large scattering in the expected data. Killian's account of this episode does not do full justice to the meaning (or lack of meaning) of these new data on the one hand, or to the raging controversy about the desirability of reaching agreement on a nuclear test ban on the other.

Killian's account does not stop with his resignation from office in May 1959. He outlines briefly the role of his successor in advising President Eisenhower, and he dedicates an entire chapter to his perception of the Eisenhower years, in particular with respect to Eisenhower's relations with the "military-industrial complex"—the famous phrase coined in Eisenhower's farewell address. It is in this summary chapter that one sees the emergence of Eisenhower's worries that "intemperate technological fantasies" would drive military and other initiatives and the recognition of his reliance on his science adviser to exert a moderating force.

The book closes with a brief summary of the science advisory situation after Eisenhower left the presidency. The decline of the science adviser's role beginning with the late Johnson years and culminating with Nixon's Executive Order abolishing PSAC, the Office of Science and Technology (OST), and the post of Special Assistant for Science and Technology altogether is well known. Killian played a substantial role in the successful persuasive effort, both in Congress and in the Executive Branch, to reestablish a science advisory at the presidential level in some form. He proudly recites the events that led to President Ford's reestablishment of a science advisory mechanism in the form of the Office of Science and Technology Policy in May 1976, and he praises the qualifications of the first incumbent of that office, his colleague Frank Press.

In his concluding chapter Killian lists the arguments for science advice at the White House level. Here again, if a fault can be found in his account it would be that he fails to mention the deficiencies in the PSAC mechanism that became apparent in its later years. In the Killian and Kistiakowsky era of science advice PSAC was a coherent deliberative body, consisting almost entirely of physical scientists and dealing with problems almost exclusively in the military and space fields. In the later years an increasing number of problems having to do with environment, medical care, and social concerns led to the introduction of a wider spectrum of disciplines to PSAC. Although this was a clear necessity, it did mean that the cogency of PSAC deliberations on any one subject suffered. Killian's account emphasizes the positive aspects of the OST-PSAC mechanism exclusively.

In summary, this book is an eminently readable historical account of the first period of the Office of the Special Assistant for Science and Technology to the President and, in less detail, of the subsequent fall and rise of the science and technology advisory mechanism in the White House. The account gives many important insights into historical events. It highly accents the positive, with respect to the achievements of the science advisory mechanism and the contributions of individuals; for this reason some of the conflicts of those years and the deficiencies in administrative leadership in technology tend to be less well presented than the constructive moves that were made in response to the gloom about U.S. science that prevailed immediately after Sputnik.

WOLFGANG PANOFSKY
Stanford Linear Accelerator Center, Stanford, California 94305

Early Geology Reexamined

The Making of Geology. Earth Science in Britain 1660–1815. ROY PORTER. Cambridge University Press, New York, 1977. xii, 288 pp. $18.95.

Current historical ideas about the origins of geology can be traced to a great extent to views expressed by geologists of the early 19th century. Acutely aware of their membership in a recently matured discipline, geologists of the early 1800's frequently contrasted the happy new state of their science with the less fortunate antecedents it had so recently supplanted and (so it seemed) repudiated. From their judgments emerged a historical picture of earlier, would-be geologists misguided by subservience to theology or rash speculation or both. It was as if these inquirers of previous centuries stared geology in the face but failed to recognize it because they could not clear away erroneous preconceptions and inappropriate methods.

We have been learning lately to read the 19th-century histories more skeptically, to see for example that Lyell's account of geology's past in his *Principles of Geology* was designed more to justify and support his own partisan vision of the proper aims and methods of the field than for any other, more purely historical purpose. Meanwhile fresh studies of many aspects of geology's formative period have been undertaken, but with results that all too often receive little attention beyond that given by a small band of specialists in this area of the history of science, perhaps in part because these studies have not for the most part been drawn together in a form calculated to attract the attention or serve the needs of others. Porter has changed this. His book, which is both a well-informed synthesis of recent scholarship and an original interpretation with its own special insights and emphases, goes far toward providing a newly integrated historical understanding of geology's emergence as a science.

As the title indicates, Porter's study confines itself to the British, but this limitation helps make possible what is perhaps the most interesting and valuable feature of the book, its consistent focus on the social as well as the intellectual currents out of which geology materialized. With much erudition and historiographic sophistication Porter locates the various earth scientists of his period within their cultural contexts. This is no easy task, as it requires an awareness of shifting patterns in virtually all dimensions of British society (religious, philosophical, political, economic, technological, and so on), as well as familiarity with problems intrinsic to a science of the earth. By joining together social and conceptual perspectives, Porter has taken an approach that, though not new in the history of science at large, has never to my knowledge been attempted in a work of comparable scope in the history of geology. On the whole the attempt is very successful.

Among Porter's arguments a few of the more central and interesting are the following contentions: The natural history of the earth tended to move from the descriptive study of objects, through their examination in relation to specific geographic-lithological localities, toward their coordination in a larger regional-geological framework. This broadening of natural history's scale of vision was accompanied by a narrowing of the scope of "geocosmic physics" from the whole earth to just its crustal parts and by an increasing sense of understanding natural history through "an organized system of forces and products" rather than as a static inventory of things. A unified cognizance of an overall stratigraphic structure in the earth's crust was achieved only between the late 17th and the mid-18th centuries, and an increasing concentration on the significance of strata then came to be decisive in the intellectual reformulation that resulted in geology. Earth science experienced im-

portant growth in its "social base" during the 18th century (even while by some measures it seemed to be declining from its relatively high appeal in the late 17th century), through such developments as the rise of provincial science, the promotion of popular science as a form of leisure, and the growth of tastes for exploration and landscape appreciation. A rising class of professionals (surveyors, prospectors, assayers, civil engineers, and the like) gave increasing support to the cultivation of earth science during the 18th century, usually with local and practical aims focusing on strata, and so English geology matured in an unhomogeneous social setting. Early-19th-century British geology, much influenced by the antispeculative climate of conservative reaction against the French Revolution, was established with a very low level of agreement on theory, but with common agreement on a narrowly inductive methodology that had little room for anything other than fieldwork.

