Plant Evolution and Diversity

Six specialists, Robert F. Scagel, Glenn E. Rouse, Jane R. Stein, Robert J. Bandoni, W. B. Schofield, and T. M. C. Taylor, from the University of British Columbia, cooperated to bring together in this book, **An Evolutionary Survey of the Plant Kingdom** (Wadsworth, Belmont, Calif., 1965. 670 pp., $11.50), modern thinking about plant diversity, by using information from various research fronts. The mycologist of the group was responsible for bacteria, slime molds, and fungi; the two phycologists for algae; the bryologist for lichens and bryophytes; the paleobotanist for pteridophytes and fossils; and the higher-plant taxonomist for the angiosperms. The book, which grew out of their 1-year course on the plant kingdom, is nicely coordinated: the terminology used in the parts is consistent, where possible, and in general the continuity is smooth. The liberal integration of recent work from physiology, cytogenetics, and electron microscopy is especially commendable. For only one person to write a book such as this today in the face of so much recent work, to say nothing of the special knowledge required in each division, would be a formidable task.

A two-column, easy-to-read format is used, and most of the illustrations, which include photographs and salient line drawings, are very good. A well-chosen glossary is provided; and the references selected for the bibliographies not only pertain to the chapters, but will lead the pupil to stimulating new approaches and experiences.

A student (or a professor, for that matter) who really knew and could handle all of the ideas and information given here would be an excellent botanist indeed. In contrast to what I take to be the recent vogue of "watering down" the factual basis of our knowledge of plant diversity, a text as complete as this one calls attention to the true complexity of the world of plants, and to the enormous information-content needed to comprehend plants. A merely generalized knowledge of "cell biology" or "plant physiology" (as these terms are usually used) can give only a remote shadow of what plants—as plants—are really like and of what they really do. The same may be said of the simplistic "plant morphology," of the typologist.

No specialist, of course, is likely to find his own specialty as well treated in this book as are the other subjects. As a vascular plant student, I might have preferred to see more on the angiosperms, which were awarded only 60 pages (compare the algae, with 155 pages). Also, there are unquestionably many specialistic details that will need to be modified in future revisions as the book receives more and more use.

The sizeable volume will probably be chosen by, and for, numerous college students at the upper-division and graduate level, who today seem to be looking more to their texts as references and relying on their lecturers for delimiting the choice of subject and viewpoint. The book will serve as a student's textbook, its avowed function, but it may also be selected by professional biologists as a convenient work to have in their personal research libraries.

The unifying concept in the presentation was evolution, as opposed to the so-called "typological" or "type method" approach. As we study this book, the fact becomes manifest that we really know little about the broad phylogeny of plants, partly because of their abominable fossil record, and partly because of our disagreements about homologies. Some students may be disappointed by this; but others, on the contrary, will find these very problems intellectually stimulating.

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Earth Sciences

A. O. Woodford's **Historical Geology** (Freeman, San Francisco, 1965. 522 pp., $9.50) is an unusual book. It will be challenging to students who use it and can be read profitably by any geologist. Instead of giving the entire history of the earth the once-over lightly, Woodford chose episodes to focus on fundamental concepts in historical geology and on the evolution of life. The book has no professional or provincial bias. Those who are not familiar with the author's background will not realize that he is primarily a petrologist and that his training and practically all of his professional career have been in California.

The first eight chapters furnish a background for the remaining eight which deal with sequential episodes. Woodford has always been interested in the history of the development of geology, and that interest is shown in chapters 1 and 3. Chapter 3 traces the building up of a geologic column in England and Wales. Many parts of that column have become standards for the rest of the world. Chapter 2 deals with ancient life and chapter 4 with stratigraphic assemblages. The contrast between eugeosyncline, miogeosyncline, and platform are effectively brought out in chapters 5 and 6, "The Grand Canyon platform and the Cordilleran geosyncline," and "Platform and geosyncline in east-central North America," respectively. Much of chapter 7 ("Correlation by fossils") is drawn from Woodford's essay, under the same title, published in *The Fabric of Geology* (1963). Evolutionary sequences and stratigraphic gaps (Woodford prefers the more sophisticated term lacunae) are illustrated by Brinkmann's elegant statistical analysis of some 3000 specimens of the Jurassic ammonite genus *Kosmoceras* collected from a 42-foot sequence of Oxford Clay. The chapter includes an extended discussion of the Jurassic zones and stages of western Europe and their recognition elsewhere. Chapter 8 is an up-to-date account of radiometric ages, a much better term than the misleading absolute ages. It is concluded that at the present time in most cases (a weasel phrase, to adopt a light touch, on p. 180) correlations based on fossils seem (another weasel) to be safer guides than correlations based on radiometric ages.

The sequential episodes begin with the Precambrian, with special emphasis on the Canadian Shield and South Africa. Three "systems" (author's quote), each comparable to all the Mesozoic systems or even all the Paleozoic systems, based on stratigraphic relations and radiometric ages, are recognized and named in the Lake Superior region. It is suggested that at least six, possibly seven or eight, "systems" are represented in South Africa, which may eventually furnish the best world standards. Then follow successively the Cambrian and its trilobites, the evolution of the four classes of fishes from Ordovician through Devonian and the Old Red Sandstone as the nonmarine Devonian standard, the rise of Silurian and later Paleozoic land floras, and Gondwanaland and its overtones of paleomagnetism and continental drift. The one Mesozoic episode is appropriately titled "The reptilian heyday." "The age of mammals" and "The Pleistocene," the concluding chapters, are fol-

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