not be expected. The soil nutrient factor is deliberately excluded from discussion. Most of the articles begin with concise and informative literature reviews of the theoretical problems. The authors have not tried to simplify the application in practice, but have pointed out gaps, due mainly to a lack of adequate methods for physiological analyses, between climatology and biochemistry on the one hand and practical yield on the other. Any given article may contain little that is new to a specialist in its field; the book should be read by those who are interested in the whole problem of vegetable production. It is then a source of information for agronomists, plant physiologists, and experimental ecologists alike.

If anything is to be criticized it ought to be the meager treatment of protein production, which is considered only with respect to the rather specialized rice plant, with matters of more general importance taken up only by a discussant. On the credit side, it should be mentioned that although a conference report the book is not burdened by rhapsodic discussion minutes.

H. G. BURSTRÖM
Department of Plant Physiology,
University of Lund,
Lund, Sweden

Superior Designs

Strength of Biological Materials. HIROSHI YAMADA. F. Gaynor Evans, Ed. Williams and Wilkins, Baltimore, Md., 1970. x, 298 pp., illus. $22.50.

Yamada, in the introductory chapter of his book, makes two interesting statements: "A full understanding of the structure of human and animal bodies depends upon a knowledge of strength of biological materials. Engineers are greatly interested in the superior designs of the Creator in order to formulate ideas for the construction of machines." The first sentence describes the author's purpose in writing the book; the second describes the aspects of the book this reviewer has found most fascinating.

Strength of Biological Materials is a vast compilation of data in both graphical and tabular form (235 figures and 190 tables), measured by Yamada and his students over a period of 25 years and previously available only in the Japanese language. It is probably the largest and most complete collection of information on the strength and other mechanical properties of biological tissues available. Tests of properties such as tensile, compressive, bending, torsional, and impact strength, and expansion, bursting, tearing, cleavage, abrasion, shearing, crushing, and hardness, were conducted with fresh, unembalmed material and standard or specially modified engineering test equipment. The test material included locomotor, circulatory, respiratory, digestive, urogenital, and nervous system organs and tissues of humans, other mammals, birds, reptiles, amphibians, and fish. An especially valuable section describes the effects of age changes on the strength properties. A chapter on materials and test methods and a glossary of engineering terms make the book reasonably self-contained. The data appear to be of high quality, with careful attention given to statistical variation of test material.

Some intercomparisons of biological data from the book and their similarities and contrasts with conventional industrial materials have provided this reviewer and his colleagues with a number of hours of stimulating thought and discussion. Some typical examples follow: Among human tissues, hair is by far the strongest (ultimate tensile strength 19.7 kg/mm^2, comparable to that of rolled aluminum), a fact probably not surprising to anthropologists. The second strongest type of tissue is compact bone (such as femur), with an ultimate tensile strength of 10.9 kg/mm^2, almost the same, on a weight basis (specific strength), as that of mild steel. Surprisingly, bone has an elongation at rupture of only 1.4 percent compared to 25 percent in mild steel. Most of the soft tissues reported behaved as elastomers, such as rubber, becoming stiffer as they were stretched. But in contrast to rubber with its maximum elongation at rupture of hundreds of percent, the elongation at rupture of calcaneal tendon is only 9 percent. The biological necessity of small elongations in tendon is obvious, but the sophistication of a structure which exhibits such behavior is remarkable.

This book should be of significant value as a collection of data, but even more as a source of ideas for investigations by the "biological materials scientist."

SIDNEY B. LANG
Department of Chemical Engineering,
McGill University,
Montreal, Quebec, Canada

Atmospheric Economics

The Value of the Weather. W. J. MAUNDER. Methuen, London, 1970 (U.S. distributor, Barnes and Noble, New York). xxvi, 388 pp. + plates. Cloth, $12; paper, $6.50.

This book concentrates on an attempt to place a "value" on the atmosphere as a resource, or more specifically on such natural weather elements as rain, temperature, wind, and storms. It also considers the value of artificial modification, both intentional and inadvertent, the latter including air pollution and its effects, of weather and climate information, and of weather predictions.

The author's primary concern seems almost foolish, since the atmosphere is essential as a medium for life and thus must be assigned an infinite value which is not reduced by losses due to storms, frost, or other phenomena, or augmented by conditions favorable for crop growth or business activity. Insofar as the information he presents serves as a basis for decision-making through the use of weather and climate records, weather predictions, or weather modification procedures, however, the main body of the book contributes to answering the more reasonable questions, How valuable are the services provided by government weather bureaus and private meteorological consultants? and How much would their value be increased through the improvements planned under such programs as the World Weather Watch and the Global Atmospheric Research Program?

The book is largely a literature survey, reviewing studies of such matters as the loss of life and property from floods and hurricanes, the dependence of agricultural yield on precipitation, temperature, and sunshine, the economic benefits to airlines from artificial fog dispersal at airports, the relationships between weather and riots and weather and crime, and the effects of weather on health. Methods of studying these relationships are reviewed, including modeling of economic consequences of weather variations and the utilization of weather forecasting and weather modification. The results of some cost-benefit studies are presented; these show that the economic benefits from use of weather predictions depend strongly on the cost of protective measures, but may be very great.

Air pollution is referred to in sev-

eral places, both as a negative value in itself and as the cause of inadvertent weather modification that has potentially adverse effects on various aspects of human activity. Thus econometric voices are added to the chorus condemning the blight that economic activity—the production of goods and services—has given rise to.

Regrettably, the book is repetitious and awkwardly written. However, to my knowledge there is no other place where one can find a comprehensive guide to the literature on the costs and losses of adverse weather elements and the possibilities of benefits accruing from intelligent use of currently available weather information and methods of weather modification and from future improved methods of forecasting and modifying the weather.

