

will have to be taken into account, with special consideration of sport for the handicapped, now being studied by such experts as Sir Ludwig Guttmann, Hans Lorenzen, Max Halhuber, and Daniel Brunner.

Eventually, the writer of a book on exercise physiology will have to be able to take it for granted that his readers are acquainted with standard works on medical physiology and biophysics such as those by Ruch, Bard, and Sodeman, as well as with the extensive literature on coaching. Much of the material contained in Harold B. Falls's new and well-produced volume will be found relevant to such a treatise.

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## Plant, Soil, and Atmosphere

**Water Deficits and Plant Growth.** T. T. KOZŁOWSKI, Ed. Vol. 1, Development, Control, and Measurement (xiv + 394 pp., illus. \$17.50). Vol. 2, Plant Water Consumption and Response (xiv + 336 pp., illus. \$15). Academic Press, New York, 1968.

Knowledge of plants as a factor in water consumption and of water as a factor in plant growth and development has never been so important as in this age of ever-increasing demands for water conservation and higher crop yields. This two-volume treatise on plant-water relations provides a timely and authoritative reference for workers of many disciplines involved in the surging research activity of this field.

Fourteen prominent plant, soil, and atmospheric scientists from the United States and abroad contributed to this work. Volume 1 is devoted largely to discussions of the physical properties of water in plants and soils and of the physics and dynamics of water movement through the complex soil-plant-atmosphere continuum. Here the authors make use of basic principles of heat and mass transfer and the tools of mathematics to emphasize the conceptual point of view. The concepts generally are related well to plant structure and function and supported by pertinent literature and experimental evidence. In some places, however, the physical descriptions are terse, and many readers probably will find it necessary to consult other references for full comprehension and appreciation of

the particular matter being discussed.

The continuing terminology problem of how best to describe the energy state of water in soil and plant systems is considered in detail by the late S. A. Taylor and touched on from time to time by other authors. While it is good to see the term "water potential," based on the thermodynamic concept of chemical potential, somewhat formally adopted for the entire treatise, there are some inconsistencies in its use by various authors and some unnecessary uses of the related, but less meaningful, diffusion pressure deficit terminology.

Included in volume 1 is a long and exceptionally fine chapter by H. H. Barrs on the determination of plant water deficits. Although some readers will question some of his views of thermocouple psychrometry for measuring leaf water potential, his discussions of various methods nevertheless provide useful guidelines, and, one hopes, will help standardize the methodology of the field.

Volume 2 is concerned with applied aspects of plant-water relations. Included is a chapter by P. W. Talboys on vascular wilt diseases, a unique contribution not found in earlier works devoted to plant-water relations. Otherwise, the volume is concerned with evapotranspiration from agricultural crops and forest stands and with physiological and growth responses of herbaceous and woody plants to water deficits. However, probably not more than 25 percent of the combined text of the two volumes is devoted to growth responses. Even though this is an improvement over existing texts on plant-water relations, one can validly question whether the entire work is properly titled.

The relatively small coverage given to the physiological role of water in plant growth unfortunately reflects the amount of past research on the subject. C. T. Gates in his excellent chapter on the effects of water deficits on the development and growth of herbaceous plants acknowledges that most research on plant-water relations has been devoted to the study of water movement into, through, and from plants, and he makes a strong plea for future emphasis on truly definitive analyses of the growth response to water deficits.

Indeed, this approach to plant-water relations research deserves increasing attention. Perhaps one of the most successful ways we can increase the water use and production efficiency of crops

is by incorporating into the plant genetic makeup adaptive mechanisms for maintaining favorable rates and quality of growth under suboptimum water conditions. This can best be achieved by generating selection criteria from a better understanding of the biochemistry and physiology of water in growth and in water-deficit control mechanisms.

The authors of this treatise do not emphasize this point of view, but their contributions summarize existing knowledge and concepts of plant and soil water relations on which the wide range of workers charged with the responsibility of increasing water use and production efficiency can build. These contributions are important and useful additions to the field.

