SCIENTIFIC BOOKS

ELECTRICAL DISCHARGES IN GASES

Fundamental Processes of Electrical Discharges in Gases. By LEONARD B. LOEB. Pp. xviii + 717. 297 figures. New York: John Wiley and Sons, Inc. 1939. $7.00.

IT is the author's objective to present "the reader with the facts and conflicting views, and . . . thereafter throw the weight of his authority in whatever direction it should, in his opinion, go, giving his reasons in each instance." This aim establishes the tone of the treatment, which is refreshingly outspoken. There is always a full discussion of the facts which form the basis for the author's judgment. The style is clear and incisive.

The presentation has been systematized in a way that is a real help in grasping essentials in a situation. Advantages and disadvantages of a method, assumptions underlying a theory, alternative mechanisms in a process, and so on, are throughout consistently listed seriatim, 1, 2, 3, etc.

The detailed treatment accorded to many of the methods, particularly those used in investigating the properties of ions, gives the book almost the character of a laboratory manual in places.

The first three chapters as well as the sixth are devoted to ionic behavior—the measurement of ionic mobilities, the experimental data and mobility theory, the recombination of ions, their diffusion, and the formation of negative ions. This amounts to one third of the book. The author's great interest in ionic behavior has led him to go into historical and experimental details which would be in place in a monograph on gaseous ions. Here they distract attention from other aspects of gas discharges and even crowd some of these out.

A chapter on electron mobility serves as an introduction to a thorough treatment of the energy distribution in an accelerated stream of electrons. The Druyvesteyn, Morse-Allis-Lamar and Smit derivations are all given. The important effect of electron interaction in creating a Maxwellian distribution in glows and arcs is, however, only mentioned in one sentence and a single reference. Nor is the effect mentioned of the positive ions in a plasma in decreasing the electron mobility.

The important subject of probes is competently discussed, and is concluded with a pertinent section on sources of error in probe measurements. The author is slightly handicapped, however, because the space-charge limited current problem and allied problems are postponed to a later chapter, with no perceivable advantage.

Ionization by electron collision is treated statistically and the relation is derived between Townsend's α and the differential ionization just above the ionization potential. But the general course of the differential ionization curve as well as values of total ionization and the formation of multiply charged ions are not discussed.

Another chapter is devoted to the second Townsend coefficient. It includes a critical discussion of spurious effects and summarizes alternative explanations.

An excellent treatment of sparks in the penultimate chapter is divided into three parts: theory, techniques in study and special types of breakdown including, among others, vacuum sparks, corona and lightning.

One reaches the final chapter on glows and arcs realizing that although one of the important applications of electrical discharges is to lighting, there has been no treatment of excitation and radiation.

Unfortunate confusion arises in this last chapter between glow and arc, and low and high pressure discharges. A "positive column" section under the glow discharge really deals with the low-pressure glow *or* arc, while a similar section under arcs deals with the high-pressure arc. The same is true of the two "anode fall" sections. Thus, the generally false impression is created at this point that arcs can not be low-pressure affairs and that they can not have low current densities.

This chapter is inadequate in other respects. The low-pressure positive column in which ions fall, without impact, to the wall is not mentioned although it has had far better experimental confirmation than the quasi-neutral diffusion case. It would be desirable to know what the effect is of a magnetic field on the arc and that current limiting factors exist. Of comparable importance to sparking is the disappearance of ionization after the interruption of an arc and the application of such de-ionization to the thyratron principle, but this is not discussed.

There are three appendices, one on the kinetic nature of a gas, the others consisting of a table of critical potentials and a table of physical constants.

The extremely comprehensive author and subject indices as well as the wealth of direct references are valuable features.

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THE ULTRACENTRIFUGE

The Ultracentrifuge. By THE SVEDBERG and KAI O. PEDERSEN, in cooperation with J. H. BAUER, E. G. PICKELS, G. BOESTAD, E. O. KRAEMER, J. B. NICHOLS,

O. LAMM, A. S. MCFARLANE, R. SIGNER. Pp. x + 478. 174 figs. New York: Oxford University Press. $12.50.

AN ultracentrifuge is defined by Professor Svedberg as a centrifuge in which convection-free sedimentation can take place. Such an instrument is a valuable tool, first for the determination of particle or molecular sizes and weights and, second, for the purification or concentration of various materials. In this book the authors deal principally with the first of the above applications, together with the design and construction of the various types of ultracentrifuges which they have used.

