jo "mercantile interests," moreover, no class of wealthy commercial stockmen developed to challenge the matrilineal inheritance system.

Poewe's approach to her Zambian data is, by contrast, ahistorical. She argues that support for or opposition to matrilineal inheritance among contemporary Luapula depends on class and gender. Male capitalists having annual incomes ranging from 1500 to over 400,000 Kwacha, as well as wives of small capitalists, favor father-centered households, father-son inheritance, and Christian ideologies that advocate these goals. Rich female capitalists and the poorer strata of both sexes support matrilineal inheritance. The rich females have an obvious interest in the status quo and the wives of small capitalists have an understandable interest in change, but why do the poorer strata prefer matriliny? Poewe says they hope for advancement through windfall inheritances, but surely any inheritance system can foster such hopes. One wonders therefore whether some of these people may not be supporting matriliny to avoid offending superiors. Poewe's discussion of this important issue is inconclusive.

Colson has been doing research among the Tonga for 35 years, and the advantages of such extended study are obvious here. Despite extensive change during the present century, neither Plateau nor Gwembe Tonga have altered the main elements of their matrilineal family organization. Among the Plateau Tonga of the 1940's, for example, only the few wealthy males were inclined to follow attempts by British Colonial authorities to undermine matriliny. And even those males acted indecisively because they were uncertain that the advantages of a change in inheritance rules outweighed the disadvantages.

The Gwembe Tonga also support the matrilineal system and have supported it for a variety of reasons not only earlier in the century but in recent periods as well. In the late 1950's particularly, the damming of the Zambezi forced resettlement of the Gwembe Tonga. This led to radical change in the demand for agricultural labor, but it did not destroy the preference for matrilineal labor organization. Nor, when Zambian independence led to a "revolutionary change" in occupational aspirations, did the Gwembe Tonga alter their support for the inheritance rules. Nor, finally, did an increase in immigration to Lusaka and the change to urban living destroy matriliny. Rather, through all these changes, Gwembe Tonga seem to have creatively used their matrilineal beliefs to deal with the new conditions.

Although Kelley, Poewe, and Colson are careful to express doubts about the long-term ability of matriliny to survive, their work taken together clearly indicates that matrilineal family organization may well be much more adaptable to modern conditions than many of us have supposed. Conceivably we will have to explain the demise of those matrilineal systems that have disappeared not by worldwide "unilineal" developments alone but by some much more complex combination of such developments with the specific historical circumstances particular peoples are confronting.

ROBERT A. RANDALL
Department of Anthropology, University of Houston Central Campus, Houston, Texas 77004

Sophisticated Designs

The Mechanical Properties of Biological Materials. Papers from a symposium, Leeds, England, Sept. 1979. Published for the Society for Experimental Biology by Cambridge University Press, New York, 1981. x, 514 pp., illus. $69.50. Symposia of the Society for Experimental Biology, No. 34.

The mechanical properties of biological materials is a relatively new topic that draws on engineering, materials science, polymer science, morphology, and physiology. This book of symposium proceedings is a collection of 18 papers and 11 poster session presentations that spans nearly the entire range of plant and animal materials, including wood and plant cell walls; bone, teeth, cartilage, and keratins; and mollusk shells, silk, insect cuticle, and mucus. Fundamental papers on fracture, composites, elasticity of rubber-like materials, and viscoelasticity, plus the abundant details in the applied papers, provide sufficient background for the nonspecialist in materials science to comprehend this unusual approach to certain areas of biology.

The book emphasizes three categories of features exhibited by the mechanical properties of biological substances. First, organisms utilize both a remarkable variety of physical characteristics and composites of different materials to solve their design problems. Many living organisms cope with excessive loads not by overdesign with large factors of safety but by deflecting under load. For example, small plants such as grasses stand up to routine loads from the wind and their own weight, but when trodden upon they simply buckle and deflect and in due course recover. A tension structure, such as a tendon, is subdivided so as to minimize the transmission of strain energy between fibers. Bending structures, such as the feathers of birds, are made of many isolated and weakly interconnected elements, so that the loss of individual components does not weaken the structure as a whole. Many soft materials such as skin and artery walls have J-shaped stress-strain curves that are initially almost horizontal. Thus, there is virtually no shear modulus at low and moderate strains, and the materials exhibit great tear resistance.

