of this group of excellent developmentalists, behaviorists, physiologists, and biochemists. The book is highly recommended to all ecological readers, many of whom would do well to ponder the omissions and assess their own roles in the matter. The general reader as well will find the book replete with challenging ideas and containing a generous sampling of a widely scattered literature here drawn together in a first attempt to span a new field: biochemical control *in* ecology.

The scheme of this series centers upon biochemical aspects of development, behavior, and physiology, all established fields. The chapters on microorganisms, for instance, contain little reference to the large subject of microbial ecology, whose massive chemical literature is so sorely in need of organization and critique. The higher plants fare much better at the hands of R. H. Whittaker, who alone among the contributors addresses himself to community processes and the environmental complex. His review of allelopathy, although tailored to the occasion, is at least masterly. It is interesting to note that Whittaker, who is unique among the authors in never having been experimentally involved in the subject of his chapter, has produced a treatment totally committed to the title of the volume.

The central position and greatest space are devoted to chemical aspects of insect interactions and development. A delightful and effective chapter on insect food plant selection and its chemical basis by V. G. Dethier is remarkable for the depth of its analysis of the evolution of this intricate phenomenon. Dethier's suggestion of simple genetic control of the action of chemical receptors and consequent ease of mutation would take much of the mystery out of the origin of nutritional behavior in phytophagous insects. His views are rendered as palatable to the reader as plants are to insects by his emphatic recognition that plants and insects evolved under the selective pressures of a multifactorial environment—not just subject to each other. Refreshing differences of opinion appear among the authors on occasion. For instance, C. M. Williams's discussion of the role of ecdysones and juvenile hormones of both insect and plant origin closes with the opinion that the great abundance of ecdysones in ferns and in gymnosperms were not "carried along for millions of years as excess baggage" but had their origins in defense against insect predation. But in the same connection Dethier notes that ferns existed long before phytophagous insects.

Upon reading T. Eisner's long chapter on chemical defenses against predation, one is apt to react like a new father in a toy store. It is a veritable museum of surprising oddities, carefully detailed as to chemical and behavioral bases, effectiveness, and phylogenetic variation.

In the final chapters the biosynthetic origins of compounds important to some of the preceding discussions are detailed. It would clearly have been impossible to treat them all, but one is struck by the absence of consideration of the classes of chemicals most abundantly and most widely loosed into the environment. The origins, release, transformations, and eventual fates of the terpenes, phenolics, alkaloids, and many other classes of biochemical constituents of the gross environment would have made a welcome addition. In a comprehensive treatment of this subject lie the key to characterization of the biochemical parameter of the environmental complex and the fundamental basis of chemical ecology. That basis is the theme upon which the individual cases are but variations.

The extreme paucity of textbook treatments of any phase of biochemical ecology makes this book a valuable reference for advanced students. It may be superseded by subsequent volumes more quickly for some readers than for others; in the area of its principal emphasis it will have lasting value.

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Volcanic Islands

Volcanoes in the Sea. The Geology of Hawaii. GORDON A. MACDONALD and AGATIN T. ABBOTT. University of Hawaii Press, Honolulu, 1970. x, 442 pp., illus. $15.

It is interesting to speculate what course volcanic geology might have taken in America if Hawaii were somewhere in the south Indian Ocean and under the administration of a non-English-speaking nation. The influence that studies of the islands have had on the development of igneous petrology is matched only by that of the Skaergaard intrusion in eastern Greenland and the Tertiary volcanic centers of Scotland. Hawaii has become a model or norm to which all other oceanic volcanism is compared.

This is not because its activity or lavas are typical of the oceans; in many ways they are anomalous. Nor is it because of the accessibility and setting of the islands, although these are certainly important factors. More important is the wealth and variety of geological data that they provide. Over a period of half a century, every aspect of the volcanoes has been studied by scores of geologists, geophysicists, and geochemists. At the head of any list of these workers one must place the name of Gordon Macdonald, whose contributions over the past 30 years approach the sum of all others combined. The present book, written by Macdonald and illustrated by his colleague A. T. Abbott, is a compilation of most of what is known about Hawaiian geology.

The authors have made no pretense of presenting new or original information; all the data could be found elsewhere by a person familiar with the literature on Hawaii. The book simply brings this information together, sorts out what is essential, and presents it in a readable form. The summaries of the geology of individual islands and accounts of important historic eruptions have been compiled from a variety of sources, many of them unavailable except in the most complete libraries. The book is clearly designed to reach a broad audience and will undoubtedly serve as a basic text for introductory geology courses at the University of Hawaii. It contains chapters dealing with almost all the principal geologic processes, including evolution of soils, stream erosion, and even the work of ice and snow, all based on examples from the islands. The clear, nontechnical treatment of this material will make the book a valuable reference for persons with little or no background in geology.

No attempt is made to discuss the complex genetic interpretations of volcanic rocks, although Macdonald is certainly qualified to do so. In view of the transitory nature of most recent theories, this is probably a wise omission. The same reasoning may account for the absence of even a passing allusion to sea-floor spreading. The book must be unique among recent texts in that it contains no diagram of symmetrical magnetic anomalies or a subduction zone. Whatever their motives, the authors have accomplished the remarkable feat of writing about oceanic

volcanism, crustal structure, trenches, and fracture zones without referring to the most far-reaching concept yet devised to explain these features. The East Pacific Rise is not only ignored as a spreading center; it is not even included in a list of the major structural features of the Pacific Ocean.

