Gifford Lectures

The Relevance of Science: Creation and Cosmogony. Gifford Lectures, 1959 and 1960. C. F. von Weizsäcker. Harper and Row, New York, 1964. 102 pp. $5.

This is a philosophy of science highly subversive of the Cult of Progress. The method of this discourse is to trace the history of Western thought through its concepts of creation and cosmogony, an appropriate subject for an astrophysicist of von Weizsäcker's stature. After tracing and interpreting the historical cosmogonies, he concludes that today's faith in science plays the role of a dominating religion, differing little in its mythical ("theoretical") components from the universal myths of the past.

The central concepts of modern science are historical extensions of the Judeo-Christian concept of a single God (that orders the universe) and of the Platonist concepts of unity, mind, and "pure idea." The science myth has considerable relevance to modern life, although the substantive basis upon which relevance is claimed (the authority and objectivity of the scientific method) is neither unique nor necessarily relevant to questions of political and social judgment. The uncertainties and mysteries have not been fundamentally altered, nor has the place of human desires and values been diminished. Herein lies the basic ambiguity and ambivalence of science.

In a prose of singular line and clarity, the author assaults some of the precious assumptions of scientific pride. The scientific method is seen as employed with as much (or as little) rigor under the rubric of other universal myths as under the rubric of science. What has basically changed is the underlying technology and those social institutions that rise and fall as mankind continually adapts his relations to nature through his artifacts and tools. Whatever the rationalizing myth of an epoch, man finds the possible ways of doing and making more or less pragmatically. The mental images and symbols of an epoch derive from a metaphysical commitment, which, to the extent that man has power to predict or control his environment (a power dependent on technology), is modified by pragmatic necessity.

Modern science claims the credit and the credibility bestowed upon it by the process of technological accretion and complication, and its chief relevance may lie in its religious component. "Scientism" comprises both the ideology of a new priestly caste (the technologist and expert) and the trust that modern technology induces in believers. The myth is evidenced by the ubiquity with which the word "science" is claimed for all manner of human activity. "Scientism" may be held in contempt by many scientists but nonetheless it provides the conceptual framework in which are structured the thoughts of today's knowledgeable men.

This incisive tome, which contains the Gifford Lectures delivered at the University of Glasgow in 1959 and 1960, represents a reduction of science to sociology, similar in many respects to the reduction of religion in the theology of Paul Tillich. The contemporary scientist who knows himself in the presence of mystery should find much to admire here; the scientist who feels too great a confidence in his theories should find this book an exercise in self-examination.

H. L. NIEBURG
Department of Political Science, University of Wisconsin, Milwaukee

A Collection of Reprints

Free-Electron Theory of Conjugated Molecules: A Source Book. Papers of the Chicago Group, 1949–1961. J. R. Platt and others. Wiley, New York, 1964. Unpaged. Illus. Paper, $2.95; cloth, $4.95.

This book, which has been published jointly with a closely related, companion volume, *Systematics of the Electronic Spectra of Conjugated Molecules*, consists of 21 reprints of papers written by one-time members of the Department of Physics or the Laboratory of Molecular Spectra and Structure at the University of Chicago. They are preceded by a one-page preface by J. R. Platt, the only one of the authors who has not changed his institutional affiliation.

First developed by Sommerfeld as a theory for metals in 1928, the free-electron approach came into its own as a powerful tool in quantum chemistry about 20 years later. At that time several researchers, notably N. S. Bayliss, W. T. Simpson, and H. Kuhn, working almost simultaneously on three different continents, showed how this model gave good predictions of the spectra of long-chain polyenes. It was also during this period that the "Chicago Group" started its pioneering researches which, from the brilliant intuitions of Platt to the mathematical wizardry of Ruedenberg, form the subject of this reprint collection. Throughout the 12-year period involved, the group not only showed how the free-electron theory could be used to interpret a wealth of experimental data on conjugated molecules, but it also analyzed the close mathematical relations between this approach and other forms, notably the LCAO approach, of the molecular orbital method. The scientific merit of the contents of these papers hardly needs any further emphasis.

I am familiar with several volumes of "Collected Papers" of distinguished scientists, usually (if not always) printed posthumously. In 1963, W. A. Benjamin, Inc., published Robert G. Parr's *Quantum Theory of Molecular Electronic Structure*, in which 125 pages of "lectures" were supplemented with 340 pages of reprints. To the best of my knowledge, the "source books" now brought out by John Wiley and Sons, Inc., are the first in our field which consist *exclusively* of a set of reprints. The success of this venture, which may literally flood the market with similar publications, depends in part on economical and practical factors that are hard to predict. Eighteen out of the 21 papers (177 pp.) which constitute the volume under review, appeared originally in the *Journal of Chemical Physics*, a periodical that is readily accessible. It remains to be seen whether researchers in the field will prefer to stock their bookshelves with "source books" or their notebooks and file cabinets with reprints and photocopies.

To quote from Platt's preface, the free-electron-network model has been established as "the most fruitful and, in fact, the only natural way of conceptually grasping LCAO wave functions in conjugated systems. It is therefore a useful teaching device and a valuable subject of study for the beginner and the advanced chemist alike. Moreover, it permits a number of interesting problems to be solved quantitatively even by first-year chemistry students." These remarks strongly sug-

gest possible uses for this source book as a teaching aid or for use by the student who is studying on his own. I sincerely hope to see the day when I can submit these reprints, or any other comparable set of research papers, as a reading assignment to first-year chemistry students. It is exactly in such a context that we cannot but wonder how much more useful a publication of this type would be if supplemented with, say, 50 pages of accompanying text.

