

recently measured relaxation times are included. The chapter closes with a brief mention of several other effects which involve rotational relaxation: structure of the scattered Rayleigh line, nuclear spin-lattice relaxation and ultrasonic relaxation.

Merz describes the structures which are characteristic of soft and hard ferroelectric materials and then reviews recent research on the various properties of ferroelectrics. Domain formation and domain wall motion are presented in considerable detail. This section closes with a catalog (5 pages) of ferroelectric materials, many of them discovered only recently.

The basic processes (impact ionization, electron capture, photoionization and cathode emission) involved in gas breakdown are discussed by Dakin and Berg. Breakdown in uniform fields, with a detailed presentation of the Townsend mechanism and then breakdown in non-uniform fields are next presented. Selected experimental results are used to illustrate the discussion. This chapter closes with a discussion of the statistical and the formative time lags involved in gas breakdown. Sharbaugh and Watson then present a review of breakdown in liquids, after an introductory section on the conductance of "insulating" liquids. Experimental work on breakdown in liquids since the review by T. J. Lewis on the same subject in the first volume of this series is summarized, and finally several hypotheses regarding the mechanism of breakdown in liquids are critically considered.

The final paper considers "all processes for producing the segregation of positive and negative electrical charges by mechanical actions which operate by contact or impact between solid surfaces, solid and liquid surfaces, or in the rupture or separation of solid or liquid surfaces by gases or otherwise, including also the action of ionized gases. These processes may involve frictional, contact or tribo electrification, spray electrification and electrification in dust, snow or thunderstorms." A wide variety of phenomena are discussed; this review will be continued in the next volume of the series.

The book is well written and contains excellent bibliographies for the special fields covered. It is, however, a book written by experts for experts and is not intended for the general reader. It is recommended to libraries and to specialists in dielectrics.

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Molekulverbindungen und Koordinationsverbindungen in Einzeldarstellungen. Elektronen-Donator-Acceptor-Komplexe. By GUNTHER BRIEGLEB, o. Professor der Physikalisches Chemie an der Universität Würzburg. Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf, Germany. 1961. x + 279 pp. 16 × 23.5 cm. Price, DM. 48.-.

This is an authoritative account written by one whose own contribution to the study of molecular complexes has been outstanding during the last decade. No other work even approximates the very thorough coverage of Dr. Briegleb's book which is a "must" for everyone interested not only in molecular complexes themselves but also in the more general area of solution spectroscopy, solvent effects, equilibria in solution, etc.

It excludes in its coverage only the complexes of metal ions with electron pair donors, complexes involving "biochemical" molecules, and the study of situations in which complex formation is rapidly followed by chemical reaction. The omissions are probably justified, since these areas are either insufficiently studied, or have developed along lines rather different from those around which Dr. Briegleb's work is focused.

The subject is treated primarily for the spectroscopic standpoint. This is inevitable since the study of charge-transfer spectra has been the most useful single tool, and has been the authors own special field. Other areas of study are not neglected, however. A fairly complete account is given of the investigation of dipole moments of complexes, another subject to which the author is a distinguished contributor, the determination of equilibrium constants, and thermodynamic properties. The scanty X-ray data on the geometry of charge-transfer complexes are also reviewed. The spectroscopic coverage is not entirely restricted to charge-transfer spectra. Shifts in infrared frequencies observed on complexing are well covered, as is the rather less extensive work on changes in the higher-energy absorption bands of the components on complex formation.

Useful tables of charge-transfer band positions and intensities are included. The range of donor molecules covered is very wide. That of the acceptors is more limited, but includes as well as the halogen, chloranil and trinitrobenzene "old stagers" a good deal of more recent work on such substances as tetrachlorophthalic anhydride and tetracyanoethylene.