A second category is the importance of a number of levels of structure in determining the mechanical properties of tissues. An excellent example is bone, which can be viewed on four levels of organization. On the molecular level, bone is composed of organic components, principally collagen, which has the good energy-absorbing characteristics of polymers, and inorganic components, chiefly small crystallites of hydroxyapatite, which has two-thirds the stiffness of steel but is quite brittle. The organic and inorganic components are combined on a second level to form a complex heterogeneous and anisotropic composite. The third level is demonstrated by the densely packed concentric lamellar structure, the Haversian system or osteon, which is in part responsible for both the elastic and the viscoelastic behavior of mature cortical bone. On the fourth or macroscopic level, the size and shape of the whole bone must be considered.

Perhaps most amazing of all is the remarkable degree of sophistication of the mechanical properties achieved through evolution. The dragline silk of the *Araneus sericatus* spider has a breaking energy of 158 megajoules per cubic meter and fails at a strain of 0.2 to 0.3, values five to ten times those of cellulose. If the dragline had the same tensile strength but a lower extensibility, less energy would be required to break it and it would be unable to stop the fall of the spider. The energy cost of producing the web is one of the largest energy expenditures of the spider, so it is definitely advantageous to produce a web with a minimum volume of silk and therefore a minimum expenditure in the form of protein secreted. The maximum force that the radial fibers of a web can support is a function of their extensibility, and dragline silk has close to the theoretical optimum value.

The papers in this volume are largely self-contained and can be read independently. In general they are thoroughly referenced. The book contains detailed author and subject indexes. It will be of obvious value to the materials scientist or physiologist working in biomechanics, and it can be read profitably by many molecular, cell, developmental, and evolutionary biologists, as well as by physicians, anatomists, and ecologists.

SIDNEY B. LANG
Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer Sheva, Israel

Patterns of Predation

Predation and Freshwater Communities. THOMAS M. ZARET. Yale University Press, New Haven, Conn., 1980. xiv, 188 pp., illus. $15.

As an alternative to the *post hoc ergo propter hoc* syndrome typified by ecological studies of competition, the author of this book tries "a different approach . . . From inductive reasoning, community models [of predation] are developed. . . . predictions are generated and tested with field data." Zaret has been a leading researcher on size-selective fish feeding, effects of prey visibility on rates of predation, and vertical migration as an antipredator tactic in both temperate and tropical lake ecosystems. He thus writes with authority on the effects these and other aspects of predation have on freshwater communities. The result will certainly be of interest to ecologists seeking readable descriptions of the various processes by which predation molds the structure of natural communities and to freshwater biologists desirous of a well-referenced review of research on interactions among pelagic animals in lakes.

However, the book does not provide concise, quantitative models of predation that would serve as a basis for significant advancement in lake ecosystem studies. The models presented in chapter 6 are simple summaries of community patterns presented in earlier chapters along with descriptions of the species interactions (also presented earlier) that generate them. We learn that, when predation by planktivorous fish is moderate in lakes of northeastern United States, predation by invertebrates tends to be intense. This leads to the predominance of prey species 0.8 to 1.8 millimeters long that have reduced visible body size (to avoid vertebrate predators) and enlarged helmets and tail spines (to foil the invertebrate predators). The models provide interesting and perceptive accounts of predation mechanisms that lead to community patterns routinely observed in lakes, although, curiously, the commonly observed coexistence of *Bosmina* and *Epischura* is not predicted. Too qualitative and descriptive to provide any but the most generalized predictions, these models also come dangerously close to being truisms. Field tests of the models presented in chapter 7 are based on two data sets (Galbraith's on Michigan lakes and Brooks and Dodson's on Connecticut lakes) that have already been cited in the development of the models. A third test data set (Nilsson and Pejler's on Swedish lakes) necessitates the development of a new submodel to account for the observed patterns.