M. NEIBURGER
Department of Meteorology, University of California, Los Angeles

Geology Byte by Byte

Computer Simulation in Geology. JOHN W. HARBAUGH and GRAEME BONHAM-CARTER. Wiley-Interscience, New York, 1970. xiv, 576 pp., illus. $24.95.

Today more than ever geologists feel the need to frame their conclusions in more quantitative terms. To some extent, this feeling stems from the ever-increasing amount of quantitative data being collected in geological studies, but in larger measure it reflects the growing trend toward a mechanistic approach in describing the dynamic processes that have shaped the earth's surface, past and present. This new text in quantitative geology is written by geologists for geologists. Actually, as the authors point out in the preface, simulation is not a new concept in geology. Geologists have long been engaged in formulating conceptual models for testing hypotheses concerning earth history. What is new about simulation brought on by the computer is the numerical treatment of geological data in a model framework which has enabled the geologist to portray his data and characterize his results on a scale that heretofore was not possible. Because numerical simulation has developed a methodology of its own, the authors have sought to introduce these techniques to the geologist at a level commensurate with his background.

The first two chapters of the book introduce the reader to a systems viewpoint in geology. Here the classes, uses, and construction of simulation models are discussed. The prime example of a dynamic quantitative model given, that of the study by Briggs and Pollack (1967), who interpreted the pattern of evaporite deposition during Silurian time in the Michigan basin, serves to motivate the reader to learn more about simulation techniques. The techniques are described in chapters 3 through 8, which comprise slightly more than half the book and cover a variety of mathematical methods, most of which are unfamiliar in detail to most geologists. Included are the generation of random variables, Markov chains, fluid flow and diffusion equations and their numerical solutions, control theory, and optimization methods. In each case, the concept underlying the method is introduced and the basic theory outlined briefly; this is followed by a discussion of the application of the method in different situations. In keeping with a practical approach to problem solving advocated by the authors, computer algorithms written in Fortran IV are provided. Problem sets follow each chapter.

Chapters 9 and 10 deal with the application of numerical simulation to problems in geology. Chapter 9 deals mainly with applications in sedimentation, the field of specialization of the authors. It is in this chapter that their firsthand knowledge of the use of computers in geology is most evident. Chapter 10 contains a summary of applications in simulation to other areas of geology, among them ecology, paleontology, geochemistry, petrology, structural geology, geophysics, geomorphology, and hydrology. Perhaps of greatest value in this last chapter is the bibliography given at the end of each section.

It is premature to state what importance numerical simulation will have in influencing geological thinking in the years ahead. It does seem clear, however, that as more geologists come to use computers for processing data, sooner or later they will wish to use the computer as an experimental tool. When they do, it is likely that they will turn to this book for the details.

RICHARD B. MCCAMMON
Department of Geological Sciences, University of Illinois at Chicago Circle, Chicago

New Journals Received

Cosmic Electrodynamics. An International Journal Devoted to Geophysical and Astrophysical Plasmas. Vol. 1, No. 1, April 1970. Four issues a year. Editor: C. P. Sonett (NASA, Ames Research Center). D. Reidel Publishing Co., P.O. Box 17, Dordrecht, Netherlands. To institutions $35, to individuals $15.40, plus postage.

Gynecologic Investigation. International Journal of the Science of Reproduction. Vol. 1, No. 1, 1970. Bimonthly. Editor: W. L. Herrmann (University of Washington School of Medicine). S. Karger, Publishers, P.O. Box 352, White Plains, N.Y. $16.20.

Marine Geophysical Researches. An International Journal for the Study of the Earth beneath the Sea. Vol. 1, No. 1, August 1970. Quarterly. Editor: B. J. Collette (University of Utrecht). D. Reidel Publishing Co., P.O. Box 17, Dordrecht, Netherlands. To institutions $36.40, to individuals $11.20, plus postage.

Ophthalmic Research. Vol. 1, No. 1, 1970. Bimonthly. Managing editors: O. Hockwin (Bonn), G. Naumann (Hamburg), D. F. Cole (London). S. Karger, Publishers, P.O. Box 352, White Plains, N.Y. $16.20.

Steroidologia. European Journal of Steroidology. Vol. 1, No. 1, 1970. Bimonthly. Editor: M. Marois (Paris). S. Karger, Publishers, P.O. Box 352, White Plains, N.Y. $16.20.

Theory and Decision. An International Journal for Philosophy and Methodology of the Social Sciences. Vol. 1, No. 1, October 1970. Five or six issues a year, four issues per volume. American editors: W. Leinfellner (University of Nebraska) and A. C. Michalos (University of Guelph). D. Reidel Publishing Co., P.O. Box 17, Dordrecht, Netherlands. To institutions $19.95, to individuals $11.15, per volume.

Books Received

The Actinomycetales. The Jena International Symposium on Taxonomy, Jena, Germany, September 1968. H. Prauser, Ed. Fischer, Jena, 1970. 440 pp., illus. Paper, DM 90.

Assessment of Brain Damage. A Neuropsychological Key Approach. Elbert W. Russell, Charles Neuringer, and Gerald Goldstein. Wiley-Interscience, New York, 1970. xii, 168 pp., illus. $12.95. Series on Psychological Disorders.

Development and Evolution of Behavior. Essays in memory of T. C. Schneirla. Lester R. Aronson, Ethel Toback, Daniel S. Lehrman, Jay S. Rosenblatt, Eds. Freeman, San Francisco, 1970. xviii, 856 pp., illus. $12. A Series of Books in Psychology.

Disciplines in Combinational and Sequential Circuit Design. R. M. M. Oberman. McGraw-Hill, New York, 1970. xiv, 754 pp., illus. $19.50. Electrical and Electronic Engineering Series.