Theoretical aspects of the subject are fairly well dealt with—essentially from the standpoint developed by Mulliken. In the interest of consistency in his own treatment, however, the author has re-formulated several of the well-known approaches in his own terms. For the reviewer at least this made, for example, the Mulliken-Orgel treatment of contact charge transfer, or of

the equilibrium between several isomeric C.T. complexes seem rather unfamiliar. Even the Benesi-Hildebrand treatment of simple charge-transfer equilibria suffers some inversions and changes of notation. Nevertheless it must be admitted that Briegleb's approach may make easier reading for the student entering the field than are the original materials.

On the negative side, a good many interesting phenomena are presented without much attempt at interpretation, either in terms of more sophisticated quantum theory than that presented in the theoretical section, or even in terms of precise assignments of energy levels involved. Thus, for example, although several general reasons are given for the appearance of more than one charge-transfer band in certain complexes, none of the several examples quoted is assigned precisely to a specific cause. The question of the symmetry of components and complex also receives scant treatment.

A brief section at the end deals with the rapidly developing area of semiconductivity, photoconductivity, E.S.R. spectra and the general "solid state" approach to the study of donor-acceptor complexes. One gets the impression that this material has been added as an afterthought and that it is less complete and perhaps less well-organized than the rest of the book.

Nevertheless there are few serious criticisms that can be made of such an admirable work and the above remarks refer to what are relatively minor defects.

References are included up to the middle of 1960 and form the most comprehensive collection of donor-acceptor studies available for those wishing to survey the field.

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Kern- und Radiochemie. Grundlagen. Praktische Methoden und Technische Anwendung. By ROLAND LINDNER, Lehrstuhl und Institut für Kernchemie der Technischen Hochschule Göteborg/Schweden. Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf, Germany. 1961. xii + 369 pp. 16.5 × 24 cm. Price, DM. 49.80.

Lectures in a two-semester course in Nuclear and Radiochemistry at Göteborg led to a manuscript written in Swedish and later translated into the German for this book. The text is designed primarily for chemists, physicists and engineers, though it is admitted that the chapters on nuclear theory may seem elementary to the physicist.

After an introductory chapter on the structure and properties of the atomic nucleus there are chapters dealing with radioactivity, nuclear reactions, nuclear chain reactions and reactors, radiation danger and protection, determination of radioactivity, radiochemical separation of the important, commonly used radio-nuclides, reactor chemistry, and finally a discussion of numerous scientific and technical applications. Topics which are generally regarded as falling within the compass of nuclear chemistry comprise approximately forty per cent of the book.

The topics that are covered have been done well. The text is up-to-date as indicated by the inclusion of such material as the discovery of elements 102 and 103, the Mössbauer effect and the selection of applications of radioactivity. With a number of good texts published in English available there will be little appeal of "Kern- und Radiochemie" to those who prefer not to do their reading in a foreign language.

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High Polymers. Volume XV. Radiation Chemistry of Polymeric Systems. By ADOLPHE CHAPIRO, Laboratoire de Chimie Physique de la Faculté des Sciences de Paris, Paris, France, and Laboratoire de Chimie des Radiations du Centre National de la Recherche Scientifique, Bellevue (S. et O.), France. Interscience Division, John Wiley and Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 1962. xvi + 712 pp. 16 × 23.5 cm. Price, \$21.00.

Over the past ten years radiation chemistry of polymeric systems has been one of the most actively studied fields of science and technology. In earlier years anyone could stay abreast of the entire field of radiation chemistry and polymers by reading a small number of papers. Now, with a plethora of theoretical and applied publications in this field, anyone desiring full information would have difficulty keeping abreast of publication abstracts much less complete articles. Dr. Chapiro's book fills the need for a comprehensive and up-to-date review of the subject matter. The text gives a comprehensive survey of polymerization initiated by ionizing radiation followed by a detailed discussion of radiation effects in natural and synthetic polymers.

The author's prose style is clear and incisive and makes the book a pleasure to read.