Zaret considers the polarization in lake studies that has developed between "predationists" and "competitionists" to be counterproductive. He sensibly recommends that studies seeking to elucidate the ecological conditions under which each process is dominant will be the most profitable. Agreed; however, I think an important but little-discussed difference between the two processes deserves emphasis. Zooplankton communities in which competition predominates are inherently more efficient at transferring energy from algae to fish than are those in which the extra trophic link of predation is present. Thus for studies of lake productivity the distinction between competition and predation is important, whereas for explanations of why a small cladoceran disappears following removal of fish planktivores it is of little value. In fact, throughout the book Zaret gives little consideration to energy flow and ecological efficiency in lakes, emphasizing instead factors determining the densities of predators and their prey. Granted he makes no claim to address these problems, but some report of the considerable quantity of data on effects of prey size on fish growth efficiency and relations between production efficiency and body size in lakes would have been useful. Zaret's decision not to deal with algal grazing by zooplankton will be a disappointment to algologists who consider this to be a legitimate case of predation.

In his appended "further considerations" Zaret lists some interesting problems yet to be resolved. How do prey patches affect planktivore feeding? Why do tactile feeding copepods and filter-feeding cladocerans need eyes? Are toxic prey rare in lakes because, at the low light levels in which fish planktivores feed, aposematic coloration is ineffective? Does *Leptodora*'s strong oxygen dependency affect its ability to compete with other invertebrate predators? These and other questions are useful, but the list could become quickly dated because of the rapid progress of zooplankton ecology. Since the publication of the book it has already been shown, for instance, that cyclomorphosis in some *Daphnia* species (which Zaret correctly interprets as an antipredator tactic) can be induced by chemicals from notonectid and chaoborid predators. Because the book was a long time in preparation (since 1974) much recent work is not adequately incorporated, particularly that presented in the large volume published after the Dartmouth zooplankton symposium (*The Ecology and Evolution of Zooplankton Communities*, W. C. Kerfoot, Ed., University Press of New England, 1980).

Although this book is clearly a labor of love, it does not make a major contribution to the study of predation in freshwater communities and thus cannot be highly recommended.

W. G. SPRULES
Department of Zoology, Erindale College, University of Toronto, Mississauga, Ontario L5L 1C6

Books Received

Advances in Electronics and Electron Physics. Vol. 55. L. Marton and C. Marton, Eds. Academic Press, New York, 181. xii, 404 pp., illus. $62.

Advances in Organometallic Chemistry. Vol. 19. F. G. A. Stone and Robert West, Eds. Academic Press, New York, 1981. x, 318 pp., illus. $54.50.

The Americas in the 1980's. An Agenda for the Decade Ahead. Alejandro Orfila. University Press of America, Washington, D.C., 1980. viii, 158 pp. Cloth, $17.25; paper, $8.75.

Animal Diversity. Milton Fingerman. Saunders, Philadelphia, ed. 3, 1981. viii, 310 pp., illus. Paper, $9.95. Modern Biology Series.

Animal Physiology. Adaptations in Function. F. Reed Hainsworth. Addison-Wesley, Reading, Mass., 1981. xxvi, 670 pp., illus. $24.95.

Annual Review of Earth and Planetary Sciences. Vol. 9. George W. Wetherill, Arden L. Albee, and Francis G. Stehli, Eds. Annual Reviews, Palo Alto, Calif., 1981. x, 502 pp., illus. $20.

Annual Review of Public Health. Vol. 2. Lester Breslow, Jonathan E. Fielding, and Lester B. Lave, Eds. Annual Reviews, Palo Alto, Calif., 1981. xii, 506 pp., illus. $20.

The Biology of Desmids. Alan J. Brook. University of California Press, Berkeley, 1981. x, 276 pp., illus. $50. Botanical Monographs, vol. 16.

Burn-Out. The High Cost of High Achievement. Herbert J. Freudenberger with Geraldine Richelson. Anchor (Doubleday), Garden City, N.Y., 1980. xxiv, 216 pp. $9.95.

Carbon Dioxide and Climate. Australian Research. Papers from a symposium, Canberra, Sept. 1980. G. I. Pearman, Ed. Australian Academy of Science, Canberra, 1980. vi, 218 pp., illus. A$19.95.

Cryptography. A Primer. Alan G. Konheim. Wiley-Interscience, New York, 1981. xvi, 432 pp. $34.95.

Cunningham's Textbook of Anatomy. G. J. Romanes, Ed. Oxford University Press, New York, ed. 12, 1981. xii, 1078 pp., illus. $39.50.

Desertification of the United States. David Sheridan. Council on Environmental Quality, Washington, D.C., 1981 (available from the Superintendent of Documents, Washington, D.C.). vi, 142 pp., illus. Paper, $4.25.

(Continued on page 1286)