lowed by four appendices that deal with fossils and Mesozoic stages.

Three post-Mesozoic systems (Paleogene, Eogene, and Pleistocene) are adopted "on a basis comparable to that now used for the older rocks." Does boosting Pleistocene to system rank conform to that intent? The term Tertiary is studiously avoided. It appears in Tables 3-1 and 3-4 as an old division still in use. The Tertiary series names (subsystems of Table 3-4) also are avoided as much as possible. They could not be avoided, however, in chapter 15. Middle Paleogene (Eocene) and Lower Eocene appear on the same page (p. 402). How would Early Lower Eocene be expressed in Paleogene terms?

The book shows careful editing and proofreading. It is lavishly illustrated and the reproductions are good, although Figure 9-16 is so greatly reduced that parts of it are illegible without a reading glass. The frontispiece is beguiling, and light touches unexpectedly brighten somber discussions.

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Modern Meteorology Minus Mathematics

Modern meteorology minus mathematics is authoritatively presented in **Introduction to the Atmosphere** (McGraw-Hill, New York, 1965. 377 pp., $8.95), the first new elementary textbook in the field published in almost a generation. The author, Herbert Riehl, after almost two decades at the University of Chicago, has been professor of atmospheric science at Colorado State University for the past 5 years. His book is intended for "nonspecialist 'terminal' courses" that offer "a concise yet thorough view of the field" to "students with a general science background."

For several years I have taught such a "weather" course, one which satisfies the science requirements for students who have completed college courses in the physical and biological sciences. Because the half-dozen available textbooks, all obsolescent in outlook and content, are either too elementary or too technical, I eagerly adopted Riehl's new book after a glance at the page proofs. But my students complain that "a previous knowledge of weather fundamentals is assumed"; that technical terms are used without adequate definition; that some explanations invoke material presented much later in the book; that many diagrams, while attractive, are hard to interpret; and that "too many things are covered without really going into any depth."

Such objections, also applicable in varying degree to other "elementary" textbooks, are from students whose high school and college science courses emphasized fusion, fission, and space propulsion but neglected the gas laws, specific and latent heats, and the laws of motion, with the result that many students do not comprehend casual references to these foundations of meteorology.

Synoptic meteorology is Riehl's major interest (he pioneered modern concepts of tropical meteorology) and provides the basic orientation of his book. He begins with an admirable essay, "Survey of the atmosphere," which sounds like an encyclopedia article, as do many of the other 13 chapters, which are grouped in four parts: Physical Processes (130 pp.), Weather Disturbances (54 pp.), Climate Controls and Climates (78 pp.), and Weather and Climate Applied (60 pp.). The appendices, on reading weather maps, conversion scales, and data sources, include 20 "general and special subject texts" and 7 journals. The only other references are credits for some of the 218 figures; the indexes (by subject and by location) are adequate but not exhaustive.

No formulas or equations of any kind are offered; instead, some relations are given verbally, and others are displayed on two-toned graphs, all half-page or smaller, which are generally too small and schematic for actual use. Many of the graphs have nonlinear scales, usually not identified and almost unintelligible to students not inclined to graphical thinking. Some numerical examples in the text do not specify all the variables, so that additional assumptions are needed to verify the given answer. No problems or exercises are suggested.

An amazing amount of up-to-date information is compressed into the 365 well-printed pages. Concepts and terminology are strictly current, with few exceptions; one exception is the use of "ionosphere" for "thermosphere," another is the retention of "centigrade" rather than the internationally adopted "Celsius." Metric measures are used in most cases, although English measures, especially linear, are often cited, with metric equivalents given in parentheses.

In sum, Riehl seems to have accomplished his secondary purpose—that of providing "a volume [suitable] for study and reference [use by] engineers and other professional men and women whose work requires some understanding and judgment about the atmosphere." It may be good collateral reading for courses in hydrology, historical geology, space physics, or ecology, and it can give an elementary class a superficial familiarity with the atmosphere. But it does not provide a rigorous and thorough development and explanation of basic physical principles, which are both essential to any understanding of meteorology.

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Petroleum Exploration

The applied science of petroleum exploration has an unusual literature. Many pages are published which describe single oil fields and give production statistics or news of new discoveries, but seldom is an attempt made to synthesize the data and thereby provide an explanation of where the oil came from and why it accumulated at certain places. Most of the interpretive papers that are published are pronouncements made by senior executives of petroleum companies when they retire.

In an attempt to fill this gap, the Southwestern Federation of Geological Societies held a symposium on Fluids in Subsurface Environments, in January 1964, at Midland, Texas. This volume, **Fluids in Subsurface Environments** (American Association of Petroleum Geologists, Tulsa, Okla., 1965. 422 pp., $10) edited by Addison Young and John E. Galley, is the transactions of that meeting. The conveners brought together specialists on the West Texas subsurface and research workers in the fields of organic, inorganic, and isotope geochemistry. The papers include discussions of the hydrocarbons in modern sediments, the migration of oil, the distribution of

chemically different types of oil in West Texas, the geometry of porous and nonporous rocks in several major groups of oil fields, and ground water flow through the West Texas subsurface. At the end of the volume are five excellent papers (not oriented to West Texas) discussing the origins of ground water, carbon dioxide gas accumulations, rare-gas isotopes from spontaneous fission, sulfur isotope anomalies, and the disposal of radioactive wastes.

