asserting her authority. The historical persistence of this laissez-faire attitude toward the child is illustrated by Lewis's astonishment at the "noise and chaos level of Japanese nursery schools" (p. 196). As Lewis notes, however, such classrooms are not unregulated; rather, the teacher delegates authority to the children themselves and designs her teaching to generate the spirit of group cooperation. Interpersonal harmony, "knowing one's role" (Kojima), and "role perfectionism" (Befu) are equally stressed in Japanese society. These polar views of the child as autonomous and disciplined are reconciled in the cultural emphasis, noted by many contributors, upon "effort" as responsible for accomplishments. White and LeVine find in the common vocabulary defining a good child (for example, *sunao*) a convergence of the child's self-development with the social requirement of cooperation.

Some contributions do not fit the picture outlined above, but deserve mention. Two linguistic papers (Kuno; Hakuta and Bloom) suggest possible foci of investigation for the child's language acquisition. Some of the structural characteristics of the Japanese language emphasize the speaker's empathic relationship with the listener and the person spoken about, thus throwing sidelight upon the Japanese self-concept.

Hatano and Inagaki discuss "two courses of expertise": the adaptive skill involving understanding and adaptability to novel situations, and the routine skill oriented toward efficiency within the familiar repertoire. The authors refrain from characterizing *Japanese* child development, but there are hints that Japan's school education fosters routine skill as exemplified by rote learning. Japanese education is characterized in other papers as biased for processual accuracy at the expense of conceptual grasp. Whether this bias impedes creativity and thus should be regarded as a huge price that Japan is paying in the long run for its short-run success remains unanswered.

The diversity of the papers may frustrate those looking for a coherent thesis; the editors leave the making of connections to the reader. Because of its variety, the collection will appeal to professionals and nonprofessionals, Japan specialists and nonspecialists. Those troubled by the problems of American education will gain new insight, if not solutions, from the cross-cultural material cogently presented. For those interested in further study, the concluding chapter by De Vos and Suarez-Orozco provides pertinent guidelines.

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Continental Geophysics

The Continental Crust. A Geophysical Approach. ROLF MEISSNER. Academic Press, Orlando, FL, 1986. x, 426 pp., illus. $70; paper, $34.95. International Geophysics Series, vol. 34.

Geophysical studies of the continental crust have advanced rapidly in the past decade. This growth followed a preoccupation with the oceanic crust that accompanied the plate tectonics revolution in earth sciences. The period of emphasis on continental studies has been marked by progress in deep seismic reflection and refraction/wide-angle studies, magnetotelluric investigations of deep earth conductivity, potential field investigations of gravity and magnetics, improved laboratory measurements of earth materials, and rethinking of geological concepts by field geologists. In *The Continental Crust* Rolf Meissner succeeds in providing a thoughtful and complete overview of the progress of the past decade, with an emphasis on seismological contributions.

The book is essentially in two parts, each about 200 pages. The first part (chapters 1 through 4) begins with basic definitions of the crust, lithosphere, and asthenosphere from a planetary perspective and continues with a useful discussion of laboratory and field measurements of the physical properties of the lithosphere and its constitutive materials. Included are seismological, electrical, potential field, stress determination, and laboratory methods. Overall, this part of the book is far superior to existing texts on geophysical methods, which are generally geared to seismic exploration rather than broader investigations of lithospheric structure. However, many readers will want to supplement this book with another that gives more details regarding the intricacies of the acquisition, processing, and interpretation of deep seismic reflection data.

The second part of the book presents current ideas regarding the composition, seismic structure, and evolution of the continental crust. The exposition on the mineralogy and petrology of the crust (chapter 5) rarely goes beyond college-level material, and a graduate-level course based on this book would certainly benefit from the addition of an advanced review of the petrology of the crust. The final two chapters, comprising some 150 pages, are more advanced and provide a valuable and insightful discussion of the seismic structure of the earth's crust and its probable evolution. For the research scientist, these highly current and complete chapters will form the heart of the book, material to be read and considered more than once. There exists no comparable critical summary of the key seismological observations and their geological implications. Rather than providing long lists of facts or an endless catalogue of examples, these chapters emphasize what is known about the deep structure of shields, platforms, rifts, orogens, margins, and so forth, and what this structure implies for geologic understanding of crustal evolution. The arrangement of these final chapters in chronological order, from the pre-Archean to the Phanerozoic, provides a valuable perspective on the evidence for changes in the evolution of the crust through time.

The scientific presentation in the book is well balanced, but fortunately Meissner is not averse to revealing his personal views, which have evolved over many productive years of research. Two examples are worth noting. One is his view that vertical crustal accretion (magmatic underplating and similar mechanisms), rather than horizontal accretion, is the primary mechanism of crustal growth. This concept is less surprising when one realizes that Meissner regards the creation of an island arc as vertical growth (upwelling of magma), whereas the horizontal transport and accretion of an island arc at a continental margin are not counted as creating "new" crust. A second novel view concerns the mobility of the crust-mantle boundary in active areas; this concept is invoked to explain unusually thick or thin crust and in some cases multiple Mohos. Recent seismic reflection data appear to support the concept of a mobile Moho.

The Continental Crust is a valuable, important, and much needed addition to the geophysics literature. It is very readable, with clear, well-chosen illustrations. I recommend it highly to students and researchers alike who seek an excellent survey of current geophysical research in continental crustal studies.

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Structure in Ecology

A Hierarchical Concept of Ecosystems. R. V. O'NEILL, D. L. DEANGELIS, J. B. WAIDE, and T. F. H. ALLEN. Princeton University Press, Princeton, NJ, 1986. viii, 254 pp., illus. $45; paper, $14.50. Monographs in Population Biology, 23.