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## Radiation Reactions

**Energetics and Mechanisms in Radiation Biology.** Proceedings of a NATO Advanced Study Institute, Portmeirion, Wales, 1967. GLYN O. PHILLIPS, Ed. Academic Press, New York, 1968. xviii + 530 pp., illus. \$22.50.

Under the joint direction of G. O. Phillips and R. Mason, 36 radiation scientists gathered in Portmeirion, Wales, 1-11 April 1967, for an Institute sponsored by the North Atlantic Treaty Organization. Their subject: the fundamental physics and chemistry of radiobiology. Their intent: mutual education and enlightenment. Their contribution to radiation research: a large, well-produced volume consisting of 32 papers covering a gamut of topics from the production of elementary radiochemical species in water to radiation effects in living cells and tissues.

For the wider audience to whom this monograph is addressed, it should be noted straight away that more than 80 percent of the material concerns radiation physics and chemistry. Perhaps this is justified in view of the diverse nature of the radiation reactions involved even in homogeneous condensed matter, but it follows that the biological content is restricted with respect to topics and points of view. The Institute itself may have succeeded in developing a meaningful level of interdisciplinary communica-

tion, but its proceedings do not. This monograph will appeal mainly to those interested in radiochemical processes either because they themselves are specialists in one or another aspect of radiochemistry or because as biologists they are willing to make the considerable effort required to develop an overview of present-day radiochemical research. To both groups, the biology may be of interest, but there is not enough of it to justify the price of admission.

Among the principal chemical topics taken up, the solvated electron quite reasonably occupies a considerable amount of space. Since the demonstration of its existence by Boag and Hart some six years ago, research involving this short-lived species has led to renewed vigor in chemical studies directed toward biological questions. Reviewed as well are studies of organic semiconductors, radiation transformation of organic compounds, irradiation-produced thermoluminescence, mechanisms of energy transfer in and between molecules, radiolysis of dyes, and radiation effects in carbohydrates and cellulose. The biological topics include damage and repair mechanisms related to replication in phage and bacteria and effects of radiation in connective tissue, blood vessels, heart muscle, and the eye. Significant degenerative changes in the condition and functioning of these structures after moderate doses of radiation are reported.

One might suppose, from the title *Energetics and Mechanisms in Radiation Biology*, that the contributors to this volume have identified and discussed those specific radiochemical processes that are responsible for at least an appreciable number of biological effects. Titles, by their nature, are often too brief to be adequately informative, but still it should be noted that this one implies a state of understanding that does not as yet exist. To be sure, many of the reactions and processes reviewed very likely do play a role in a number of biological effects. But regrettably it is also true that mechanisms of fundamental and general importance remain unidentified—a fact which reflects how numerous the reactions attendant upon the initial absorption of radiant energy are.

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## Regeneration

**Principles of Regeneration.** RICHARD J. GOSS. Illustrated by Louise Russell. Academic Press, New York, 1969. xii + 292 pp. \$11.50.

This book deals with regeneration of missing parts of organisms. General principles are sought as the author leads one through the best-studied cases. The cases range from replacement of major parts of the cell in single-celled plants and animals through replacement of major parts of the body in certain invertebrates to replacement of such things as lenses, jaws, parts of the brain, and appendages in fishes and amphibians. The final case is that of regeneration of horns and antlers. In many animals any part can be regenerated provided its removal does not kill before regeneration can occur.

Most of the book is devoted to experiments on regenerates. For example, in attempts to learn what information passes from a salamander's limb stump to a regenerate arising from it, various structures have been added to or subtracted from the stump. If a hand and a longitudinal half of the limb stump are removed, so that only half of a stump is left, the regenerate is usually only half of a hand. However, if half of the internal structure of the stump is removed but the skin is left whole the regenerate will be a complete hand. By such manipulations at the tissue level a considerable amount has been learned about the operation of fields of regeneration. The experiments and the results are clearly described. One gets a clear picture of the status of the problems, and many readers will be able to think of further experiments that might improve our understanding.

