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THE BASIC MECHANISMS OF STATIC ELECTRIFICATION

By Professor LEONARD B. LOEB

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THE term "static electrification," as here used, covers all processes for producing segregation of positive and negative electrical charges by mechanical actions which operate by contact or impact between solid surfaces, between solid and liquid surfaces, or in the rupture of solid or liquid surfaces by gases. These involve such phenomena as frictional electrification, spray electrification, electrification in dust storms, etc. A review of these phenomena in general shows a most unsatisfactory array of discordant, often non-reproducible and confusing results, whose theoretical interpretation in some cases is quite hopeless.[1,2,3,4,5]

It is believed that in a considerable measure this situation results from the fact that many investigators are not alert to the possibility that in any one aspect of their studies not one but perhaps two or more of the various basic mechanisms may have been active. Such complications make theoretical interpretation in terms of any single proposed mechanism most difficult. In order to clarify the situation it is proposed to list the known mechanisms and briefly to discuss them. The basic mechanisms active are:

(1) Electrolytic effects, caused by distribution of electrolytic ions in solutions of liquids of high dielectric constants between the solutions and metals or solids, on contact, followed by mechanical separation. Since diffusion of ions across interfaces build up considerable potentials,

[1] H. F. Richards, *Phys. Rev.*, 22: 122, 1923; and 16: 290, 1920.

[2] Cardani, *N. Cimento*, 23: 199, 1922; Jones, *Phil. Mag.*, 29: 272, 1915; Owen, *Phil. Mag.*, 17: 457, 1909; E. Perucca, *N. Cimento*, 22: 56, 1921.

[3] Coehn, *Ann. de Phys.*, 30: 777, 1909, and 43: 1048, 1914.

[4] Ulrey, *Phys. Rev.*, 12: 47, 1918.

[5] P. E. Shaw and C. S. Jex, *Proc. Roy. Soc. London*, A118: 97, 1928; A. Fleming, *Proc. Roy. Soc. London*, 53: 51, 1941; R. Schuurman, *Proc. Phys. Soc. London*, 53: 547, 1941; F. Boning, *Zeits. f. Tech. Physik*, 8: 385, 1927; H. Israel, *Zeits. f. Tech. Physik*, 9: 289, 1928.

sists of four main steps: (1) The determination of the physical properties and the establishment of the purity of the compound; (2) determination of the class (aldehydes, amines, acids, etc.) to which the compound belongs (by qualitative analysis, solubilities and class reactions); (3) location of the compound within a class or possibly homologous series of compounds; and (4) preparation of derivatives.

Most, if not all, of our leading universities now offer such training as a third semester course and, in the opinion of the reviewer, it should always be required for admission to original research in organic chemistry.

The text is lucid and concise, with numerous detailed experiments, illustrations, graphs, structural formulas and tables. The book is bound in dark green cloth, with gold lettering, and a red phenanthrene nucleus as a lead for the title. Type and presswork are excellent. It should be very helpful and is heartily recommended.

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PLASTICS

The New Plastics. By HERBERT R. SIMONDS, M. H. BIGELOW and JOSEPH V. SHERMAN. xii + 320 pp. New York: D. Van Nostrand Company, Inc. 1945. $4.50.

THE plastics industry has come a long way in the past five years—so far, in fact, that the authors of the book in question considered it fitting to prepare a semi-technical volume devoted almost exclusively to plastic materials, processes and uses which have been developed since 1940.

There is little question of the timeliness of their effort. It is of the utmost importance to the plastics industry that its new materials, their war uses fulfilled, should not be allowed to fall into disuse and that new mass-production techniques should not give way to costlier methods for want of quantity demand.

Almost all the regular books on plastics are forced, of necessity, to deal with such a variety of topics that only the mass-produced, established plastics and their processing methods can be discussed in any detail. Since most references to these books are made for the purpose of finding data on specific materials for more or less standard types of application, this is usually fairly satisfactory, but the lack of detailed data on new developments may lead to their being overlooked, even where they could give superior service. Of more significance, however, is the fact that lack of recent information may cause the producer of a new product to turn away from plastics because he can not find, among the standard materials, one which could suit his purpose.

The present book is by no means an encyclopedia of all that has been accomplished since 1940, but it is an excellent attempt to condense the more important information into one volume. After a brief review of the industry prior to 1940, the authors discuss, in turn, the most recent developments (plastics such as polyethylene, nylon and the silicones); certain established new materials, such as the melamine, allyl and vinyl resins; and improvements in such substances as vinyl elastic molding materials and polystyrene.

The new synthetic fibers, closely related to plastics, are then considered, with considerable emphasis on nylon, Aralac and Vinyon. Other chapters deal with such new and important adhesives as Reanite and Cycleweld cements; various new laminating materials such as glass-cloth laminates; such new applications of wood and paper as Impreg, Compreg and methylolurea-treated wood; and the various synthetic rubbers, which are not discussed in any detail.

Much has been heard in recent years about molding with electronic heating, and this and other new processes are discussed, with the inclusion of significant economic data. New forms and coatings are considered in the last technical chapter, and the book is concluded with an all-too-brief chapter on plastic trends.

To quote the jacket, "this book furnishes the most complete information on the important advances made during the last five years by the entire plastics industry," although it may not quite constitute a "comprehensive manual of practical information on *all* the new developments in plastics." The present reviewer has followed these developments with interest during the period covered by the book, however, and feels that this compact volume is a worth-while addition to the bookshelf of every individual who has anything to do with plastics, unless that person has available a complete and indexed file of the recent literature. The style of writing is factual and clear, yet not too technical for the interested layman to appreciate, at least in part.

B. H. WEIL
GULF RESEARCH & DEVELOPMENT COMPANY,
PITTSBURGH, PA.

BOOKS RECEIVED

DEGERING, ED. F. and Collaborators. *An Outline of Organic Nitrogen Compounds.* Illustrated. Pp. vi + 752. The University Lithoprinters. 1945.

GLASSER, OTTO. *Dr. W. C. Röntgen.* Illustrated. Pp. vi + 169. Charles C Thomas, Publisher. $4.50. 1945.

STEARN, E. WAGNER and ALLEN E. STEARN. *The Effect of Smallpox on the Destiny of the Amerindian.* Pp. 7 + 153. Bruce Humphries, Inc. $2.50. 1945.

LIDDELL, DONALD M., Editor-in-chief. *Handbook of Nonferrous Metallurgy.* Second edition. Illustrated. Pp. xi + 721. McGraw-Hill Book Company. $7.00. 1945.