The first three chapters on elementary radiation chemistry are somewhat pedestrian but will serve as a useful introduction to the uninitiated. From this point a comprehensive review of radiation research in polymeric systems is skillfully presented. Chapters IV to VII or approximately one-third of the book deal with radiation induced polymerization of monomers in the homogeneous liquid and heterogeneous phases as well as in the presence of added substances which markedly alter the polymerization process. Chapters VIII–XI describe aspects of radiation effects in polymers in the solid and solution states with detailed delineation between polymers of the cross linking and degrading types. The last chapter is concerned with the more practical subject of graft copolymers prepared with ionizing radiation and, while not a comprehensive review, details the salient features of these complex reaction mechanisms. The book is recommended to the skilled research worker or graduate student desiring a convenient reference source and, more important, as an authoritative text that presents the unifying concepts as they are understood today in a field complicated by a multitude of conflicting and uninterpreted publications.

GENERAL PACKAGING RESEARCH AND
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Introduction to Chemical Instrumentation. Electronic Signals and Operations. By EDWARD J. BAIR, Associate Professor of Chemistry, Indiana University. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 1962. viii + 349 pp. 16 × 23.5 cm. Price, \$10.75.

The author's preface describes this book as "a representative collection of topics which when covered by independent study or as a one-semester course will give the student beginning . . . experimental research a reasonable insight into new advances in instrumentation . . . as well as some insight into the practical art of designing instruments to solve particular problems."

Almost the first third of the book is filled by a frenetic survey of topics from chemical physics and electrochemistry with occasional incidental reference to a pertinent instrument or instrumental method. This material is collected under the chapter title, "Chemical Signal Sources"; it ranges from atomic energy levels through n.m.r. spectroscopy to X-ray diffraction, electrolysis and polarography. Theoretical remarks are often garbled and facts egregiously misstated. The writing is careless. The following quotations illustrate typically these pervasive shortcomings. Page 14: "A photon originating at a point in space radiates from that point in a spherical wave characterized by electric field vectors which have periodic maxima perpendicular to the direction of propagation." Page 16: "When there is interaction between the oscillating electric field of a photon and the oscillating field of an atom or molecule, the energy of the photon may, under some specific circumstances, be absorbed . . ." Page 20: "Angular dispersion $d\lambda/d\theta$ is the angle between rays of different wavelength . . ." Page 22: "The major contributions to the energy correspond to the size of the orbit of the valence electron . . . The resultant orbital angular momentum or resultant eccentricity of electronic orbits having the same principal quantum number accounts for somewhat smaller energy differences which are classified as different series." Page 46: "Radiation that is reemitted to the ground state is resonance fluorescence." On pp. 77–78, the L X-ray level is represented as double, the notation is archaic, and the origins of the $L\alpha$ and $L\beta$ lines are misstated. Page 81: "From the discussion of Rayleigh scattering of optical radiation it is clear that scattering and diffraction are relatively important at X-ray wavelengths." On page 107, the saturated Weston cell is said to be almost universally used as the secondary standard against which voltages are measured, and the temperature coefficient of the voltage is said to be small; the unsaturated cell is not mentioned.

The author, who refers to electronics as "the most systematic method of instrumentation," presents in the remaining two-thirds of his book a collection of notes on electronics. The proportion of elementary detail suggests that the discussion is aimed at the beginner, but the disorderliness and haphazard involution attending the introduction of basic concepts, as for example impedance, and the needlessly obscure and grossly careless exposition in such critical sections as the first pages on triodes, vacuum-tube voltages, and plate characteristics would induce in many a beginner a lifelong frustration in the face of any problem involving electronics. Three of the later chapters, entitled "Nonlinear Operations and Signals," "Analysis of Small-signal Electronic Circuits" and "Noise, Bandpass, and Information," rise above the preceding criticisms. The contrast in quality creates an impression that most of the book has been composed hastily and without editing to give bulk to a tested laboratory handbook.

