

absorption maximum at 275 $m\mu$ (molar extinction coefficient of 13,900 liters per mole $cm.$) and a minor absorption maximum at 225 $m\mu$ (molar extinction coefficient of 2980 liters per mole $cm.$).

It is not our purpose at this time to attempt any explanation of the mechanism of the formation of 2-hydroxyacetyl-furan from sugars. The study of the formation and further decomposition of this

compound during the dehydration of sugars is being continued.

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BOOK REVIEWS

Chimie Physique. By GUY EMSCHWILLER, Professeur à l'École Supérieure de Physique et de Chimie Industrielles de Paris. Vol. I, Thermodynamique chimique. Equilibres gazeux. ix + 440 pp., 34 figs. 14 × 19 cm. Price, 1200 fr. Vol. II, Equilibres en solutions. Phénomènes de surface. viii + 480 pp., 64 figs. 14 × 19 cm. Price, 1300 fr. Vol. III, Cinétique chimique. Structure des molécules. vii + 533 pp., 70 figs. 14 × 19 cm. Price, 1800 fr. Presses Universitaires de France, 108, Boulevard Saint-Germain, Paris, 1951.

It is a pleasure to welcome this valuable addition to the rather scanty production of French books on Physical Chemistry. Professor Emschwiller has done his students, and more generally all French chemists, a great service in writing this clear, comprehensive and thoroughly modern text. Indeed, for some reason or other physical chemistry has not aroused widespread interest in France until recent years; its position as a distinct entity in the general scheme of sciences was never quite clear to the French mind. For instance, it is stated in the preface: "The reader may wonder why this book was classified in the chemistry section of the Collection rather than in the physics section." It would appear that in most other countries such a question was solved long ago, if it ever came up.

The textbook is divided into three separate volumes, each with its own very detailed table of contents and a list of symbols. The latter do not always have the same meaning in the three volumes which may result in some confusion. The first volume is devoted entirely to chemical thermodynamics; the subject is first introduced from the viewpoint of affinity. This concept, which has fallen into some disrepute because of its vagueness, is used extensively and is even represented by a special symbol. The international nomenclature on thermodynamics is followed in general although there are some notable exceptions, as is befitting. Thus Helmholtz free energy is called F while Gibbs free energy is given the symbol G . . . and a new name: "Free Enthalpy." Throughout that section the treatment is rigorous without being too formal. The notions of thermodynamic potential, fugacity and activity are used after the method of Lewis and Randall. Gaseous equilibria then take up the next eight chapters. Several industrially important reactions are considered in detail as an application of general principles. The problem of specific heats is the occasion for introducing statistical thermodynamics which is then developed adequately in the last six chapters.

Volume II is divided into two main parts of nearly equal lengths: equilibria in solutions and surface chemistry. Phase equilibria are not presented as a whole in the usual fashion; instead, one-component systems are considered in a special chapter on first- and second-order transformations (in Vol. I) while two-component systems come up in connection with the colligative properties of solutions. After the classical treatment of electrochemical cells the Debye-Hückel theory is presented followed by Bronsted's theory of acids.

Colloid chemistry comprises a first section on surface phenomena and two chapters on preparation and properties of colloidal solutions. The section closes with an interesting discussion of the various methods used for particle size determination.

In the first half of Vol. III chemical kinetics are dealt with in 10 chapters extending over some 200 pages. After an outline of the fundamentals such topics as free radicals and chain reactions, explosions, electrochemical, photochemical and liquid phase reactions are discussed adequately. The second part, concerning molecular structure, is that which interested the reviewer most and which, no doubt, will prove the more useful to French chemists because of the lack of other texts on the same subject. First the Bohr-Sommerfeld theory of the atom is exposed and then the most recent views on the chemical bond. The quantum theory of valence is outlined in a non-mathematical manner, after the bond orbital and the electron pair methods. Resonance is here called "Mésomerie," but otherwise the treatment follows generally along the lines of Pauling's and similar books. One could wish for a greater number of examples than are discussed in that section. After one chapter each on molecular spectra, magnetochemistry, dipole moments and diffraction methods the book concludes with a last one on the metallic bond. The author and subject index seems quite complete but, unfortunately, it is given only at the end of the third volume. Its usefulness is therefore limited.

