

All in all, the book is clearly written and concise, and it has good numerical examples dispersed throughout as well as problems at the end of each chapter.

But one is left wondering about the pedagogical problem—do prospective students really obtain the best introduction to chemical engineering from a textbook in which a multitude of topics are introduced or should students be given thorough fundamentals and applications in separate courses in thermodynamics, chemical kinetics, and mathematics (including numerical analysis and computer techniques)? Should the first introductory course in chemical engineering be restricted to elements of the energy and material balance, including stoichiometry, and the other subjects left to subsequent courses?

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## Constituents of Life

**Comparative Biochemistry.** A comprehensive treatise. vol. 4, pt. B, *Constituents of Life*. Marcel Florkin and Howard S. Mason, Eds. Academic Press, New York, 1962. xxiii + 841 pp. Illus. \$26.

Volume 4 of this encyclopedic series opens with T. L. V. Ulbricht's stimulating discussion of the fundamental aspects of the optical asymmetry of metabolites. It is gratifying to note that Kögl's work is discussed in its true perspective.

The chapter on cellulose, starch, and glycogen (by J. S. Brimacombe and M. Stacey) provides an up-to-date review of this aspect of comparative biochemistry. F. F. Nord and W. J. Schubert have compiled an account of the biochemistry of lignin formation, from which it is apparent that our knowledge of this process is quite fragmentary, despite the tremendous amount of research that has been carried out in this field. Nature can be very reluctant to unveil its secrets!

G. Brawerman and H. S. Shapiro have assembled a wealth of information in the chapter that deals with nucleic acids. The unique occurrence of cytoplasmic DNA-containing particles ( $\kappa$  and  $\lambda$ ) in certain strains of *Paramecium aurelia* was overlooked, however. The evaluation of

variations in the protein molecule, especially when viewed in the framework of the phyletic position these biomacromolecules occupy, and of their possible role in evolution at the molecular level forms the basis of the thought-provoking chapter, "Protein molecules: Intra-specific and interspecific variations" by A. Vegotsky and S. W. Fox. The comparative aspects of the metabolism of aromatic amino acids (L. M. Henderson, R. H. Gholson, and C. E. Dalglish) are lucidly treated in a review that includes more than 500 references.

The next three chapters (on structural and chemical properties of keratin-forming tissue by A. G. Matoltsy, sclerotization by M. G. M. Pryor, and silk and other cocoon proteins by K. M. Rudall) present discussions of three important classes of biomacromolecules. The capacity of a single enzyme system to allow the heterotypic expression of traits that are associated with the development of a different character in various organisms is truly fascinating. These traits include the formation of an exoskeleton, of protective tissues, and of fibrous materials essential for the propagation and the preservation of species. The fact that similar mechanisms occur in the formation of flower pigments, flavonoids, melanins, and lignins, as well as in the pigmentation of the teguments, feathers, scales, hair, and eyes of chordates leads us to believe that nature is simple indeed and that the economy of tools may be looked upon as an essential feature of all living systems [H. A. Krebs, *British Medical Bulletin* 9, 92 (1953)].

The chapter on blood coagulation (by C. Grégoire and H. J. Tagnon) is concerned with a polymerization process of prime significance in the homeostatic processes and, consequently, in the preservation of the vertebrate body. In the chapter on metamorphosis and chemical adaptation in amphibia, T. P. Bennet and E. Frieden summarize the biochemical data available on this subject and discuss the protein transformations during amphibian metamorphosis. The following three chapters (on the structure, distribution, and metabolism of porphyrins by C. Rimington and G. Y. Kennedy, the structure and metabolism of pteridines by H. S. Forrest, and the structure, distribution, and function of carotenoids by T. W. Goodwin) continue the discussion of polymerization processes that operate in the formation of compounds

which are of great importance for life under earthly conditions. The volume closes with H. B. Steinbach's fine discussion of the comparative aspects of the biochemistry of alkali metals.

