periods there is no summary of geological events or of the evolution of the major structural pattern.

As a result, one notices striking inequalities in the treatment of some major geologic features. Thus, while there is a well-written, coherent chapter on the Precambrian belt of northwest Queensland, which contains the important Cloncurry and Mount Isa mineral fields and the Mary Kathleen uranium deposits of more recent discovery, information on the Yarroo Basin, one of the major Paleozoic structures of Queensland, must be gleaned from perhaps a dozen separate contributions scattered through some 80 pages of text.

Many facts of great scientific and economic interest are first reported in this volume—for example, the discovery of very large bauxite deposits in Cape York Peninsula and of marine Miocene below the coral formations of the Great Barrier Reef. A more detailed table of contents and a fossil index would be most helpful. All in all, this book is a mine of authentic information on stratigraphy, regional tectonics, and economic geology.

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A Point of View

The Inspiration of Science. Sir George Thomson. Oxford University Press, New York, 1962. x + 150 pp. Illus. $4.

This short book might be described as an attempt to provide for the layman some insights into both the content and the methods of physics, but scientists will also enjoy it. Sir George Thomson, co-winner in 1937 of the Nobel prize in physics and son of the great J. J. Thomson, is admirably equipped to write about the scientific enterprise—about science as it actually happens rather than about science as it is seen from outside. With brevity, and yet with clarity, he writes of those experiments of his father and others which gave us our modern picture of atomic and nuclear structure. He traces the changing concepts of time, space, energy, and mass from Ptolemy through Galileo and Copernicus to Newton and then on to Lorentz and Einstein. Other chapters describe the discoveries of x-rays and cosmic rays, the discovery of noble gases, and the recognition of the particle-like nature of photons and the wavelike nature of electrons. To cover all these topics in a small book requires oversimplification, of course, but Sir George manages to simplify without seriously misleading his readers.

Fortunately, the book is more than a brief treatment of well-known discoveries and ideas. Discoveries are used as springboards for pithy comments about what physicists, and scientists in general, actually do. Sir George has no doctrinaire approach to *the* scientific method, but rather he discusses the role of luck, the role of persistence, "science as an art," the importance of the interplay between experiment and theory, and many other factors which both delight and bother the working scientist.

In addition, there are brief but often trenchant sketches of 11 great men of the past century in physics: Maxwell, J. J. Thomson, Aston, Millikan, Rutherford, Lorentz, Einstein, Rayleigh, C. T. R. Wilson, Planck, and Davisson. Sir George's boundary conditions in choosing these men from among the many giants were two: no living physicist could be included and all must be men whom Sir George knew directly or "through a lively family tradition." It is surely to be hoped that he has deposited somewhere in safe hands equally illuminating accounts of the many other great physicists he has known but who do not yet meet his first condition.

One hesitates to quibble over prose style, but there are many passages which show evidence of overhasty editing. On page 37, for example, there are two: "Though J.J. (Thomson) was trained as a mathematician, he did much theoretical work and retained his skill in mathematical analysis to an advanced age," and "Present-day theory regards these [magnetic and electric lines of force] as merely convenient mathematical fictions, but they certainly are convenient and are proving especially so today in the study of how very hot gases can be contained by magnetic fields so as to produce a fusion nuclear reaction, the problem of Zeta." (The "problem of Zeta" is mentioned nowhere else in the book.) At times, one wonders if the book was first a series of lectures on the BBC and whether the printer set the type directly from recorded tapes.

A perhaps more important quibble must be made with respect to the statement (page 60) that "Though Aristarchos of Samos had suggested in about 250 B.C. an arrangement with the sun at the center, this had been forgotten and when Copernicus put forward his famous theory he was making an original discovery." In an early manuscript for his *De Revolutionibus*, Copernicus mentioned Aristarchos by name, and in the final draft he went to considerable length to cite various ancient authorities who believed that the earth was moving. According to Thomas Kuhn (in *The Copernican Revolution*), Copernicus also probably knew at least some of his more immediate predecessors, especially Nicholas of Cusa. In any event, the "discovery" of Copernicus was not that the earth moves around the sun, but rather that a heliocentric system could be worked out that would be mathematically simpler than the geocentric system but just as precise in its predictions of apparent planetary positions. Indeed, Sir George goes on to point out this fact.

The book can be recommended to intelligent laymen, to scientists, and to those who persist in writing about *the* scientific method. If the publishers would kindly bring it out as an inexpensive paperback, this would be a good book to ask undergraduate students to buy, read, and keep.

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Cosmic Dust to Galaxies

Advances in Astronomy and Astrophysics. vol. 1. Zdenek Kopal, Ed. Academic Press, New York, 1962. x + 366 pp. Illus. $10.

This first volume of the new series *Advances in Astronomy and Astrophysics*, edited by Zdenek Kopal, contains five papers on a variety of subjects ranging from micrometeorites to the dynamics of galaxies. The first part of the paper, by D. W. Parker and W. Hunter, on meteorites and cosmic dust, is in the nature of a review, but most of their paper consists of a very detailed description of their methods of studying cosmic dust. This very difficult research field promises exciting dividends in the next few years, particularly when material can be collected from recoverable satellites. L. Perek's comprehensive paper on the distribution of mass in oblate stellar systems is based both on velocity dis-

tribution studies and on mass distributions. Although many more observations and types of data are available for the galaxy than for other stellar systems, neither its mass nor dimensions are satisfactorily established. Perek favors a galactic mass slightly less than 10^{11} suns, while other workers in the field—for example Brandt—favor a figure more closely comparable with that suggested for the Andromeda spiral: 3 to 4 $\times$ 10^{11} solar masses.