Instrumentation is an interdisciplinary subject. To train appropriately talented students for the resourceful, creative and critical application of instrumental methods, a chemistry faculty needs to develop and retain the interested cooperation of other faculties. It has been accepted that the physics faculty should supply the basic training in mechanics, electricity, magnetism and optics, because it should do this more expertly and authoritatively than the faculty of another discipline; and the chemistry faculty has developed the applications which are within its special competence and needs. Lately, within a generation, electronics has developed as a field of applied science and engineering that has revolutionized instrumentation in every area of experiment; yet chemistry faculties have been slow to recognize that they must now send students also to the professional electronics faculties for a fundamental training in electronics, and that the chemistry curriculum can afford no time for scholastic bungling. Once equipped with a professionally laid foundation, a student can be expected to utilize the resources of electronics self-reliantly and securely to the limit of his talent, interest and opportunities.

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Ion Production by Electron Impact. By R. I. REED, Chemistry Department, The University, Glasgow. Academic Press, Inc., (London) Ltd., Wing I, 7th Floor, Berkeley Square House, Berkeley Square, London, W. 1., England. 1962. xii + 242 pp. 16 × 24 cm. Price, \$7.00.

This monograph by Professor Reed is nominally an introduction to the determination of molecular structure constants by mass spectrometric measurements of the ions produced by single electron impact in dilute gases or vapors. The first half of the volume (*ca.* 117 pages) is largely concerned with the determination of the energetics of molecules and ions from electron impact measurements, while the second half (*ca.* 90 pages) is concerned with the ions that are observed in mass spectra and the various fashions their occurrence may be interpreted in terms of the structure of molecules.

The reviewer found the volume quite unsatisfactory. Virtually none of the subjects is treated in either a systematic or a critical manner. The various chapters are composed of only loosely connected sections and only too frequently the sections are composed of unrelated paragraphs. No attempt will be made to present here a detailed criticism of this book, since a really adequate critique would require a volume of the size of the original. In the following paragraphs there will be simply given a few typical examples of the sources of the reviewer's dissatisfaction.

Chapter I consists of a brief description of mass spectrometers and their mode of operation, followed by a section entitled, "The Experimental Evaluation of Ionization Potential." The subject of this section is not defined either within the section or in the section called "Ionization Potentials" that starts Chapter III, "Theoretical Considerations." The major portion of this section on the evaluation of ionization potentials consists of a 12-page table of values (Table 1) to which there is no reference in the text, nor does the table itself contain any indication of the significance of its various columns or indications of what the reader might learn from the comparison of the numbers in the columns it contains.

The second paragraph of Chapter III reads in its entirety as follows: "Particular interest attaches to the case of carbon disulfide which is a triatomic molecule. Although precision studies upon molecular ionization potentials have not been carried out widely, there is a considerable amount of careful work which has been carried out by other techniques, particularly ultraviolet spectroscopy. Conventionally the reason for this discrepancy is considered to originate in the distinctive methods by which the ionization potential is obtained." Neither the preceding nor succeeding paragraphs throw any light on the author's interest in the fact that carbon disulfide is a triatomic molecule nor the nature of the discrepancy that originates in the methods. Some four pages later one finds the only other reference to carbon disulfide, "Collin (1960) has determined the ionization potential to be $I(\text{CS}_2, {}^2\Pi - 1\Sigma_g^+) = 10.15 \pm 0.05$ e.v. which is in good agreement with the value determined by optical spectroscopy of 10.08 e.v."!

As a final example, we quote definitions of the term "base peak" that are to be found in the footnotes to Tables 33 and 35, on pages 193 and 194, respectively. Under Table 33, "The 'base peak' represents the most abundant ion in the spectrum," while under Table 35, "The 'base peak' is the abundance of the most intense ion in the spectrum and is given a value of 100."

The only readers to whom this book can be recommended are potential authors as a collection of examples of how not to write.

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