

remaining eight chapters of the first part are concerned with those aspects of Fraunhofer diffraction which are related to crystal problems. The author bases his treatment entirely on Fourier transforms, of which he exhibits a wide understanding. Although he assumes that his reader knows what such a transform is, he gives enough illustrated examples to give a reality to the technique that is unusual in the more formal treatments; and it would be possible for a reader who knew little or nothing of Fourier transforms to learn about them here. The first part ends with a statement of the fundamental problem of diffraction analysis: the determination of the phases of the scattered beams whose intensities have been measured.

The second part is concerned with the determination of structures. In this part, the first chapter is a very brief account of some photographic methods for the measurement of X-ray diffraction intensities. The second chapter is concerned with the calculation of the Patterson function, the third with the determination of the space group, and the fourth with the problem of determination of the structure. This part of the book gives an account of the whole progress of an X-ray investigation which is very clear and should be understandable to a reader outside the field who has the necessary mathematical background. For one who plans to work in the field it provides a connected introduction on which to hang additional reading.

The third and shortest part is concerned with powder, liquid and fiber diagrams and the study of texture by these methods.

This text is an example of the clarity of language and presentation for which the French are noted and which makes its reading so pleasant and informative. The planning of the course is worthy of a real study by anyone who has the duty of teaching X-ray crystallography, and this and the earlier volumes are recommended for students of crystallography who have or need facility in French.

The book is produced in photo-offset from justified typescript and is an excellent example of this technique even as far as the X-ray photographs are concerned.

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**Landolt-Börnstein. Zahlenwerte und Funktionen aus Physik, Chemie, Astronomie, Geophysik, und Technik. Sechste Auflage. Zweiter Band. Eigenschaften der Materie in Ihren Aggregatzuständen. 4. Teil. Kalorische Zustandsgrößen.** Edited by KLAUS SCHÄFER and ELLEN LAX. Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf, Germany. 1961. xii + 863 pp. 20.5 × 27.5 cm. Price, DM. 438.--

This book contains values of the thermodynamic properties of the elements, compounds, and alloys, as well as heats of reaction for the formation of compounds from the elements and the change in heat content accompanying some other important reactions, such as the heat of neutralization of acids with bases and the heat of wetting of solid surfaces with liquids. The values are given generally in terms of joules per mole, except in a few cases where values in calories are also given. References are given to the original papers in the literature as well as references to prior compilations, though in general the two kinds of sources are not distinguished.

Covered in this book are the following: experimental and theoretical basic values for heats of combustion of organic compounds, by H. Kienitz; standard values at 25° for elements, inorganic compounds and organic compounds, for the heat capacity, entropy, heat of formation, and free energy of formation, for the change in heat content and heat capacity for changes of state, as transition, fusion, and vaporization, by W. Auer; values of the thermodynamic functions at standard pressure as a function of temperature, from low to high temperatures, for the elements and selected inorganic and organic compounds, by Kl. Schäfer and W. Auer; heat capacity as a function of temperature, from low to high temperatures, for the elements and inorganic and organic compounds, by W. Auer; heat capacity of gases as a function of pressure, by H. D. Baehr; heat capacity of gases in the plasma state, to 30,000°K., by F. Burhorn and R. Weinecke; values of the Planck-Einstein function and of the Debye function for thermodynamic functions, by Fr. Losch; values for anharmonicity and for free and

restricted internal rotation, by Kl. Schäfer; values for the Joule-Thomson effect and the isothermal Drossel effect, by H. D. Baehr; magneto-thermodynamic effect for paramagnetic salts at low temperatures, in tabular and graphical form, by H. Nelkowski; thermodynamic functions for metallic solutions, by O. Kubaschewski; heats of adsorption and wetting, by K. Bratzler; and heats of neutralization, by A. Neckel.

Prof. Dr. Klaus Schäfer and his associates are to be complimented on an excellent job. While significant advances have already occurred, it is hoped that in the years to come more international uniformity will prevail in the details of the presentation of material of this kind, including symbols, values of the fundamental constants, units of energy, etc. Every research library in science and engineering will need to have ready access to this book.

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**Biochemical Applications of Gas Chromatography.** By H. P. BURCHFIELD, Southwest Research Institute, San Antonio, Texas, and ELEANOR E. STOOBS, Boyce Thompson Institute, Yonkers, New York. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y. 1962. xviii + 680 pp. 16.5 × 23.5 cm. Price, \$22.00.

Gas chromatography, like other "chromatographic" techniques, is a device to resolve mixtures of compounds that are otherwise difficult to separate. It has accumulated already more than its due share of jargon. While the authors explain this by their repeated definitions, they do little to discourage it. If one consults a popular Oxford dictionary, one reads that "chromatography" is the "description of (or by) colors." The term chromatography was not unsuitable when applied to the visible separations of leaf pigments by Tswett on a solid column, and at least it had some justification in the early separation of protein amino acids on paper, for this operation was followed by the visible detection of the amino acids with ninhydrin. However, the term has lost all significance in its application to the separation of a mixture by what is known as "gas chromatography." It is too late to reverse the march of events and to devise a more rational nomenclature, but one hopes that this most valuable field of work is not to be as cluttered by uncritical applications as it is by unjustifiable or unclear jargon. If the simple operation long known as dialysis were to be rediscovered today, one trembles to think what the nomenclature might be.

