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.

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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

look particularly promising. We can expect increasing help from the paleoclimatologists, who are hard at work in the central and southern Andes.

These are exciting times to be working in the neotropics. Merely keeping abreast of new developments is difficult, and integrating them is a major achievement. This book belongs on the shelf of anyone who is trying. Descimon assures us that refugiology will be overtaken by other approaches in due time. Perhaps; but, in good Latin American style, it has already spawned a revolution.

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Psychopharmacology

Neuroregulators and Psychiatric Disorders. Proceedings of a conference, Asilomar, Calif., Jan. 1976. EARL USDIN, DAVID A. HAMBURG, and JACK D. BARCHAS, Eds. Oxford University Press, New York, 1977. xxx, 628 pp., illus. $29.50.

Our knowledge of the function and metabolism of neurotransmitters and of other compounds that regulate neuronal activity is much more advanced than is our understanding of the role of these compounds in psychiatric diseases. Much of the information we do have about the neurochemical correlates of psychiatric illness has come from studies of the effects of drugs on brain function. The investigation of the mechanism of action of the antischizophrenic drugs, the phenothiazines and butyrophenones, illustrates the important role of pharmacological studies in shaping our ideas in this field. In *Neuroregulators and Psychiatric Disorders*, Snyder and his colleagues review the evidence that these drugs are dopamine-receptor blocking agents. The blocking of dopamine receptors in the basal ganglia by the drugs almost certainly accounts for their production of side effects similar to the symptoms of Parkinson's disease. A plausible and widely held hypothesis is that the antischizophrenic actions of the drugs are due to their interaction with dopamine receptors elsewhere in the brain. A corollary of this hypothesis is that schizophrenia may involve an increase in the activity of dopaminergic neurons. As Matthysse emphasizes, however, there is little independent evidence for an increase in dopaminergic activity in schizophrenia. It is dangerous to extrapolate from the action of a drug to the pathophysiology of a disease.

The study of exogenous psychotogens has also yielded insights into the relationship between neuronal function and psychiatric disease. Chronic amphetamine intoxication produces an illness that is very similar to schizophrenia and that may serve as a model for the disease. Ellinwood and his colleagues describe the changes that result from amphetamine administration and make a special effort to correlate the neurochemical and behavioral effects of the drug. The actions of hallucinogens are even more spectacular, but the relevance of these compounds to normal brain function or to psychiatric disease is still obscure. Five papers, by Saavedra, Koslow, Hollister, Friedhoff, and Gillin and Wyatt, discuss these compounds. It is conceivable that exogenous hallucinogens act by mimicking the effects of some endogenous compound and that the disordered metabolism of this hypothetical endogenous hallucinogen might be related to psychiatric illness. If there are endogenous hallucinogens, *N*-methylated tryptamine derivates now appear to be the most likely candidates. Both tryptamine and a tryptamine *N*-methyltransferase activity are present in brain, and the hallucinogen *N,N*-dimethyltryptamine has been detected in blood.

The remaining chapters are devoted to other specific neuroregulatory compounds. Almost everyone's favorite compound, from prostaglandins to substance P, is discussed. Most of these chapters are similarly organized. They begin by reviewing the occurrence and distribution of some substance in brain, present some new data on the action or metabolism of the substance, and conclude with speculations about the possible role of the substance in mental illness. These chapters illustrate a fault common to much of the research in this field—a delusion of grandeur on the part of the investigator. Snyder *et al.* have pointed out the delusion clearly: "Of the literally millions of chemical systems in the human body, why should nature have chosen to inflict the 'schizophrenic abnormality' upon whatever specific chemical the experimentalist happens to be best equipped to measure?" (*Science* **184**, 1243 [1974]). Many of the chapters will serve as useful introductions to the compounds they discuss, however, and have good bibliographies.

There are several noteworthy omissions from this volume. Although Ciaranello discusses the biochemical genetics of the catecholamine biosynthetic enzymes, the genetics of schizophrenia is mentioned only in passing. This omission is particularly curious because Kety, who has done the pioneering work on this subject, was a participant in the conference from which the book stems. His research has served as a model for the design of well-controlled studies of schizophrenia and has provided some of the most compelling evidence that the disease does have a biological basis.

The book contains only a few minor errors. The editors' use of Try instead of Trp as an abbreviation for tryptophan is idiosyncratic but inconsequential; their use of TRY as an abbreviation for tryptamine, however, invites unnecessary confusion. And the editors have allowed several unfortunate neologisms to creep into the book. One can only hope that "schizotoxin," whatever it is supposed to mean, does not become a permanent addition to our vocabulary.

This is an attractive and well-edited book. On the whole, it provides a valuable survey of the current state of this exciting and important field.

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On Heisenberg's Discovery

The Uncertainty Principle and Foundations of Quantum Mechanics. A Fifty Years' Survey. WILLIAM C. PRICE and SEYMOUR S. CHISSICK, Eds. Wiley-Interscience, New York, 1977. xviii, 572 pp., illus. $42.

This book commemorates the 50th anniversary of Heisenberg's discovery of matrix mechanics. It consists of brief reminiscences by him on the uncertainty relations and 24 essays of great diversity in subject and value by various authors.

About half of the essays are devoted to aspects of the foundations of quantum mechanics. Gudder's "Four approaches to axiomatic quantum mechanics" is a splendid survey, with judicious comments from a unifying viewpoint. Sławianowski's analysis of versions of the correspondence principle—for example, the WKB (Wentzel-Kramers-Brillouin) approximation and the limits of high quantum numbers and of $\hbar \to 0$—is a profound contribution. Ludwig's operational formulation of quantum mechanics in terms of preparing systems and recording is careful but ponderous. Kraus's beautiful paper surveys previous results on the impossibility of photon position observables and cogently argues for relaxing conditions so as to permit their construction; his application of Ludwig's general ideas on measurement provides better evidence for their value than the latter's own exposition. There are two