It is difficult, however, to dwell on the faults of a book as carefully prepared, lucidly written, and beautifully illustrated as this one is. It will certainly be well received by geologists and nongeologists alike.

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The Earth and Beyond

The Atlas of the Universe. PATRICK MOORE. Rand McNally, New York, 1970. 272 pp. $35.

This comprehensive, communicative, and beautifully produced compendium of pictorial astronomy contains much accurate information. A foreword by Bernard Lovell, an epilogue by Thomas Paine, and authorship by Patrick Moore, who is one of the best-known popular writers and broadcasters of astronomy, provide it with prestigious testimonials.

The large size of the pages, 10½ by 14½ inches, allows for a flexible layout. A combination of large and small, full-color and two-color photographs, diagrams, and drawings, with explanatory text in layman's language, is assembled on each double-page spread; this provides an easily assimilated survey of present-day astronomical and geological knowledge. Many maps are provided, and at the end there are a glossary, a beginner's guide to the heavens, and a good index. The sectional arrangement and choice of topics are sensible and helpful. The order is from the known to the unknown, outward from the earth, and before tackling any of the scientific results we have a look at the tools (many types of telescopes and accessories) and the behavior of light; concepts and methods are discussed, and a good deal of the history of astronomy is surveyed. The section that follows this introduction provides a short course on the earth as a planet and includes as illustration views from the moon and from artificial satellites, comparison of these with maps, explanations of weather phenomena, geological ideas, and life on earth. Next come several sections on the moon, the solar system, and the stars, the last named being too modestly titled as it actually includes everything outside the solar system.

The *Atlas* is as up-to-date as it could be, just missing the new International Astronomical Union list of named far-side lunar features but including descriptions of quasars, pulsars, and a number of strange galaxies.

The large-scale organization is good. In detail, I find it less so, perhaps because the quantization of the contents (one subject or sub-subject to a double page or a number of double pages) is too rigid. To me, an occasional treatment seems stretched to fit the layout while a few others inevitably seem compressed for the same reason. The subjects of meteorites, meteors, and tektites (one double page for all these dubiously related objects), and infrared and ultraviolet astronomy outside the solar system (practically nothing) appear to have been shortchanged, but there is truly a wealth of information elsewhere, the language is simple and well chosen, and the *Atlas* is a joy to look at.

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Predicting Floods

Hydrological Forecasting. Proceedings of a WMO/UNESCO symposium, Surfers' Paradise, Queensland, Australia, Nov.–Dec. 1967. World Meteorological Organization, Geneva, 1969 (U.S. distributor, UNIPUB, New York). xvi, 328 pp., illus. Paper, $21. WMO Technical Note No. 92.

The theme of this symposium was the "forecasting, especially for shorter time-intervals, of rainfall floods." The proceedings should present a state-of-the-art assessment of forecasting, and the papers should be judged both on their individual merit and on their integrated effect. Unfortunately, two major papers have been published in one-page summaries, and one of these is among the three introductory overview papers. One of the two published overview papers, by Philip, gives a good, brief summary of knowledge of the microprocesses of accretion to and depletions from soil moisture; the other, by Popov, covers surface routing of flows by both hydraulic (equations of flow) and hydrologic (unit hydrograph) methods.

The remainder of the volume is divided into sections on the forecasting of precipitation (4 papers), data (4 papers), forecasting techniques (16 papers), and operational aspects (4 papers). The precipitation papers are descriptive, and indicate the major problems of a lack of adequate models for predicting precipitation, even on a short time scale, for use in streamflow forecasting. Perhaps the best paper on precipitation is that by Alexander, "Mathematical models of area rainfall," contained in the data section, which outlines the problems in the use of rainfall in modeling runoff. The papers on forecasting techniques give an excellent coverage of present practices in various parts of the world. Anyone planning to develop or choose a forecasting model would profit from reading these papers and comparing and assessing models, but only one (that by Riggs and Hanson) discusses the probability aspects of forecasting.

Barakov presents an application of the method developed by Popov to handle the partial contributing area problem, which has been discussed extensively by the Tennessee Valley Authority group in the United States. Denisov presents an approach to modeling snowmelt runoff, with data requirements of temperature, humidity, and precipitation. Kutchment presents in outline form the Russian approach to unit hydrograph analysis through the theory of incorrect problems. This approach is being introduced extensively in Russian hydrologic literature. The problem is analogous to that attacked in the paper Kutchment cites by Eagleson, in that errors in data may produce unstable solutions to the convolution integral. Each event produces a different solution, so that the instantaneous unit hydrograph (IUH) is not unique. The theory of incorrect problems provides a tool for finding an optimal solution for the IUH. These papers, plus others included in the proceedings, give a good cross section of Russian developments in mathematical analysis of hydrologic problems.

Nash and Sutcliffe present a general approach to parametric model building along the lines presented more completely in a series by Nash and others in *Journal of Hydrology*. Crawford presents the use of the Stanford Watershed Model IV as a case study in the use of conceptual models for fore-