consistencies and an occasional infusion of laboratory jargon. These are not sufficiently frequent to be irritants and may even contribute to the sense of being there where it is happening that one gets from the overall treatment.

The volume throughout is colored with the bias of present thinking of the inner circle. This bias is not necessarily objectionable provided it is recognized, but it may mislead the innocent. For example, most of the authors tend to deemphasize the fact that the use of the acetylene-ethylene reaction as an indicator of nitrogen fixation is based only on presumption. There is no question of the value of this reaction for field and laboratory studies and as a tool in enzymology, but the calibration is not rigid.

Although admittedly not a complete report of the action in nitrogen fixation, this volume includes much of current thought and is indispensable for anyone interested in nitrogen. Everyone should be.

C. C. DELWICHE
Department of Soils and Plant Nutrition, University of California, Davis

Biodisciplines

Annual Review of Biophysics and Bioengineering. Vol. 1. MANUEL F. MORALES, WILLIAM A. HAGINS, LUBERT STRYER, and WILLIAM S. YAMAMOTO, Eds. Annual Reviews, Palo Alto, Calif., 1972. x, 590 pp., illus. $10.

Compendia are never easy to review, especially if they cover a very broad spectrum of interests as does this first volume of a new series. I doubt that any one person could write authoritatively or even persuasively on all the topics that have been subsumed under these two disciplines whose limits are notoriously ill-defined. Inevitably, therefore, this review will deal with the scope of the book rather than with its content, and, equally inevitably, the reviewer's prejudices are bound to show.

It is worth asking whether it is a mark of scientific respectability to profess a discipline which is a topic of an "Annual Review" and whether the announcement of this volume automatically legitimizes the bioengineer. If so, what of the partnership between biophysics and bioengineering? To pursue these questions too far is to become entangled in semantic snares (is biophysics a branch of biomathematics or vice versa?), but some discussion of the limits and overlaps of the fields is necessary and desirable. We should first ask if engineering is in any meaningful sense a science. The goals of science, it seems to me, are directed to the *understanding* of the world around us, and those of engineering are directed to *modifying* it. Because these goals are not always pursued in the appropriate temporal order, the heavy emphasis on theoretical concepts in this book may be salutary to engineers. They are warned, however, that parts of it will seem very hard going, and they are likely to feel they have less than equitable representation.

The editors say that the "marriage between biophysics and bioengineering . . . was by no means just a union of convenience." They prudishly refrain from mentioning that they have, in fact, established a *ménage à trois* with biochemistry as the dominant partner. At least half the papers could probably be considered in that category, and unless engineering curricula have changed a good deal since my day a critical reading of several of the surveys will be beyond the scope of the bioengineer. The foregoing should not be taken to imply that none of the theoretical papers are valuable to the engineer. Pecora's paper "Quasi-elastic light scattering from macromolecules" describes a technique just due to emerge into practice which will involve advanced engineering concepts. The same is true of the sophisticated computer graphics work of Katz and Levinthal.

There are excellent papers in neurophysiology—a topic of substantial interest to practicing engineers who have traditionally seen links between their networks and those infinitely more refined communication systems found in living things. Ehrenstein and Lecar discuss the mechanism of signal transmission in nerve axons with real authority, and Hagins's discussion of the primary processes in vision is a model of its kind. Both these papers are tutorial in nature rather than surveys of recent work. They are certainly none the worse for this.

In the expectation that other reviews of this volume will come from biophysicists, this bioengineer makes a plea for a broader base in future years. May we have some materials technology, some discussion of orthotic and prosthetic engineering, some details of biological power sources, and some wide view of developments in computer science? These are but a few of the scientific advances which are clearly ready to move from academia to the wider service of man.

HAROLD W. SHIPTON
Bioengineering Resource Facility, University of Iowa, Iowa City

Geomorphology

Hillslope Form and Process. M. A. CARSON and M. J. KIRKBY. Cambridge University Press, New York, 1972. viii, 476 pp., illus. $19.50. Cambridge Geographical Studies, No. 3.

It is customary to bemoan the high cost of technical books, but in this case the contents of the work certainly provide good value for the money spent. The authors selectively consider not only geomorphic but also engineering and agricultural literature to produce a comprehensive survey of the diverse publications pertaining to slopes. Hillslopes have always been a major concern of geomorphologists, and there was a definite need for such a review and synthesis.

Hillslopes in this treatment are not just hillsides; they are taken to include any inclined surface that is composed of earth materials, ranging from short, gently sloping agricultural plots to the massive escarpments of the Colorado Plateaus. As the title indicates, the subject of the work is the form and evolution of slopes, but the major concentration is on the processes operating to cause their modification. In contrast, detailed mapping techniques and the increasingly esoteric theoretical models are given less attention; nevertheless, process-response models are developed, which are based both on physical principles and on the realities of field and experimental evidence.

Of especial value is the interdisciplinary approach, which is obviously necessary when dealing with such a complex subject. The huge body of descriptive literature is not considered except for some necessary examples. Instead, more than half the book is devoted to the pertinent aspects of physics, hydraulics, soil mechanics, rock mechanics, and rock weathering that are basic to the development of a better understanding of slopes. This makes readily available the essence of a very scattered literature. One problem is, of

course, that the application of information from these specialties to the hillslope situation may not be entirely correct. For example, we know a great deal about open-channel hydraulics, but we do not know if the direct application of its principles to overland flow is meaningful. Until further research is performed on the hydraulics of overland flow there is no alternative to this approach, however.