One notable difference between this text and English ones is the absence of the three conventional chapters on gases, liquids and solids. Most of the subjects normally covered in those are inserted here and there either in thermodynamics or in molecular structure. Others, such as viscosity of liquids, are missing altogether. The reason for this is possibly that in the French curriculum these topics are considered as relevant of the physics course. Nonetheless it does seem strange not to find at least a brief outline of the kinetic theory of matter in a text book on physical chemistry. On the other hand a particularly commendable feature of Professor Emschwiller's composition is the attention given to what might be termed the "philosophy" of physical chemistry. This is achieved through short historical notes and pertinent considerations on the importance of each subject, its implications and logical relation to the whole.

The physical presentation is appropriately described in the preface as "modest." The format is more suggestive of the typical French novel than of a textbook on science, which makes it somewhat awkward to handle. Translated into dollars the price should hover around \$18.00 for the complete work. By comparison with corresponding English textbooks (such as Glasstone's?) this seems a little high, specially considering that, true to the French custom, the three volumes are paper-bound.

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Cottrell: Samaritan of Science. By FRANK CAMERON. Doubleday and Company, Inc., Garden City, New York. 1952. 414 pp. 14 × 21 cm. Price, \$4.50.

Cottrell died on November 16, 1948, less than four years ago. It might be thought that his impact on his time and his environment could have been more adequately appraised in a biography written perhaps forty, rather than four years after his death. This may be true, but such a conclusion overlooks the importance of recording promptly the

fleeting impressions and recollections of the host of people still living who were associated with Cottrell and knew him well. It also overlooks how ephemeral and quickly scattered are contemporaneous letters and written data. This is all especially important in the case of a personality such as Cottrell's, whose stature must be measured not merely by his own significant scientific achievements and his printed papers, but by his innumerable provocative suggestions to others, his prophetic intuitions, his self-less enthusiasms and devotion to human progress, and his unflinching sympathy with the forlorn and the neglected!

This conclusion is confirmed by the statement on the jacket of this book, presumably by the author, Mr. Cameron, that the biography is based on "two years of research, the reading of 10,000 letters and documents, and a diary which Cottrell kept faithfully for forty years; and on the interviewing of 150 people who could help him to reconstruct the career and character of his subject." I want, therefore, to express my satisfaction that the task was undertaken at this time and my gratitude for, and appreciation of, the careful and understanding biography that Mr. Cameron has written.

The book tells something about Cottrell's parents and antecedents, and a good deal about his childhood and early years in Oakland, California; his alert and precocious mind, his extraordinary energy, and the breadth of his enthusiasms which gave sure premonitions of his later traits and interests.

The account of Cottrell's student days at the University of California at Berkeley is relatively brief, but it shows clearly that during his three undergraduate years and the three following years as a part-time graduate student and assistant there while he taught science at the High School in adjacent Oakland, he displayed astonishing energy and an insatiable appetite for all things scientific. Certain it is that O'Neill, the astute judge of men and Professor of chemistry, who remained a life-long friend of Cottrell, declared him to be the most promising student of science at the University during that period.

The next three years were spent in Germany, studying first with Van't Hoff in Berlin and later with Ostwald and Luther in Leipzig. These men, too, rated Cottrell at the very top, and he was awarded his Ph.D. at Leipzig *summa cum laude*.

He returned to Berkeley in December, 1902, as Instructor in Chemistry, and after a short period of recuperation, plunged vigorously into a variety of researches. These prospered; he was made an Assistant Professor, and he married his sweetheart of many years. The death of his father and family burdens kept him hard pressed financially, and this coupled with his intense interest in technological as well as in pure science, turned much of his attention to the more remunerative problems of applied chemistry and physics. This led to his invention and development of electrical precipitation, perhaps Cottrell's greatest single technical achievement.