The shock-wave theory of novae is presented in considerable mathematical detail by John Hazelhurst. Whether or not one accepts this theory (and I do not), it is valuable to have a thorough presentation of shock-wave phenomena in stellar interiors or atmospheres. The theory of starlight polarization and the method for analyzing it are presented in some detail by K. Serkowski. Although it seems most likely that polarization results from the scattering of starlight by elongated grains in a galactic magnetic field, attempts to detect or measure the magnitude of this field by studies of the Zeeman effect on the radio-frequency 21-centimeter line have proved unsuccessful.

G. Herbig's review of the *T* Tauri stars is a well-organized, lucid account of these exotic variables, which are believed to represent the earliest stages of stellar evolution. Clearly many additional difficult observations will have to be obtained before we solve the problem presented by these stars. Data from both Schmidt cameras and large telescopes are needed to supply statistics, to monitor light variations, and to provide detailed information on individual strategic stars. Unfortunately, progress toward the solution of this and many other problems, such as galactic dynamics, is impeded by lack of adequate optical instruments. Despite great increases in astronomical activity, only three optical telescopes with an aperture greater than 60 inches have been constructed in the United States since World War II: California Institute of Technology, Kitt Peak National Observatory, and Lick Observatory. Most observatories have only small telescopes, many of which are more than half a century old.

Kopal and his associates have done a good service to astronomy by producing this excellent volume; hopefully, many other volumes will be published in the series.

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Avian Biology

The Life of Birds. Joel Carl Welty. Saunders, Philadelphia, 1962. xiii + 546 pp. Illus. $9.

This textbook of avian biology is intended for general, not advanced, students, and it successfully avoids mere technicalities. However, despite Welty's expressed modest aims, the coverage is much greater in scope and more inclusive in content than the opening statements led me to expect. In fact, the book will easily hold its place among recent ornithological texts. The author has read widely and has chosen his sources wisely. He states that he has depended on Stresemann's masterful volume more than on any other single reference (and who can criticize him for this?), but that he has included material and ideas from over 8000 books and articles, of which more than a tenth are listed in his bibliography. He has done a good job of organizing this vast amount of information and has created a simple, straightforward account that the general reader can follow with easy comprehension.

The material is presented in 23 chapters covering various aspects of morphology, physiology, locomotion, behavior, life histories, ecology, evolution, and the classification of birds. Each chapter is well illustrated with photographs, drawings by the late Norman Tolson, diagrams, and tables. On the whole, the drawings, either from the birds themselves or from the literature, are well done and demonstrate the superiority of drawings over photographs in conveying information. Bird photographers have produced pictures that give pleasure to lay audiences, but by and large they have not added seriously to the knowledge of birds. I have long thought that the very excellence of many photographers' "shots", which obviously involve the expenditure of much time, skill, and patience, could almost be used as a measure of the unused opportunities these men had to learn new facts.

Thus, the book's coverage is broad; birds from all parts of the world and of all families are used to exemplify and to illustrate special problems and topics, and the pertinent literature is used to document the account. If any criticism is to be made, and this may be only my personal reaction, it is that some of the author's generalizations are oversimplifications—for example, the first sentence of chapter 1: "The great struggle in most animals' lives is to avoid change," or the statement (p. 139) that brood parasites possess a "psychic control over egg-laying." The index is adequate.

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Organic Reaction Mechanisms

Physical Organic Chemistry. Jack Hine. McGraw-Hill, New York, ed. 2, 1962. x + 552 pp. Illus. $11.50.

After the appearance, in the early 1940's, of the important books on organic reaction mechanisms by Branch and Calvin, by Hammett, and by Watson, more than a decade passed before books of comparable scope and stature were published by Ingold (1953) and Hine (1956). Inasmuch as Ingold wrote as a charter member and dean of the field, it is a tribute to Hine that his *Physical Organic Chemistry* (a misnomer) achieved influence and authority on a par with Ingold's work.

This second edition, thoroughly revised and brought up to date, is as authoritative for 1962 as its predecessor was for 1956. The organization of the first edition is retained, for the most part, but two chapters have been added. One, on methylenes, is welcome both for the importance of the topic and for Hine's special contributions to that area. Another, on quantitative correlation of rates and equilibria, includes topics formerly treated in other chapters.

Hine's scheme of organization and his general emphasis tend to be guided by tradition. These and other conservative qualities are laudable, in that they guarantee attention to topics of focal interest in the recent past and restrain the endorsement of radical points of view, but the traditional approach is often uneven. For example, the chapter "Mechanisms for nucleophilic displacements on carbon" deals only with those mechanisms in which the old bond is broken *before* or *during* formation of the new bond. The equally important mechanism in which the old bond breaks *after* the new bond is formed is not presented until several chapters later, and even then that aspect is not placed in proper perspective.

Some topics are not adequately treated, and some important ones are