Porter shows that the new science of geology was made by a process that was complex, continuous, and collective. The creation of geology was not essentially a revolutionary rejection of antiquated notions, nor was it in the main the result of heroic scientific deeds. The ideas of earth scientists before the 19th century come into perspective not as a series of obstacles in need of removal but as natural and constructive steps, resolving themselves through a sequence of changes into the components of the new science. Porter identifies the historical developments of 18th-century earth science as part of a process of reconceptualizing the earth, a process he aptly summarizes in this way: "To speak very boldly, investigating individual terrestrial products and features as isolated objects, perhaps within a philosophy of Creation, gave way to considering the Earth as a fully articulated, historically-related system of forces and materials" (p. 5).

Porter could not be expected, of course, to achieve his "programmatic interpretation" and at the same time provide a coherent narrative replete with details about individual figures, their investigations, ideas, and controversies. The perhaps inevitable result of the practical constraints placed on his ambitious project is a dense and sometimes allusive discussion. Some readers may find here and there that they lack knowledge Porter presumes, but the notes and references will take care of such problems for the perseverant. Few individual scientists receive really extensive treatment, the notable exception being Hutton. In a penetrating analysis Porter illuminates Hutton's geological work, but largely in order to show him to have been in many respects outside of the British geological mainstream, almost a peripheral figure in the constitution of British geology notwithstanding his creative genius. The rather disproportionate depth and detail Porter devotes to Hutton represent the closest thing to a departure from his plan to construct a broad "interpretative pattern for a lengthy time period," but in view of its quality this is a near anomaly for which we should be grateful. If there are other specific aspects of the subject we might wish to see treated with equal or even greater detail, we can be glad that Porter promises to publish more. Meanwhile this provocative book will be studied profitably by all interested in the history of geology, and it should also bring the field a wider audience.

KENNETH L. TAYLOR
Department of the History of Science, University of Oklahoma, Norman 73019

Neotropical Biogeography

Biogéographie et Evolution en Amérique Tropicale. Papers from a colloquium, Paris, May 1976. H. DESCIMON, Ed. Laboratoire de Zoologie de l'Ecole Normale Supérieure, Paris, 1977. viii, 344 pp., illus. Paper, 80 F. Publications du Laboratoire de Zoologie de l'Ecole Normale Supérieure, No. 9.

Only 18 years ago the most widely used ecology text in American universities said of tropical forests: "Numerous archaic types of both animals and plants survive in the numerous niches of the unchanging environment." The notion of an eternal, imperturbable tropical climate pervaded much of the diversity-stability debate that enlivened ecology in the 1960's. The usual argument was that species diversity was greater at low latitudes because they had not been subjected to the extinctions imposed elsewhere by geologic and climatic change; it appears, for example, in the famous Connell and Orias cybernetic model published in 1964 and, years later, in Pianka's resume of the controversy in his textbook *Evolutionary Ecology*. The book under review here demonstrates just how thoroughly this line of reasoning has been stood on its head in the past few years.

The book is a collection of 11 papers. Most of the contributors are French; two papers are in English and one is in German. (With some notable exceptions, much of the exciting work on ecology and biogeography in Latin America is being done by Europeans and Americans and published in languages other than Spanish and Portuguese, an unfortunate state of affairs that one hopes is a transitory phase in the development of these subjects.) Most of the papers deal with particular groups of organisms rather than broad biogeographic principles. There is one paper each on birds, amphibians, freshwater sponges, and the phytogeography of unforested habitats in the Guianas, and six on Lepidoptera. Except for the paper on sponges, which is primarily taxonomic with some physicochemical "limiting factor" limnology, all the papers are more or less preoccupied with the red-hot subject of Pleistocene climatic change and its consequences for speciation in the tropics.

The editor, Henri Descimon, provides a perceptive introduction in which he underlines current directions and potential problems. He notes the vindication of allopatric speciation à la Mayr in the reinterpretation of Amazonian diversity, where it had always seemed least convincing, and nods in tribute to Robert MacArthur and to island biogeography theory. True, the study of ecological "islands"—nonforest habitats, alpine *páramo*—lends itself to this sort of thing; but it can be argued that the most important cross-fertilization goes in the other direction, in that Pleistocene refugiology has reinvigorated tropical ecology and forced us to think about latitudinal gradients in new and very different ways.

Descimon is cautious. Refugia can explain a great deal, he warns, but not everything. We must beware the tendency to create a refugium to account for every endemic, or to generate new taxa in one group when a refugium is postulated to account for distributional phenomena in another. Very true, but it is reassuring that Vanzolini and Williams working on lizards, Haffer on birds, and Turner on butterflies have generated such similar maps of Pleistocene refugia. (Turner, in his excellent review of *Heliconius* in this volume, gives proper credit to the late R. M. Fox for thinking refugially when he revised the Ithomiid butterflies in 1949. In another paper in the volume, Brown begins what promises to be a demolition of Fox's taxonomic judgments.)

Most of these papers are in the nature of progress reports, but the neotropical data base in certain groups is getting big enough that many of the patterns we see will probably prove robust in the face of future collecting. Up to now, forest butterflies and *páramo* birds have been most useful; now *páramo* butterflies and the high-elevation "temperate" floras