

gation and evolution of species. Chapter 3 deals with the morphological and functional differentiation of gametes (or conjugants) in various groups. Chapter 4 reviews the special mechanisms, often ingenious devices, which facilitate meeting of the gametes, such as chemotaxis and trapping of male gametes, mating behavior, and seasonal effects. Chapter 5 is devoted to the cellular mechanisms in the cytoplasmic and nuclear union of the gametes. Specific receptor substances, egg-membrane lysins, and the role of the acrosome in sperm entry are discussed, including recent electron microscopic observations. Chapter 6 gives an account of the general structural and metabolic changes observed in eggs upon sperm entry, with special reference to the mechanisms excluding supernumerary spermatozoa from the fertilization process. Chapter 7 discusses some un-

usual and aberrant types of fertilization.

The text is concisely and clearly written, with abundant illustrations. A detailed subject index is provided. There is a classified and selected bibliography.

This is an excellent book, and the author is to be congratulated for having selected so many illuminating examples and for integrating the data into broad principles and generalizations. The general reader should find it a useful, and conveniently compact, source of information. It is indispensable reading for students of fertilization. The broad scope and unifying concept of the book should help fill the gap that often exists between workers in various fields of reproductive physiology.

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Chemical Properties of Thermal and Mineral Waters

Japan is noted for its numerous hot springs of widely differing chemical types, and for its extensive utilization of these springs for bathing and therapeutic purposes. Because these thermal and mineral waters are important in the lives and economy of the Japanese, hot springs have been studied extensively by geochemists, geologists, and geophysicists. To a far greater extent than in any other country, this effort has been made by the staffs of the chemistry departments of universities.

Since 1935, more than 500 papers have been published, almost all of them in Japanese, in chemical journals. Thus, the literature is not well known outside Japan, nor is it readily available to most earth scientists. Yasumitsu Uzumasa's purpose in writing this book, **Chemical Investigations of Hot Springs in Japan** (Tsukiji Shokan, Tokyo, Japan, 1965. 189 pp.), was to review the more important results and to make these results available in concise form to non-Japanese scientists. Professor Uzumasa is well qualified for this task because he, his associates, and his students at the University of Hokkaido have been responsible for a very considerable part of the total output.

Prior to 1935, nearly all analyses of spring waters included only the common constituents—sodium, calcium, magnesium, silica, the carbonates, sulfate, and chloride. Since then, many advances have been made by the Japa-

nese and others in developing new methods for water analysis, and much attention has been focused on the minor or trace constituents of hot spring waters.

The nine chapter titles are: "General aspect," "Methods of analysis," "Common constituents," "Minor constituents," "Radioactivity," "Hot spring deposits," "Origin and mechanism of flow of hot springs," "Activity of mineral waters," and "Utilization of hot springs."

The author has accomplished his first objective admirably. The text and its extensive bibliography (535 items) give earth scientists a very good coverage of the Japanese literature to date. A few of the more notable springs of each region are described briefly. Relatively little original data are quoted; instead, constituents are arranged statistically on graphs or are grouped by concentration range.

In the chapter on minor elements, frequency diagrams of individual elements are plotted on a logarithmic scale; each element tends to occur through a concentration range of about three orders of magnitude. A few conclusions that relate content to type of water are reached in this section. The ratios of lithium/sodium in hot spring waters, for example, range from 0.1 to 6×10^{-3} , and these values are higher by one or two orders of magnitude than those of oil-field brines and

sea water. The author and his associates have made many careful searches for the minor alkali metals lithium, rubidium, and cesium. Frequencies of occurrence of each metal in the different concentration ranges (log scale) are compared with the ranges that Japanese geochemists have observed in river water, sea water, oil-field brines, and average igneous rocks; other ratios are similarly compared. The graphs emphasize previously recognized tendencies for enrichment in lithium/sodium, cesium/sodium, and cesium/potassium in hot spring waters relative to other natural waters.