By 1911 the success of this process was assured, and a substantial return from his patents was in sight. Here, another facet of Cottrell's brilliant personality shone forth! In spite of his still not wholly relieved financial exigencies, he decided to follow a long cherished plan, namely, to turn over most of his income from his patents to a non-profit, self-sustaining agency devoted to the prosecution of scientific research. He spent months of thought and effort in planning such an organization, displaying therein the same depth of insight and dauntless optimism as he had in his studies of scientific problems. The final outcome was the establishment of the Research Corporation as the recipient of the income from his patents, with a distinguished, altruistic but hard-headed Board of Directors. This organization has prospered and continues to this day to exercise its beneficent functions. As Cottrell had hoped, other scientists and inventors have turned over their patent rights to it, and, best of all, it has served as a stimulant for the establishment of other similar organizations.

At this same time Cottrell resigned his professorship at the University of California, and, under the magnetic influence of Dr. Holmes, the first and great Director of the Bureau of Mines, became Assistant Director of the Bureau. With this step Cottrell entered a larger and even more varied sphere of activities, for the most part governmental, in which he continued for the rest of his life and where his great gifts and his energy found even wider scope and influence. This period of Cottrell's life, while centering

about Washington, took him all over the country, to Japan, and repeatedly to Europe. It gave him an opportunity to apply his scientific genius and his altruism to several problems of major importance to our country and to advance by his indefatigable efforts the cause of an international language, a project always dear to his heart.

Cottrell was endowed with extraordinary physical and mental energy, but periodically he drained it to its dregs. His idealism and his spirit were overpowering! Moreover, during most of his life he was the victim of financial worries due in part to the persistent illnesses and misfortunes of his relatives, but also to his own inveterate generosity. As a consequence, he was subject to periods of deep exhaustion and discouragement. Mr. Cameron touches on these matters with understanding and sympathy, but, as one reads, one cannot but be distressed at the anxieties and sacrifices which Cottrell and his valiant wife had to face.

In thinking about Cottrell, and particularly since reading this biography, two analogies have often come to mind: First, he resembled Lincoln in many ways; in form and in feature; in fairness and charity of mind; in warm sympathy for his fellow men, especially the forlorn and unfortunate; in the gift of the humorous and pertinent anecdote; and finally, in his indomitable idealism. Second, Cottrell might well have spoken the words of the Hunter of Truth in Olive Schreiner's "The Story of a South African Farm," who, after a lifetime spent in quest of Truth, having built paths and stairways to the summit of an all but impassable mountain range, finally dying, but grasping in his hand a single feather, wafted downward, from the white Bird of Truth, says: "I have sought, for long years I have labored; but I have not found Her. I have not rested, I have not repined, and I have not seen Her; now my strength is gone. But where I lie down worn out, other men will stand, young and fresh. By the steps that I have cut they will climb; by the stairs that I have built they will mount. They will never know the name of the man who made them. At the clumsy work they will laugh; when the stones roll they will curse me. But they will mount, and on my work; they will climb, and by my stair! And no man liveth to himself, and no man dieth to himself."

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Six Membered Heterocyclic Nitrogen Compounds with Four Condensed Rings. By C. F. H. ALLEN, Eastman Kodak Company, Rochester, New York; in collaboration with D. M. BURNES, JEAN V. CRAWFORD, F. W. SPANGLER and ELEANOR R. WEBSTER. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y., 1951. xiii + 345 pp. 16 × 23.5 cm. Price, \$10.00; special subscription price, \$9.00.

This volume describes heterocyclic nitrogen analogs of the seven ring systems established by fusion of four benzene rings. Accordingly, the azalogs of naphthacene, benz[a]-anthracene (exclusive of those which are benzacridines or benzophenazines), benzo[c]phenanthrene, chrysene, triphenylene, benzanthrene and pyrene are discussed. All systems in which there is a nitrogen atom common to two rings are omitted since these types will be collected in a subsequent volume.

Liberal use is made of structural formulas. The azo names are given in boldface type beside each of the ring skeletons. These names are followed by the preferred *Chemical Abstracts* systematic names together with other names which have appeared in the literature and Ring Index numbers. Tables which list practically all of the compounds reported constitute an important feature of this volume. The references are collected at the end of each chapter.

The material treated in this volume is well organized and large gaps in our knowledge of six-membered heterocyclic nitrogen compounds with four condensed rings are recognizable. In spite of these gaps, the student of this volume will be impressed by the amount of information already accumulated in this area of organic chemistry. The authors have performed an admirable service in tabulating this information in such a convenient form.

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