Because of the diverse subjects treated, each reader may find minor weaknesses in the presentation of material with which he is most familiar. For example, the authors perpetuate the error of Horton and of Leopold *et al.* (pp. 210–11) in assuming that Renner's data were presented in degrees; he used percentages. In fact, Renner explained that in his area maximum erosion on 35- to 45-percent slopes was due primarily to the activity of cattle rather than to gravitational and hydraulic interactions as assumed by Horton.

Minor problems aside, the work is indispensable for the geomorphology postgraduate student and his professor. Much future research will be based on the authors' comments, criticisms, and conclusions. They have performed a significant service for their colleagues and for anyone concerned with the changing landscape.

S. A. SCHUMM
Colorado State University, Fort Collins

Effects of Plant Substances

Phytochemical Ecology. A symposium, Englefield Green, Surrey, Apr. 1971. J. B. HARBORNE, Ed. Academic Press, New York, 1972. xiv, 272 pp., illus. $15. Annual Proceedings of the Phytochemical Society, No. 8.

This symposium volume consists of 14 chapters by different authors who discuss a great diversity of phenomena ranging from biosynthesis of fungal toxins to feeding habits of gorillas. The common theme is the worthwhile but often elusive goal of unraveling the ecological functions of secondary compounds in plants. Strictly speaking there is not much ecology in this book. The authors are concerned chiefly with chemical structure, biosynthesis, physiology, and behavioral bioassay in the laboratory. Only in a few instances, such as the studies reported here by C. H. Muller and C.-H. Chou and by D. A. Jones, has there yet been any attempt to evaluate quantitatively the significance of chemical adaptations in natural populations or communities, yet this must be the ultimate objective of the chemical ecologist. Muller and Chou compare various mechanisms whereby terpenoid and phenolic compounds are released by certain shrub and tree species, inhibiting the growth of surrounding and potentially competing vegetation. Jones offers a plausible explanation for the observed polymorphic pattern of cyanogenesis in natural populations of some legume species. Deterrence of herbivores favors cyanogenesis in relatively warm and low-lying areas but is offset at higher elevations by risk of autotoxicity due to frost damage or perhaps by higher metabolic costs associated with cyanogenesis.

Growth rates of phytophagous insects may be determined by the concentrations of relatively few key compounds in their food plants. For two aphid species reared on various cruciferous plants, H. F. van Emden demonstrates that quantitative variation between plants of amino acids and of allyl isothiocyanate alone accounts for most of the variation in aphid performance from one plant to another. The great variety of plants attacked by leaf-cutting ants may be attributable in part to novelty-preference behavior (J. M. Cherrett). Miriam Rothschild emphasizes the importance of the visual acuity of bird predators as a factor in the evolution of the feeding habits of many herbivorous insects. Other chapters concerned with the chemical basis of food plant selection by animals are presented here by E. C. Bate-Smith (higher animals), G. W. Arnold and J. L. Hill (ruminants), and T. A. Rohan (chemistry of flavor).

Reviews of the occurrence, toxicity, and metabolism of secondary compounds in plants are presented by A. Shrift (selenium compounds), E. A. Bell (unusual amino acids), A. R. Mattocks (*Senecio* alkaloids), and M. O. Moss (fungal toxins). Though the impetus for much of the research on these and other toxic plant compounds stems from their possible effects on man and his domesticated animals, ecologists are likely to remain frustrated by the relative lack of information (and sometimes even of concern) as to their functions in natural communities.

The book concludes with two interesting chapters on phytoalexins (B. J. Deverall) and on the chemical mechanisms by which seeds of various parasitic higher plants are stimulated to germinate in close proximity to their host plants (W. G. H. Edwards).

This book is full of interesting facts and ideas and can be recommended both as good reading and as a valuable reference source. A useful feature is the inclusion at the end of the volume of an additional index each for all plant species, animal species, and authors cited in the text.

PAUL FEENY
Department of Entomology and Section of Ecology and Systematics, Cornell University, Ithaca, New York

Oceanography Observed

The Great Ocean Business. BRENDA HORSFIELD and PETER BENNET STONE. Coward, McCann and Geoghegan, New York, 1972. 360 pp. + plates. $12.95.

This is an integrated exploration of the scientific, economic, social, and political consequences of the last two decades of explosive growth in oceanography. Its authors are mainly observers of science rather than practitioners, although Stone has a background in geology. They are journalists, scriptwriters, directors, and broadcasters who have personally interviewed many of the diverse groups of people whose work they discuss. From these beginnings they have gone on to original work at the frontiers of the earth sciences. To quote Sir Edward Bullard's preface, "It is one of the attractions of travelling on a rapidly accelerating bandwagon that so many people jump on, and in two or three years one finds oneself among the oldest travellers and a sage in one's own right."

The first half of the book is concerned with continental drift, sea floor spreading, plate tectonics, and the scientific revolution that these special terms identify. The reader is led through a historical sequence from the ancient time (1910–1920), through the period of descriptive groping (1950's), to the integrating hypotheses of the 1960's.

The authors had to leave the bandwagon sometime, and, allowing for reasonable publishing rates, it probably was near the end of 1970. The output of papers on plate tectonics is doubling every two years. Inevitably the aficionado will find some conclusions out of date. The global model of the sea floor, shown in dramatic photos, is an example of a solidified myth. The descriptive groping still continues.