The standard reviewer's cliche, "this symposium volume gives an up-to-date summary of the field," cannot be applied to *Fluids in Subsurface Environments.* Although the laboratory of every large oil company is actively working on the problems addressed in this volume, only the paper by Silverman is a contribution from a major petroleum laboratory. Further, the candor of Silverman's paper is marred by his illustrating and discussing an oilfield (pp. 62 to 64) without identifying the field by name, location, or age of the rocks. However, the editors are to be commended for assembling a useful volume despite the industrial restrictions on releasing information and interpretations. This symposium volume is unique in covering the wide range of fluids recoverable by drilling in sedimentary rocks. Those who would like to drop such neologisms as *criconden-bar* and *salaquifer* into future discussions would be well advised to procure a copy.

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Mineral Resources of Africa

A comprehensive compilation of mineral resources data for Africa has long been needed by both technical and nontechnical persons concerned with the development of that continent. In writing the volume reviewed here, **The Mineral Resources of Africa** (Elsevier, New York, 1965. 766 pp., $40), Nicolas de Kun has fulfilled this need by preparing part 1, Industrial Development and Mineral Economics (pp. 1 to 211), in a form that will be useful to the nontechnical audience, particularly economists and other social scientists, and part 2, Economic Geology (pp. 211 to 740), in a more technical fashion for use by geologists and mining engineers.

In part 1, a general section of Africa's share of world resources and production precedes discussion of the distribution of African output and resources in terms of the metal or mineral groups, such as iron and bauxite, base metals, gold, ultrabasic minerals, tin, carbon fuel, water, and soils. A very interesting section entitled "History and Development of Mining" clarifies the complex interrelationships of many of the African mining companies listed in appendix II; the author then describes the distribution and production of resources by regions—northern, northeastern, west, middle, and southern Africa, including "The Islands and the Sea"—and by countries within regions. The value and production of the economic materials of each country and their relationship to the totals for Africa and the world are reviewed in relationship to the existing mining companies, and notations are given on known occurrences that, in the future, may be important because of improved transportation or other economic factors. One of the unusual aspects of this compilation is that, in addition to minerals and fossil fuels, it treats both ground and surface water, with emphasis on their use for power.

Part 2, a discussion of the economic geology of the individual deposits, is arranged under the same genetic group headings used in part 1—that is, iron and bauxite, gold, and so forth. These genetic types are considered in relation to the author's "Mineralogenic Provinces"—High Africa, East Africa, the Atlantic Rim, Nigeria, the Guinean Shield, the Mauritanian Arch, the Atlas, the Sahara, and the Red Sea. The orogenic-metallogenic belts within these provinces have been delimited, on the basis of age, into seven cycles, dated as 3400 to 3000, 2800 to 2400, 2300 to 1900, 1050 to 850, 650 to 450, 400 to 200, and 150 to 0 million years. The most intense mineralization in these belts was at about 2100 million years, the next most intense at about 650 million years. Oil and coal deposits formed most abundantly at about 200 million years.

The author has a wealth of data at his disposal, and as a compilation this book has an unusually wide coverage. References to the source data in part 1, and more references in part 2, would enhance the usefulness of the book to serious students who will be interested in detailed information on specific areas.

Although all compilations must be abstracts of existing data, in this case the condensation of material in many places has been carried to the point where the data are almost useless. Perhaps this is partly because the author's native language is not English, but appropriate editing could have corrected much of it. I noted numerous typographical errors. All in all, it is difficult to read this book and to understand the author's original intent. Nevertheless, as a reference source the book will fulfill a very useful purpose in that it will acquaint interested persons with the tremendous known and potential natural resources of Africa.

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Insect Physiology

A feature of the 12th International Congress of Entomology, held in London in July 1964, was a symposium on the physiology of insect central nervous systems. This meeting marked the recognition of the insect nervous system as an important object of study in its own right, with the aid of the wide variety of research tools currently available. It also served to show that many fundamental problems of integrative physiology in nervous systems might be intensively studied with advantage in relatively simply organized insect ganglia. The speakers have elaborated on their contributions, which have been collected together in a handsome volume—**The Physiology of the Insect Central Nervous System** (Academic Press, New York, 1965. 287 pp., $10), edited by J. E. Treherne and J. W. L. Beament.

The 15 articles that make up this book range in scope from broad reviews—for example, T. Narahashi's review of the physiology of insect axons—to research data not published elsewhere (G. A. Horridge, J. H. Scholes, S. Shaw, and J. Tunstall and G. Hoyle). Excellent articles on the chemical environment (J. E. Treherne and J. H. Ray) precede a survey of the ultrastructure of synapses by D. S. Smith. Microelectrode and pharmacological studies on transmission are contributed by J. Boistel, J. J. Callec, J. Bernard, and Y. Gahery. There is a thoughtful general article on neuronal pathways by the versatile G. M. Hughes and specialized accounts of locomotion in a cater-