of disengagement and inactivity vis-à-vis the environment. It is a response characteristically evoked when input becomes or is perceived as excessive and beyond the organism's capacity actively to cope with or becomes or is perceived as inadequate to meet the organism's needs. In behavioral terms, these also define conditions under which the organism loses control by virtue of dissociation between responses and reinforcement. The biological goal of conservation-withdrawal is to conserve resources and to assure autonomy until environmental or internal conditions are more suitable. As a basic biological regulatory system, conservation-withdrawal operates in all forms of life. Seligman's contrived experimental situation is one highly likely to activiate the neurally preprogrammed biological system mediating conservation-withdrawal. Accordingly, what the animal learns is not "helplessness" but the conditions under which there is survival value in responding with conservation-withdrawal. Conservation-withdrawal must be analyzed in biological terms. The way in which the circumstances under which it is to be evoked are learned must be analyzed in behavioral terms.

Once due consideration is given to the various frames of reference implicated in the study of depression, many contributions in the three books fall into place and seminal questions are generated. From both the phylogenetic and the ontogenetic perspective, conservation-withdrawal and the neural organization mediating it may be regarded as the biological substrate for all depressive phenomena that involve reduced activity and passivity. This provides a biological frame of reference. Conservation-withdrawal is experienced as "pseudoanergia," as described by Karno and Hoffman. This is a psychological frame of reference. The behavioral frame of reference helps to define some of the conditions under which the organism learns to invoke conservation-withdrawal. Learning theory and psychodynamic concepts together provide insight into both the developmental and the precipitating factors in episodes of "pseudoanergia," felt conservation-withdrawal, so to speak. But as Beck points out, not all manifestations of depression can be ascribed to a desire to conserve energy. It is in this regard that psychodynamic, including psychoanalytic, perspectives prove helpful, for they provide insight into the multiplicity and complexity of the personality variables that may affect how an individual experiences and responds to giving up and to conservation-withdrawal. Schmale points out that giving up with its associated affects of helplessness or hopelessness may evoke a conservation-withdrawal response or may lead to various defensive and coping maneuvers aimed to overcome giving up or to avert conservation-withdrawal. From this can be anticipated a variety of clinical patterns of depression. Chodoff, noting the lack of evidence for any consistent personality pattern predisposing to depression, proposes that personality patterns exert their effects by coloring and altering the manifestations of depressive illness.

By designating a biological threshold mechanism and response system, conservation-withdrawal, as the keystone of depression in all its forms, it also becomes possible to understand depressive episodes that originate from neural activity, such as ictal depressions with temporal lobe disorders or depressions induced by amine-depleting substances. Similarly, one may postulate that defects in biochemical mechanisms regulating the neural system underlying conservation-withdrawal may result in abnormally low thresholds for induction of depressive reactions or abnormally high thresholds for their termination.

Friedman and Katz's book raises many more questions than it answers, but they are questions that indicate progress toward understanding the spectrum of human experiences called depression.

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Evolutionary Ecology

Coevolution of Animals and Plants. Papers from a symposium, Boulder, Colo., Aug. 1973. LAWRENCE E. GILBERT and PETER H. RAVEN, Eds. University of Texas Press, Austin, 1975. xiv, 246 pp., illus. $12.50. Dan Danciger Publication Series.

This book is a product of a symposium whose 11 contributors were charged to weave together a diversity of fascinating botanical and zoological information, much of it new, in support of coevolution as a process. The authors have worked assiduously in preparing a set of papers that covers a delightfully broad range of topics, concentrating on interactions between flowering plants, insects, rodents, and birds.

Paul Feeny's article on biochemical coevolution is a valuable summary of recent ideas and evidence on the ecological significances of secondary plant chemicals in relation to insect-plant evolution. He lays out clearly the evolutionary and ecological costs of various protective strategies that plants have available to them and develops this within a context of community evolution. Miriam Rothschild presents a broad overview of the evolutionary history and significance of carotenoids and enthusiastically develops what may well prove to be an incisive hypothesis, namely, that these plant pigments have played a major role in providing the biochemical basis for the evolution of the majority of animal senses.

Christopher Smith concentrates on temperate-zone rodents as seed predators and advances the conceptual basis of coevolution and community stability. His presentation provides a fine counterpoint for the well-known work of Daniel Janzen on insect seed predators in the tropics. Brian Hocking, who to everyone's great loss died before seeing his work in print, provides a splendid discussion of the mutualistic relationships of ants and tropical *Acacia* plants, with an emphasis on the energy needs of both.

Calaway Dodson summarizes much of his own and his students' work on the relationship of New World orchids and bees, concluding that with the probable exception of euglossines little coevolution has occurred between the two groups. Herbert and Irene Baker thoroughly review the chemical constituents of nectar together with substantial new results of their own in a characteristically solid and interesting paper. Though they point out that the wide array of chemicals in nectar provides a spectrum of potential interactions and opportunities for coevolution, their evidence argues strongly for long-continued fine tuning by the flowers for their own advantage in exploiting insects and other pollinating animals. Bernd Heinrich develops his ideas on how nectar- and pollen-foraging behavior in bumblebees is largely structured by energetics and presents elegant new supporting data.