One thesis pervades the book. Regeneration is a fundamental property of life. The ability to regenerate has been lost in many parts of many organisms. In the course of evolution it has often been of survival value to acquire some physiological advantage which precludes regeneration. Whether the ability can be restored in a particular case will depend on our knowledge of the physiological change.

This book should appeal to many who want an introduction to the subject. To others it would be of value as a refresher because it covers the most modern as well as the older work.

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## Books Received

**Acid-Base Behavior in Aprotic Organic Solvents.** Marion Maclean Davis. National Bureau of Standards, Washington, D.C., 1968 (available from the Superintendent of Documents, Washington, D.C.). vi + 154 pp., illus. \$2.25. NBS Monograph 105.

**Advances in Clinical Chemistry.** Vol. 11. Oscar Bodansky and C. P. Stewart, Eds. Academic Press, New York, 1968. xviii + 358 pp., illus. \$16.50.

**Advances in Electronics and Electron Physics.** Vol. 25. L. Marton and Claire Marton, Eds. Academic Press, New York, 1968. x + 350 pp., illus. \$16.

**Advances in Heat Transfer.** Vol. 5. Thomas F. Irvine, Jr., and James P. Hartnett, Eds. Academic Press, New York, 1968. xii + 540 pp., illus. \$22.50.

**Advances in Immunology.** Vol. 9. F. J. Dixon, Jr., and Henry G. Kunkel, Eds. Academic Press, New York, 1968. xiv + 290 pp., illus. \$13.50.

**Advances in Marine Biology.** Vol. 6. Frederick S. Russell and Maurice Yonge, Eds. Academic Press, New York, 1968. x + 406 pp., illus. \$17.50.

**Advances in Materials Research.** Vol. 3. Herbert Herman, Ed. Interscience (Wiley), New York, 1968. x + 422 pp., illus. \$19.50.

**Advances in Organometallic Chemistry.** Vol. 7. F. G. A. Stone and Robert West, Eds. Academic Press, New York, 1968. xii + 340 pp., illus. \$16.

**The Age of Discontinuity.** Guidelines to Our Changing Society. Peter F. Drucker. Harper and Row, New York, 1969. xiv + 402 pp. \$7.95.

**Air Pollution.** Vol. 3, Sources of Air Pollution and their Control. Arthur C. Stern, Ed. Academic Press, New York, ed. 2, 1969. xxvi + 870 pp., illus. \$47.50. Environmental Sciences Series.

**Algae, Man, and the Environment.** Proceedings of an International Symposium, Syracuse, N.Y., 1967. Daniel F. Jackson, Ed. Syracuse University Press, Syracuse, 1968. x + 554 pp., illus. \$18.

**Almost Periodic Functions.** C. Corduneanu, with the collaboration of N. Gheorghiu and V. Barbu. Translated from the Romanian edition (Bucharest, 1961) by Gitta Bernstein and Eugene Tomer. Interscience (Wiley), New York, 1968. x + 246 pp. \$13.50. Interscience Tracts in Pure and Applied Mathematics, No. 22.

**American Society for Testing and Materials Proceedings.** San Francisco, 1968. Vol. 68, Committee Reports. American Society for Testing Materials, Philadelphia, 1968. viii + 568 pp. \$12.

**Analytical Heat Diffusion Theory.** A. V. Luikov. James P. Hartnett, Ed. Translated from the Russian edition (Moscow, 1967). Academic Press, New York, 1968. xvi + 688 pp., illus. \$32.50.

**Anatomy of the Newborn: An Atlas.** Edmund S. Crelin. Lea and Febiger, Philadelphia, 1969. xiv + 258 pp., illus. \$24.

**Annual Report on Support of University Research, 1967-68.** Published under the authority of Charles Mills Drury by the National Research Council of Canada, Ottawa, 1968. x + 342 pp. Paper, 50¢. NRC No. 10238.

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