Twelve of this volume's 15 chapters are concerned with nature's important polymers and polymerization processes; thus, volume 4 presents a continuity that is lacking in volume 3 [reviewed in *Science* 137, 745 (1962)]. Although the editors were confronted with serious difficulties in insuring publication without delay, it would have been much more preferable to follow the original plan of organization. If chapters 7 (on natural saccharides and oligosaccharides), 10 and 11 (on the structure, distribution, and metabolism of terpenoids), and 12 and 13 (on quinones and melanins) published in volume 3 had been combined with the 12 chapters mentioned above, a volume of unique continuity would have resulted.

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## Transition Metal Chemistry

**Introduction to Ligand Field Theory.**

Carl J. Ballhausen. McGraw-Hill, New York, 1962. ix + 298 pp. Illus. \$11.75.

Ligand field theory, a theory of the electronic structures, atomic configurations, spectra, and magnetic properties of transition element coordination complexes, has become highly fashionable only in the last decade, but in fact (at least with respect to the crystal field theory contained in it) the theory dates back to Becquerel's and Bethe's famous papers in 1929 and to the important contributions made by Kramers, van Vleck, and others a little later. A book which represents the present state of the subject and which is written by one of the principal contributors to its recent development and applications will be welcomed by those who work in the field and by those who only wish to learn something about it. Such a book was indeed overdue. The only previous work that covered comparable ground, Griffith's *The Theory of Transition Metal Ions* (1961), is possibly too formidable for any but true aficionados. Orgel's *An Introduction to Transition*

*Metal Chemistry* (1960), a valuable but brief and nonmathematical survey, is not truly comparable.

Ligand field theory depends heavily on the theory of atomic spectra, group theory, and molecular orbital theory, and approximately one-third of the book is devoted to a rather condensed development of these fundamentals. The reader's understanding of elementary quantum mechanics should be at about the level of that in the book by Pauling and Wilson or the one by Schiff, and he should have at least a smattering of group theory (including representation theory).

Crystal field theory is developed in greatest detail for the octahedral field, in the weak, strong, and intermediate field cases, but a brief parallel development is also given for the more important lower symmetries. As examples, wave functions and energy expressions are worked out in detail for  $d^1$  and  $d^9$  configurations. In a later chapter, spin-orbit splittings of crystal-field configurations are discussed and applied to calculation of  $g$  factors and magnetic susceptibilities. A chapter on vibronic interactions deals largely with band intensities for vibronically allowed transitions and ends with an extensive and valuable discussion of Jahn-Teller configurational instability.

Other topics, which are discussed more briefly, are the Faraday magneto-optic effect, optical rotatory dispersion, electronic structures of "sandwich" compounds such as ferrocene, and spectrochemical and nephelauxetic series and thermodynamic stabilities of complex ions. The final chapter, a systematic discussion of selected inorganic complex ions and their spectra, is especially valuable for its 435 references to the original literature. References in the remaining chapters add up to a nearly equal number.

The author's approach is intentionally utilitarian rather than elegant. His intent was to write for chemists, not for theoretical physicists. Possibly some chemists will wish for a little more formalism and elegance in some areas, especially in the application of group theory. However, the essential content is clear, and the book is reasonably easy to read.

Without doubt this book will occupy a prominent position in this field for years to come.

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## Weather Technology

**Cloud Physics and Cloud Seeding** (156 pp.); **Radar Observes the Weather** (159 pp.). Louis J. Battan. Doubleday, Garden City, N.Y., 1962. Illus. Paper, 95¢ each.

These paperbacks are volumes in the Science Study Series created by the Physical Science Study Committee, originally organized at Massachusetts Institute of Technology and now operating under the aegis of Educational Services, Inc. (Watertown, Mass.). The committee was fortunate in obtaining the services of Louis J. Battan to write these volumes. Battan (Institute of Atmospheric Physics, University of Arizona) is one of the outstanding authorities on the subjects, and he writes in a free, informative style.