Ecological systems comprise many populations of different species of organisms and the abiotic parts of the environment with which they interact. Such systems have no boundaries in space or time—they are not discrete, identifiable units like organisms.

During the past century, the writings of ecologists have repeatedly exhibited the resulting awkwardness of ecosystem concepts and difficulty in resolving the most fundamental issues. Nowadays most ecologists embrace the idea that system function can be understood as the sum of the behaviors of individual parts (that is, organisms and physical compartments), but the notion that ecosystems are self-regulating "superorganisms" with "individual" purpose has surfaced repeatedly in the literature. Conceptual difficulties have also spawned an unnatural dichotomy between perspectives emphasizing population processes, on the one hand, and such ecosystem functions as energy flux and nutrient cycling, on the other.

In this turbulent and murky atmosphere, any new concept that provided clarification and unity would be most welcome. Measured against this lofty expectation, *A Hierarchical Concept of Ecosystems* provides fresh insight but ultimately fails in its purpose.

O'Neill and his co-authors clearly perceive a modern trend in ecology toward regarding ecological systems as collections of entities and processes occupying a continuum of temporal and spatial scales. They then take the additional steps of suggesting that observable pattern represents organization and that each level in the hierarchy of organization has its own controls and stability. Finally, they suggest that the hierarchical structure itself is the result of system "evolution," that is, that the development of each higher level of organization depends on the dynamic stabilization of the level immediately below it.

According to O'Neill *et al.*, ecosystems are organized into hierarchies of levels, each defined by processes having similar dynamics (revealed, for example, by rate of return to an equilibrium state). Within each level, one finds subsets of processes called holons defined by the strengths of interactions among components. Although the discreteness of levels and holons is arguable, the basic concept seems a reasonable description of structure, particularly when spatial and temporal scales of processes are interrelated. The utility of such a concept will, however, depend on its ability to produce a new and more useful phenomenology of ecosystems and to generate new hypotheses or interpretations concerning the origin and maintenance of their structure.

Hierarchy is a theory, developed in the context of general systems theory, that has found application in engineering and other human endeavors. O'Neill *et al.* claim that the theory predicts the basic features of ecosystem structure and function. But unless I missed something, their presentation of "theory" appears to be a description of structure rather than a set of premises that allow one to predict structure. That the properties of ecosystem structure are predictable is, however, asserted, primarily by analogy to engineered control systems whose relevance to ecological systems is questionable. Also, according to the authors, hierarchy theory has been formalized mathematically, but neither the mathematics nor formal predictions of the theory it represents appear in this book.

A Hierarchical Concept of Ecosystems has four parts. The first is a discussion of ambiguities in the ecosystem concept and the inadequacies of previous attempts to tackle its major issues. The second develops the hierarchical concept, whose utility would seem to be the decomposition of an intractable middle-number system, encompassing all populations and processes, into a nested hierarchy of more tractable small-number systems. The third part transforms "concept" into "theory," relying heavily on analogies to such physical phenomena as the formation of convection cells in heated fluids and evolution of the structure of atoms and molecules. Accordingly, the hierarchical organization of systems develops as externally imposed fluctuations lead to instabilities, which are dissipated (as new stabilities are inaugurated) by the development of higher-level interactions and integration. The final part of the book, Applications, shows how observations and experiments on natural systems and the results of simulations of mathematically defined systems are consistent with the hierarchy concept.

O'Neill *et al.*'s discourse fails to illuminate the control of ecosystem processes and the existence of ecological systems as nontrivial hierarchies of organization. The authors assert that ecosystems contain a natural hierarchical constraint structure and, therefore, that one cannot predict their behavior from the behaviors of their individual parts. The analogies used to support this assertion do not convince me of its validity. We are told that the grouping of trees into a forest "incorporates" (controls, or damps) short-term perturbations to which isolated trees are subjected. Does this mean that the forest exhibits a higher level of organization than the individual tree? In microcosm studies as well as in simulations, the output (system function) often exhibits signals of lower frequency than those of the input (component function), in much the same way as unlike tuning forks together produce a beat at a lower frequency than either alone. These low-frequency signals are accepted as evidence of organization within the system at a higher level than that of the individual components of which the system is made. The authors further assert that organization is based on an asymmetry of effect between levels. Slower (higher) levels dominate and constrain faster (lower) levels, which, because they cannot affect them, follow the slower ones. Physical analogies, microcosm studies, and simulations would seem to argue otherwise, that higher-level properties follow upon lower-level ones. The beat of two tuning forks does not alter or obliterate their individual vibrations. It is a poor analogy, but if one were to filter the higher frequencies the existence of the slower beat would be inexplicable.

Whether the hierarchical organization of the ecosystem is analogous to, or exhibits properties similar to, the management hierarchy of a corporation or the cell-tissue-organ hierarchy of the organism is not made clear. The purpose of the last two is apparent only when the function of the entire unit is understood. The authors do not claim such purposeful behavior of the ecosystem. But if hierarchy theory has value in ecology, it should be able to explain why complex but nonpurposeful collections of interacting elements either resemble or do not resemble purposeful organizations. From premises concerning asymmetry of effect and constraint, the theory should predict whether or not the placing of a component into a larger system changes the underlying dynamics of the individual component or merely their expression. That is, are components subservient to the properties of the larger system or do they determine these properties? If discrete hierarchical levels of organization, and holons within those levels, exist, do they naturally emerge as intrinsic properties of complex systems, are they trivial, statistical consequences of aggregation, or are they imposed by interaction with factors in the physical surroundings of the system that change over a wide spectrum of temporal and spatial scales? Ecologists cannot answer such questions at this time. Hierarchy provides a provocative way of organizing concepts about ecosystems, but as presented in *A Hierarchical Concept of Ecosystems* it is not a theory with clear predictive power in ecology.

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