Japanese geochemists have been interested in the radioactivity of thermal and mineral waters for more than 50 years, and have paid special attention to radium. Other studies are concerned with the disintegration products of radium, uranium, and the thorium series.

Results of Kitano's studies of carbonate deposits, and natural conditions of formation of calcite versus aragonite are reviewed. Aragonite is favored by high rate of precipitation and high content of strontium, magnesium, and to lesser extents of other substances. Many thermal springs deposit native sulfur. Arsenic sulfide (orpiment?) is abundant at Nasu. Tamagawa Springs in Akita Prefecture deposit a lead-bearing variety of barite, called hokutolite, which is also rich in radioactive elements.

The author's summary of current interpretations by Japanese geochemists of the origin and mechanism of flow of hot springs of different types is one of the most useful chapters of the book. All gradations may exist between high-temperature, acid, volcanic fumaroles, discharging from new lava at the surface, and neutral alkali chloride waters related to magma at considerable depth. The fascinating Tamagawa Springs are the most notable example of an intermediate type. The chemistry of these springs has been studied in detail by Minami, Iwasaki, and their associates; the rate of discharge of the main spring is an astonishing 9200 liters per minute at a temperature of 98°C; pH of the water is only 1.2! In this chapter, Uzumasa also emphasizes the importance of the halides in distinguishing oil-field brines from sea water and most hot spring waters. Oil-field waters are generally slightly enriched in bromine/chlorine and are markedly enriched in iodine/chlorine and bromine/iodine relative to most other waters.

Some recent Japanese studies on the influence of precipitation and tides on

discharge and geyser activity are reviewed. The final chapters treat utilization of hot springs, especially for therapeutic purposes, but the recently developing interest in geothermal energy and their possible usefulness in predicting volcanic eruptions are also noted.

The author only touches on such geologic aspects as structural control and the influence of specific rock types on the chemical compositions of hot spring waters, leaving these subjects for future study by geologists or geochemists.

Because the general approach is to consider the chemical constituents singly or in small groups, the chemical, physical, and geologic aspects of individual hot spring areas are dispersed throughout the book. Nevertheless, even for one whose interest is focused on a single area, this volume fills a long-existing need. The extensive bibliography can serve as a guide for those who wish to acquire additional chemical detail. About 190 different hot spring areas are listed in the index.

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Colleges of Agriculture

The College of Agriculture: Science in the Public Service (McGraw-Hill, New York, 1966. 249 pp., \$6.95), by Charles E. Kellogg and David C. Knapp, reflects present trends in the development of three functions of the colleges of agriculture within the land grant system—resident instruction, research, and extension education. The majority of the book is devoted to resident instruction at the undergraduate and graduate levels, with emphasis on the former.

During 3 years of visiting campuses and reviewing literature the authors gained an excellent perspective of the colleges of agriculture, and they have described quite accurately the trends in thinking of deans and directors of research, extension work, and resident instruction.

The authors have not hesitated to reflect their own views concerning what they consider the best of what they observed in undergraduate education. Furthermore, they express their own views of what colleges of agriculture should provide in the way of curriculum con-

tent and organization, counseling services, and public information programs as well as their views on the quality of instruction. Emphasis has been placed on the development of curricula heavily weighted toward basic courses in the natural sciences, social sciences, and humanities. Major changes in the curriculum which they favor are (i) a curriculum that includes mathematics through calculus and a foreign language; (ii) an introduction to the biological sciences by way of a molecular biology course rather than through the conventional introductory courses in botany, zoology, and bacteriology; and (iii) the elimination of the conventional introductory agricultural courses taught in the freshman year because the subjects must be taught again when the students have gained a foundation in the physical and biological sciences.

The authors feel that until the land grant colleges of agriculture become overcrowded, states should not attempt to provide additional colleges of agriculture. The technical courses in agriculture could be taught in the junior and senior years which would permit more students to take their first two years in a junior college or perhaps at another university and thus relieve some overcrowding. A case is made for colleges of agriculture offering shorter programs that range up to 2 years in length.