In *Cloud Physics and Cloud Seeding* his approach is fundamental and direct; Battan begins with the condensation nuclei, "the building blocks of clouds," then discusses clouds as collections of water droplets, mostly 10 to 20 microns (four to eight ten-thousandths of an inch, according to the appendix) in diameter, which can be collected and studied in detail. After illustrating how ice crystals form in various kinds of clouds, the author devotes a special chapter to them and includes pictures of their delicate tracery. Then he is ready to discuss the formation of rain, snow, and hail.

In the final 40 pages, Battan treats the scientific basis and the practical application of artificial modification of clouds. This excellent exposition of a difficult subject has statistical ramifications that are based, to a large extent, on Battan's own experience.

Battan has already published a scholarly book on weather radar, and *Radar Observes the Weather* again shows his intimate knowledge of the subject. The principles of radar and its application to the detection of rain, hail, snow, thunderstorms, tornadoes, and hurricanes are described in an exciting manner. The reader is taken easily and naturally into such intricate subjects as Rayleigh and Mie scattering, index of refraction, and iso-echo contour mapping. Finally, the use of radar by airplane pilots and some interesting special applications are treated.

I have not tested these books on their intended reading audience —

high school students, amateur scientists, and "interested laymen"—so I can give only my impression of their probable effectiveness with these readers. But I believe the books will be extremely well received by the audience for whom they are intended.

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## New Books

### General

**The Book of Health.** A medical encyclopedia for everyone. Compiled and edited by Randolph Lee Clark and Russell W. Cumley. Van Nostrand, Princeton, N.J., ed. 2, 1962. 912 pp. Illus. \$16.50; deluxe ed., \$25.

**The Cabot Voyages and Bristol Discovery under Henry VII.** James A. Williamson. Cambridge Univ. Press, New York, 1962. 348 pp. Illus. \$7.50.

**Carnegie Institution of Washington Year Book, 1961.** Carnegie Institution of Washington, Washington, D.C., 1962. 537 pp. Illus. \$1.50.

**The Common Market.** The European community in action. J. Warren Nyström and Peter Malof. Van Nostrand, Princeton, N.J., 1962. 134 pp. Illus. Paper, \$1.45.

**The Genetic Code.** Isaac Asimov. New American Library, New York, 1963. 187 pp. Illus. Paper, 60¢.

**William Harvey.** Trailblazer of scientific medicine. Rebecca B. Marcus. Watts, New York, 1962. 137 pp. Illus. \$2.95 (juvenile book).

**Johannes Kepler.** And planetary motion. David C. Knight. Watts, New York, 1962. 192 pp. Illus. \$2.95 (juvenile book).

**The New Soviet Society.** Final text of the program of the Communist Party of the Soviet Union. With annotations and introduction by Herbert Ritvo. *New Leader*, New York, 1962. 251 pp. Paper, 75¢.

**Puerto Rico.** Ally for progress. Earl Parker Hanson, Van Nostrand, Princeton, N.J., 1962. 136 pp. Illus. Paper, \$1.45.

**Science Writer's Guide.** John Foster, Jr. Columbia Univ. Press, New York, 1963. 271 pp. \$6.

**A Short History of Medicine.** Charles Singer and E. Ashworth Underwood. Oxford Univ. Press, New York, ed. 2, 1962. 874 pp. Illus. \$10.

**State and Local Taxes for Public Education.** Jesse Burkhead. Syracuse Univ. Press, Syracuse, N.Y., 1963. 123 pp. Illus. Paper, \$1.75.

**The Travels and Controversies of Friar Domingo Navarrete 1618-1686.** vols. 1 and 2. J. S. Cummins. Cambridge Univ. Press, New York, 1962. vol. 1, 283 pp., vol. 2, 321 pp. Illus. \$7.50 each.

**Water Atlas of the United States.** Basic facts about the nation's water resources. David W. Miller, James J. Geraghty, Robert S. Collins. Water Information Center, Port Washington, N.Y., 1962. 7 pp + 40 plates. Illus.