nitrosamine, for which the lung is the principal target regardless of its mode of entry. Certain respiratory viruses behave similarly, going to lung preferentially, and these also may be important as cofactors or as initiators of DNA alterations in pulmonary cells.

The five-paper section on cellular and functional injury following inhalation exposure is not immediately relevant to carcinogenesis, but it establishes the sensitivity of radioactive thymidine indices of DNA synthesis and cell turnover in the alveolar portion of the respiratory tract, which reflect injury to the lung. Susceptibility of the lung to bacterial infection is also a sensitive measure of injury. However, no clear case can yet be made for relationships between cell turnover and carcinoma or between susceptibility to infection and carcinoma.

The results of cigarette-smoking experiments in rodents and dogs are important to hasten abandonment of such exposure by humans, to locate the carcinogenic agent, and perhaps to stimulate development of a "safer" cigarette. W. Dontenwill's experiments on long-term exposure of hamsters, mice, and rats to cigarette smoke to simulate human exposure have evolved to allow analysis of epithelial changes, including tumors in the larynx and precancerous lesions beyond, and of deposition by ^{14}C labeling of cigarette smoke. In the hamster about 48 percent of deposition is in the head and palate and 52 percent in larynx, trachea, and lungs. In these experiments and also in Auerbach's the airway epithelial changes are impressive, though invasive tumors are infrequent. Cigarette smoke causes accumulation of macrophages in alveoli, and this effect in the absence of clearance of these cells may have important sequelae. The book serves as a description of the techniques of inhalational exposure, a review of some aspects of cell injury, and a progress report on the special subject of inhalation exposure in experimental carcinogenesis. Plans pointing toward a "systems" approach to inhalation carcinogenesis by the National Cancer Institute, the National Institute for Environmental Health Sciences, and the Atomic Energy Commission are described. It should be of greatest interest to investigators in this field.

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Sponges

The Biology of the Porifera. Proceedings of a symposium, London, Sept. 1968. W. G. FRY, Ed. Published for the Zoological Society of London by Academic Press, New York, 1970. xxviii, 512 pp., illus. $22.50. Symposia of the Zoological Society of London, No. 25.

This volume is the proceedings of a symposium on the biology of sponges which virtually all the investigators in the world currently working with this phylum attended. Approximately 50 people were there. The papers presented at the symposium are ordered under five headings: The Palaeontological Evidence, Spicules and Evolution, Ecology and Biogeography, Biochemistry and the Cell Surface, and Cells, Integration and Morphogenesis. The proceedings as a whole make interesting reading because many of the papers present conflicting views and because there are so few investigators working on sponges that everyone has to be a generalist. It is refreshing to read a paper by an ecologist that refers to a study by an embryologist and vice versa. By and large the students of sponge systematics and phylogeny handle controversial issues in a respectable manner. The investigators working on the biochemistry of the sponge cell surface, however, have gotten to the point where one party, A. S. G. Curtis, denies the existence of the species-specific cell sorting out that the other two investigators in this area, A. P. MacLennan and T. Humphreys, use as an assay in their work. This case seems more like stubbornness than controversy.

One of the highlights of the meeting was the report of W. D. Hartman and T. F. Goreau on coralline sponges. The fossil record indicates that sponges were dominant reef builders during Paleozoic times; there has been no good evidence that sponges play such a role today. Hartman and Goreau have discovered a class of sponges, initially thought to be corals, that appears to be continually consolidating the bases of reefs today in much the same way the fossil forms did.

The part of the symposium that I found the most interesting was the section on integration and morphogenesis. The work that is summarized here is forcing zoologists to change the way they look at sponges. Traditionally the Porifera have been distinguished from more complex animal phyla because they do not have a consistent organization above a cellular level. This diagnosis has led to the view that sponges are bags of cells. The elegant experiments of H. Mergner on the formation of the osculum have shown that tissue layers are probably the most important units in the integration of morphogenetic events in sponges. This point is also made very convincingly in the papers of R. Borojević and C. Lévi, who review their excellent histological and experimental studies which define at least some of the factors that control the histogenesis of the various cell types in sponges during embryogenesis.

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Productivity in Plants

Physiological Aspects of Crop Yield. Proceedings of a symposium, Lincoln, Neb., Jan. 1969. JERRY D. EASTIN, F. A. HASKINS, C. Y. SULLIVAN, and C. H. M. VAN BAVEL, Eds. American Society of Agronomy and Crop Science Society of America, Madison, Wis., 1969. xx, 396 pp., illus. $10; to members of the societies, $8.

Based on 16 lectures, this conference report intends to cover the strictly theoretical aspects of the study of crop yield, from climatology to biochemistry and physiology, and selected practical measures. The task seems formidable, but by careful choice of speakers and restrictions of the topic the organizers have succeeded in it. They present a homogeneous, well-balanced volume with contributions of a uniformly high standard and hardly any overlapping.

The dominating theme is the production of organic matter in photosynthesis in relation to microclimate and crop morphology and the distribution of the organic matter leading to the practical yield. Comprehensive treatments are given of plant morphology and leaf pattern, irradiance, gas exchange, and water stress in crop stands, as well as of the biochemistry of photosynthesis and photorespiration insofar as knowledge of these processes is required for understanding production. Perhaps the most striking link between theory and practice is the demonstration of the importance of the "source to sink" principle of nutrient transport for the formation of the plant products. Strictly practical measures for increasing yield, called manipulations, are treated only by means of examples, and more could

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.

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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."

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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-