They suggest that colleges of agriculture provide three courses which would help orient the agricultural students during their first two years in college: (i) A broad course in the history of agriculture that deals with the social, economic, and political problems associated with the development of agriculture; (ii) a broad course in world agriculture that would provide a perspective of the main crops of the world; and (iii) a broad course in soils that would provide the students with a worldwide perspective of soils and related natural resources.

The authors have developed a useful guide for those who shape policy in colleges of agriculture. However, had the authors served as deans of agriculture, I suspect they would have a greater appreciation for the role of vocational agriculture and freshman courses in agriculture in motivating and sustaining the interest of students in a field so vital to the welfare of this country.

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New Books

Biological and Medical Sciences

The Chemistry of Wheat Starch and Gluten and Their Conversion Products. J. W. Knight. Leonard Hill, London; Chemical Rubber Co., Cleveland, Ohio, 1965. 168 pp. Illus. \$12.

Current Topics in Radiation Research. vol. 2. Michael Ebert and Alma Howard, Eds. North-Holland, Amsterdam, 1966. 408 pp. Illus. \$12.60. Seven papers: "Radiation chemistry of synthetic macromolecules in solution, LET effects" by A. Henglein and W. Schnabel; "Some chemical and biological effects of elastic nuclear collisions" by H. Jung and K. G. Zimmer; "Energy transport in carbohydrates" by Glyn O. Phillips; "The molecular basis of biological effects of ultraviolet radiation and photoreactivation" by Jane K. Setlow; "Approaches to the determination of the initial sites of action of radiations in *Escherichia coli* and yeast" by F. Joset, E. Moustacchi, and H. Marcovich; "Radiopathology of extracellular structures" by R. Brinkman and H. B. Lamberts; and "Radiation biology as applied to radiotherapy" by J. F. Fowler.

Electrolytes, Fluid Dynamics, and the Nervous System. Joseph Henry Cort. Czechoslovak Acad. of Sciences, Prague; Academic Press, New York, 1965. 231 pp. Illus. \$10.

The Entomology of Radiation Disinfection of Grain. P. B. Cornwell, Ed. Pergamon, New York, 1966. 256 pp. Illus. \$10. Thirteen reports on work carried out by the Entomology Group of the Wantage Research Laboratory, 1955 to 1961.

General Biology. James Watt Mavor and Harold W. Manner. Macmillan, New York, ed. 6, 1966. 720 pp. Illus. \$8.95.

Modern Life Science. Frederick L. Fitzpatrick and John W. Hole. Holt, Rinehart, and Winston, New York, 1966. 576 pp. Illus. \$5.60.

Peptides and Amino Acids. Kenneth D. Kopple. Benjamin, New York, 1966. 149 pp. Illus. Paper, \$3.95; cloth, \$8. The Organic Chemistry Monograph Series, edited by Ronald Breslow.

The Physiology of the Mouth. G. Neil Jenkins. Davis, Philadelphia, ed. 3, 1966. 507 pp. Illus. \$11.50.

The Prenatal Lung. S. Engel. Pergamon, New York, 1966. 79 pp. Illus. \$7.

Radiological Anatomy. D. Nagy. Translated from the Hungarian edition (1959) by A. Deák. Pergamon, New York, 1965. 526 pp. Illus. \$17.50.

Sand and Water Culture Methods Used in the Study of Plant Nutrition. E. J. Hewitt. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England, ed. 2, 1966. 561 pp. Illus. \$15.

Sex Determination. Guido Bacci. Pergamon, New York, 1965. 318 pp. Illus. \$15. International Series of Monographs in Pure and Applied Biology, vol. 26, edited by G. A. Kerkut.

A Survey and Illustrated Catalogue of the Teredinidae (Mollusca: Bivalvia). Ruth D. Turner. Museum of Comparative Zoology, Harvard Univ., Cambridge, Mass., 1966. 275 pp. Illus. \$8.