The text should not only provide a preface to, and critical summary of, what is presented in the present volume, but also contain appendices clarifying many features that of necessity had to be compressed in the research papers involved. Finally, a survey of the related work of other authors, merely referred to in Platt's preface, would be very much apropos here (particularly the later developments due to H. Kuhn). In the meantime we can only hope that the publication of this "source book" will create renewed and broader interest in this beautiful method of quantum chemistry. Perhaps this will help point toward the need for a true and comprehensive textbook on free-electron theory.

J. DE HEER
Department of Chemistry,
University of Colorado

Paleontology

Colloque sur le Paléogène (Bordeaux, September 1962). Mémoires du Bureau de Recherches Géologiques et Minières, No. 28. vols. 1 and 2. Éditions Technip and Éditions B.R.G.M., Paris, 1964. vol. 1, xvi + 544 pp.; vol. 2, iv + 563 pp. Illus. Paper, F. 240.99; cloth, F. 270.

The publication of Lyell's *Principles of Geology*, 1830 to 1833, was one of the outstanding milestones in the development of the science of stratigraphy. Since that time changes in the concepts, methods, and techniques have been produced at an ever increasing tempo. Unfortunately much of the development has been haphazard, and many cherished ideas have "grown like Topsy," with little discipline apparent in their establishment and acceptance.

In the third volume of his work, Lyell subdivided the Tertiary into four periods (nowadays usually ranked as *epochs*): Eocene, Miocene, Older Pliocene, and Newer Pliocene. Later Pleistocene was substituted for Newer Pliocene. Lyell expressly provided for the intercalation of new periods, and subsequently Beyrich created the Oligocene and Schimper the Paleocene to complete the usually accepted sequence. The types (all in western Europe) of these periods were not indicated with a precision suitable to present day needs and their limits were vague, but they form the standard with which the sequences of other parts of the world are sooner or later compared.

Two decades after Lyell's book, Alcide D'Orbigny proposed other stratigraphic subdivisions, which he termed *étages*, or in English, *stages*. Subsequently modified in concept and refined, the stages of the Tertiary have subsequently usually been ranked as subdivisions of Lyell's periods. Since then proposed stages have proliferated apace, especially within the Tertiary, and often, until relatively recently, with little discipline. Many have as rapidly passed into limbo; some have had only local use, but others have been utilized on a worldwide basis. Modern analyses and needs have brought to light many contradictions, inconsistencies, and inadequacies in the definitions and usages and hence emphasized the need for worldwide agreement on stratigraphic standards and interpretations. The Colloque sur le Paléogène, held at Bordeaux in September 1962, is one of several noteworthy attempts in recent years to improve the situation for the Tertiary; the present volumes represent the results of that gathering.

The 1107 (+ xvi + iv) pages (the review copy has paper covers and a weak back) include 102 separate papers, a terminal table of contents listed alphabetically by senior author, and an introductory table of contents in which the papers are classified according to various categories. There is no general introduction giving the purpose of the conference, no listing of participants, nor any general index. It is thus exceedingly difficult to locate considerations of specific subjects, places, or individuals. A little more editorial care would have made these meaty volumes much easier to utilize and thus better serve the purposes of the conference. The first set of papers is concerned with the following areas: the Paris Basin (169 pp.); the Aquitaine Basin (307 pp.); other parts of France (63 pp.); the Nordic Basin (52 pp.); Mediterranean and Alpine areas (142 pp.); the U.S.S.R. (84 pp.); Africa (28 pp.); and Greenland (4 pp.). Papers on boundary problems of the Paleogene occupy 66 pages. Forty-six pages are devoted to consideration of new and better ways of subdividing the Paleogene. Paleontological papers take up 108 pages. In the final 28 pages the sedimentary facies of the Montian of western Europe are considered.

As in all gatherings of this sort, the participants were of diverse calibers, training, and viewpoints, and the resulting papers represent various degrees of scholarliness and preparation. In consequence, no matter what his philosophy or background, a user will find something of which he will approve or disapprove. However, one thing is certain: anyone attempting to correlate with the "standard" sections in Europe, or to use them as a standard, should consult these volumes.

J. WYATT DURHAM
Department of Paleontology,
University of California, Berkeley

Chemical Propellants

Energetics of Propellant Chemistry. Bernard Siegel and Leroy Schieler. Wiley, New York, 1964. xiv + 240 pp. Illus. $10.

This new addition to the rapidly growing library of texts on rocket propellants and propulsion is simply, if not too efficiently, organized. The authors begin with a discussion of the basic principles of propulsion and methods of calculating the performance of propellants (chapter 1). The energetics of propellant combustion products (chapter 2) and of propellant reactants (chapter 4) are considered individually but with the common theme of the fundamental role played by molecular bonding. The behavior of the combustion products as a working fluid with dissociation-limited temperature is discussed in chapter 3. This background is fused into a treatment of actual, or at least possible, propellant systems in chapter 5. Such an organization inevitably leads to considerable repetition which sharper editing could have reduced. For example, the outline of the book is given in the preface, in the last paragraph of chapter 1, in the first paragraph of chap-