

from the 21-centimeter line in 1951 and in 1954, his part in establishing the synchrotron nature of the emission in the continuum of the Crab Nebulae, his discovery of the high-velocity clouds in the central regions of our galaxy during the late '50's, and his continued participation in the work of the great radio-observatories of Holland. All these and much more testify to Oort's unique place in the astronomy of this century.

Oort's contributions to astronomy are enhanced by his inspiration and guidance of successive generations of astronomers who have gone to Leiden to learn from him. Besides, he has played a major role in international organizations such as the International Astronomical Union: Oort was the General Secretary of the International Astronomical Union for some 13 years (1935-1948) and President for three years (1958-1961). He was also the initiator and guiding spirit in the building of the radio astronomical observatories at Dwingeloo and Westerbork and in later years also of the European Southern Observatory.

This handsome volume describes all of these accomplishments and gives a picture—often intimate—of the manner of man Oort is. The reviewer was particularly impressed by the papers by Blaauw, by van der Laan, and by Margaret and Geoffrey Burbidge describing the many phases of Oort's scientific contributions. Papers by Christiansen and by Allen and Ekers describe in considerable detail Oort's contribution to radio astronomy and his part in the building of the great radio-observatories in Holland. And there are several papers devoted to recollections and remembrances which provide a charming picture of Oort's humaneness and of his relations with his students and his colleagues. It is clear from these tributes that his associates value his personal friendship almost as much as his scientific contributions.

I have not had the good fortune to have been associated with Oort in any substantial way, but I do recall his visiting the Yerkes Observatory of the University of Chicago, as a guest of his friend, the late Gerard Kuiper, in 1959. During an hour's discussion I had with Oort, he described with great enthusiasm his then recent discovery of the nature of the high-velocity clouds in the center of the galaxy. But toward the end, with his natural politeness, he asked me of my own interests. When I mentioned to him the results of some laboratory experiments in hydromagnetics that had just been completed by one of my associates, Oort asked me, "But when are you going

to come to grips with the real problems of astronomy?" The real problems of astronomy have always been Oort's abiding concern.

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Biogeochemistry

Environmental Chemistry of the Elements. H. J. M. BOWEN. Academic Press. New York, 1979. xvi, 334 pp., illus. \$43.50. Revision of *Trace Elements in Biochemistry* (1966).

How much copper is there in kale? Can fungi live without zinc? What is the titanium content of the average human diet? What elements tend to accumulate in cultivated soil? What is the metabolic role of molybdenum? For the answers to questions like these, consult this compilation of the basic data of biogeochemistry.

In chapter 6, "The elemental composition of living matter," we learn that kale contains 4.9 milligrams of copper per kilogram of dry matter. Chapter 8, "Essentiality, deficiencies and toxicities of the elements," tells us that fungi require zinc for healthy growth, as do bacteria, blue-green algae, green algae, and seed plants. Table 8.7 lists elements in human diets; these include titanium at the rate of 0.8 milligram per day. Chapter 12, "Environmental effects of human activities," includes an illuminating discussion of the geochemical budgets of typical soils. Arsenic, cadmium, fluorine, iron, lead, selenium, and vanadium are the elements that appear to be accumulating in moderately contaminated, cultivated soils. Chapter 9, "Chemical forms and functions of the elements," reveals that molybdenum is a constituent of several oxidases, a dehydrogenase, and the nitrogenase enzyme system.

The last chapter, "Elements in the geosphere and the biosphere," presents a summary of biogeochemical data, arranged alphabetically by element, for all of the elements in the periodic table up to curium. Data for a typical element occupy half a page and include: abundances and half-lives of naturally occurring stable and radioactive isotopes; average concentrations in various types of rock as well as fresh water, sea water, and air; common minerals; concentrations in various classes of organisms, as well as information on essentiality, toxicity, and accumulator species; natural organic compounds and biochemical functions; and a

list of recent review articles. This compilation of data is compact but easy to understand.

Perhaps a third of the rest of the book is occupied by detailed tabulations of data, and the text is equally rich in hard fact. There is little interpretation, explanation, or speculation, and perhaps this is a weakness. This is a book about the where and the what of biogeochemistry, not the why and the how. The tables provide ready answers to specific questions, but more extensive use of graphs might have made it easier to perceive patterns in the chemical interaction of organisms and their environment.

This interaction offers many opportunities for interesting and important research. Biogeochemical knowledge contributes to the realistic assessment of the hazards of pollution, improved potential for sustainable exploitation of earth's living resources, and a clearer understanding of factors that have affected the course of biological evolution. Bowen has advanced biogeochemistry both with his *Trace Elements in Biochemistry* (Academic Press, 1966) and with this expanded and up-to-date volume.

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Books Received

Acute Toxicity in Theory and Practice. With Special Reference to the Toxicology of Pesticides. V. K. Brown. Wiley-Interscience. New York, 1980. x, 160 pp., illus. \$28. Monographs in Toxicology.

Adaptation to Thermal Environment. Man and His Productive Animals. Laurence E. Mount. University Park Press, Baltimore, 1980. xiv, 334 pp., illus. Paper, \$27.50. A Series of Student Texts in Contemporary Biology.

Advances in Aquatic Microbiology. Vol. 2. M. R. Droop and H. W. Jannasch, Eds. Academic Press, New York, 1980. xii, 356 pp., illus. \$46.

Basic Chemistry. General, Organic, Biological. Denis M. Callewaert and Julien Genyca. Worth, New York, 1980. xxiv, 838 pp., illus. \$19.95.

Basic Pharmacology for Health Occupations. Henry Hitner and Barbara T. Nagle. Bobbs-Merrill, Indianapolis, Ind., 1980. viii, 272 pp., illus. Paper, \$12.95.

Beginning Algebra for College Students. Karl J. Smith and Patrick J. Boyle. Brooks/Cole, Monterey, Calif., ed. 2, 1980. xiv, 448 pp., illus. \$15.95.

Biochemical Characterization of Lymphokines. Proceedings of a workshop, Ermatingen, Switzerland, May 1979. Alain L. de Weck, Flemming Kristensen, and Maurice Landy, Eds. Academic Press, New York, 1980. xxxii, 622 pp., illus. \$39.50.