In a masterly survey of information on fruit dispersal by birds, Doyle McKey approaches coevolution more as a product than a process. He presents evidence for a major dichotomy between high-quality seed dispersal by specialized frugivores, involving k selection, and low-quality dispersal of large numbers of seeds, involving r selection. The remarkable mechanisms by which seeds are ingested but not digested, as well as a host of other fascinating information, are summarized and related to the long-term evolutionary interplay between tropical fruits and frugivorous birds. Gordon Frankie, in a novel and refreshing manner, summarizes his own and others' extensive research on neo-

tropical forest communities, with emphasis on the diversity of annual cycles of flowering and pollinators in relation to community partitioning. The final article, by Lawrence Gilbert, is a summary of his evidence for coevolutionary interactions between a neotropical butterfly genus and two groups of flowering plants, one of which is used for larval and the other for adult food. His study makes a reasonably convincing case that coevolution has promoted species diversity in all three.

The strength of this book lies in the competence and cogency with which the individual authors present their material. Its weakness lies in a loss of focus on the central theme set out by the editors, namely, coevolution as an important process in community evolution. Thus, only half the articles refer to coevolution in their concluding remarks. Nevertheless, by virtue of the breadth of the information summarized the book presents a challenge, demanding a fuller development of the theoretical aspects of coevolution. For this reason it must be regarded as an important contribution to modern evolutionary ecology.

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Chemistry of Soils

Soil Components. JOHN E. GIESEKING, Ed. Vol. 1, Organic Components. x, 534 pp., illus. $72.80. Vol. 2, Inorganic Components. xii, 684 pp., illus. $74.80. Springer-Verlag, New York, 1975.

As the world demand for food inexorably expands, the applied sciences involved in crop production must inevitably undergo a revitalizing resurgence of interest. Soils, lying literally at the root of all agricultural production, have thus become a renewed focus of attention for researchers. Soil science is no single discipline, but a conglomerate of many aspects of chemistry, physics, and several biological sciences such as biochemistry, microbiology, and botany, and the time is ripe for the experts in the various branches of soil science to create order in their own house, to make it possible to communicate their specialty better to others.

It is encouraging to note that in recent years soil chemists have not been dormant, waiting for the specter of world famine and malnutrition to revert attention to their endeavors, but have been steadily collecting and sifting information, searching for understanding of the intricate chemical mixtures on whose vegetational outgrowths the human populace essentially plays parasite.

These two books reveal through a detailed treatment of the subject that, paradoxically, much but still only little is known about many of the constituents of soil, even when they are considered in isolation from one another. The coverage is wide, but intentionally not exhaustive with regard either to materials covered or to extent of treatment.

The approach is descriptive rather than interpretative: the chemical constitutions and properties of the main soil minerals and the organic constituents of topsoils are methodically reviewed with only minimal discussion of their implications for soil fertility, agricultural production, pedogenesis, soil classification, soil conservation, the suitability of soils for accepting solid or liquid wastes, the interaction of soils with man-made substances, or any other of the practical or ecological concerns that have provided the justification for much recent soil research and that occupy major portions of conventional soil science texts.

The second volume is perhaps the more basic one, providing an excellently organized presentation of the wealth of detail on the crystal structures and properties of the principal soil silicates, clay minerals, crystalline and amorphous oxides and hydrous oxides, fibrous and heavy minerals, and the like that is now available as a result of modern instrumental analyses. Much attention is devoted to classification of minerals according to structural features. The stage has thus been set for a systematic nomenclature for soil minerals. It becomes apparent that the continued use of trivial names will inhibit systematic learning of soil mineralogy.

The volume is rounded off by chapters on biolith inclusions and water in soils. The latter chapter is not the conventional treatise on the physics of water in soil and soil-moisture relationships but rather a consideration of physicochemical soil-water interactions. In other chapters the use of thermal and infrared analysis to characterize clay mineral constituent is thoroughly and excellently reviewed. The important subject of minor and heavy elements in soils is hardly discussed, however.

With soil organics, the heterogeneity is so great that much less is known about their structures in soil. Description of the bulk of soil organic matter—the intractable humic substances—thus reduces to a recounting of physical properties and gross chemical composition and characteristics and speculation about origin and constituents. Unfortunately the main chapter in volume 1, though performing these tasks very well, contains much outdated organic nomenclature. More accurate descriptions can be, and are, provided for the sugar, polysaccharide, organophosphorus, organosulfur, lipid, and nitrogenous organic constituents of soils. Accounts of the microscopic appearance of soil organic matter and the relationships between humus and soil types complete the picture, although these topics lend themselves even less well to systematic treatment and are of questionable appropriateness in a work devoted primarily to chemical aspects of soil components.

While one must admire the effort invested here in collecting and collating data on soil constituents, one must recognize that in the field simple, readily analyzable systems are seldom encountered, and the interaction of inorganic and organic constituents inter se and with the soil solution, soil microbiota, and vegetation creates an immensely more complicated situation. Nonetheless, these authoritative volumes help clarify much of the current status of soil chemistry. Such individuals as can pay the price will get their money's worth.

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Books Received

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