrand in writing an introductory textbook on the polarizing microscope, but this is not a revision of his earlier volume. Roubault, with his collaborators, has produced an entirely new text, which is divided into three parts. In part 1 (98 pages), the polarizing microscope is described and its use discussed. This is followed by a rather clear discussion of symmetry and crystals. Crystallogy is explained along with the necessary notations. In addition to the Miller indices we find those of Haüy-Lévy given, and both are used throughout the book. The treatment of optical crystallography provides a fair amount of detail on the various optical properties of crystals and how to recognize them.