About four fifths of the book is written by the two principal authors, The Svedberg and K. O. Pedersen, and one fifth by the cooperating authors. Each of the contributors is especially well qualified to discuss his particular topic and the book is thoroughly authoritative.

The subject-matter is divided into four parts. Part I is a detailed and critical discussion of the theory of sedimentation by Svedberg and Pedersen, with a chapter at the end by Kraemer. The equations are derived for the two cases usually employed for the determination of particles or molecular sizes and weights, *i.e.*, for sedimentation equilibrium and for sedimentation velocity. The theory of sedimentation equilibrium is discussed, not only for uncharged particles and molecules but also for the case of salts, colloidal electrolytes and mixtures where equilibrium exists between several components.

Part II describes the construction and operation of the various types of ultracentrifuges. A most interesting review is given by Svedberg, Boestad, and Pedersen of the development of the Svedberg ultracentrifuges, as well as a detailed description of his most recent types now in use at Upsala. These include both the low-speed centrifuges used mostly for sedimentation-equilibrium measurements and the high-speed oil turbine ultracentrifuge with which Professor Svedberg and his students have carried out so many epoch-making experiments. The discussion of the design and construction of the rotors and cells are of special interest to any one interested in centrifuge design, since the principles may be used for any type of rotor. Part II closes with a valuable chapter by Bauer and Pickels on the air-driven ultracentrifuges which they have used in their work.

Part III gives a most useful discussion of the methods of measuring the concentration gradients in the ultracentrifuge cell which are necessary for the determination of molecular or particle weights and sizes. The authors of this part are Pedersen, Lamm, and Kraemer.

Part IV deals with the results obtained with the Svedberg ultracentrifuges. The first section, written by Pedersen, presents and discusses the results obtained with animal and plant proteins. McFarlane contributes a chapter on the plant virus proteins. The second section presents the results on organic colloids (except proteins) and is written by Kraemer, Nichols, Signer, and Pedersen.

The appendix contains tables of constants and other data necessary for calculating the results from the experimental data. The bibliography contains practically a complete list of papers dealing with ultracentrifuge technique and data.

Although, as stated in the preface, the authors have confined themselves to a discussion of their own types of ultracentrifuges and the results obtained with them, the theory and methods presented are largely applicable to any type of ultracentrifuge. Also, the results are illustrative of the usefulness of the ultracentrifuging technique. Professor Svedberg and his collaborators have rendered a great service in writing this indispensable handbook to every one interested in using any type of ultracentrifuge or in the interpretation of sedimentation data.

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SPECIAL ARTICLES

ON THE IDENTITY OF VITAMIN H WITH BIOTIN

IN a recent communication[1] we called attention to the possible identity of vitamin H, the curative factor for egg-white injury in rats,[2] with biotin,[3] a growth factor for yeast, and with coenzyme R,[4] a growth and respiration factor for many strains of legume nodule bacteria. The identity of biotin and coenzyme R had already been indicated by other investigators.[5,6] Our conclusion that vitamin H and biotin were either identical or very closely related compounds was based on the close parallelism that was found to exist in the distribution and in the chemical and physical behavior of the substances, as brought out both by our own experimental work and by data derivable from the literature.

It was found that no important differences in dis-

[1] P. György, D. B. Melville, D. Burk and V. du Vigneaud, SCIENCE, 91: 243, 1940.

[2] P. György, *Jour. Biol. Chem.*, 131: 733, 1939.

[3] F. Kögl and B. Tönnis, *Zeits. Physiol. Chem.*, 242: 43, 1936.

[4] F. E. Allison, S. R. Hoover and D. Burk, SCIENCE, 78: 217, 1933.

[5] P. M. West and P. W. Wilson, SCIENCE, 89: 607, 1939.

[6] R. Nilsson, G. Bjälfve and D. Burström, *Naturwissenschaften*, 27: 389, 1939.