In a necessary and systematic listing of terms, one reads (page 9) that "A chromatogram is a plot of the detector response versus time or volume of carrier gas. Idealized chromatograms obtained with differential and integral detectors for one component are shown in Figure 3." Or, again, "A peak is the portion of the chromatogram recording the detector response [differential type] while a single component emerges from the column [if separation of a mixed sample is incomplete, two or more components may appear as one peak]." This sort of thing, whether quoted from other sources or not, proceeds through innumerable definitions and descriptions of phases of the technique. One wonders whether those who approach the problem without prior knowledge of the subject will find it easy to interpret this sort of writing. And when under Essential Oils one reads about "gas chromatography" of whole plant families, described as "chromatography of Myricaceae," "chromatography of Rosaceae (rose oils)," "chromatography of Labiatae," etc., one wonders whether all traces of sensitivity to the precise use of words has disappeared. If botanists use the book, some will shudder to see whole plant families apparently characterized by one sample separation of one class of compounds, from one or even a few species. While some may justify this sort of thing by expediency and a plea that everybody knows what the authors mean, is it too much to ask that the words that are to convey this meaning should be appropriate? Perhaps, however, the "chromatography" is not any more precise than the words which describe it, for one gets the impression that the unwary may place implicit faith in the deceptively precise peaks on the line tracings that appear on the gas "chromatograms." In this, as in all other cases of chromatography of complex mixtures, a peak may often cover up more than one com-

pound and is no substitute for other chemical techniques except in special cases where the components of the mixture are virtually known at the outset. Fractional crystallization is a method of separation, but the classical work of organic and biochemists did not admit of identifications based on the mere separation of the crystals, and it even required more supporting evidence than melting points! One may repeat what has been said before, namely that there are no faster means of getting the wrong answers than by chromatography and radioautography. It is because there are no more powerful tools in the right hands and with the right precautions than these techniques that it is constantly necessary to stress these points. Because the elegant ways in which the technique now known as gas chromatography have given new dimensions to analytical separations and practice constant, vigilance needs to be exercised to ensure its critical evaluation and interpretation.

This book is essentially a compilation. It presents a valuable summarized account of the possibilities inherent in the application of the technique known as gas chromatography to some materials of biological interest. As pointed out by the authors, the suggestion that a gas might be used as the mobile fluid in a chromatographic system was made about 20 years ago by the pioneers of modern chromatography, and the developments which have been made in the last ten years have caused the resulting technique to spread as widely and as rapidly as its predecessor on paper into all phases of analytical work. The authors have carefully documented these developments, though they seem, from the author index, not to be numbered among those who have either conspicuously originated, or even applied, the procedures they describe. Nevertheless, those who have heard of the usefulness of the technique, and now wonder whether it has application to their own special problems, will here find a useful summary of the possible variations on the basic procedures, guidance on the types of instruments that may be used both to separate, detect and measure the components of the mixture, and with examples of the results that may be obtained with different types of materials to which the techniques are amenable. The book is well produced and arranged, with substantial reference lists to each chapter. And it has indices by author, by subject, and also to the methods that are appropriate for different classes of compounds or materials. Appendices deal with manufacturers of gas chromatographic and auxiliary equipment, etc. The work is, therefore, well suited for those who need a handbook for ready reference in this rapidly expanding area of application.

The first (and longest) chapter deals with theory, nomenclature, instrumentation and operational techniques. The many variations of the basic procedure are well covered, including the various problems, advantages and disadvantages of the many types of column, packing material, liquid phase substances, carrier gases, temperature programs, and methods of detecting and measuring quantitatively the components of the analyzed mixture. A broad coverage of the methods and problems concerned with the identification and qualitative analysis of components, other than simple comparison with known standards, was considered beyond the scope of the treatise. However, in consideration of the wide application of isotope techniques to biochemical investigations, a section is devoted to the special problems concerned with the measurement of radioactivity.

The remaining chapters are specialized reviews of the applications of gas chromatography to permanent gases and condensable vapors, the volatile components of tissues and fluids, cyclic compounds, essential oils, resin acids, lipids and non-volatile components of tissues. The early portion of this latter chapter is devoted to the recent work done on the analysis of amino acids and the special problems concerned with this most important area. However, these techniques need to be more refined and some of the present difficulties resolved, before the gas chromatography method can adequately replace the flexible paper chromatography procedures now being used, or relegate the present automated exchange columns to the equally important task of separating proteins and peptides as a preliminary to the ultimate determination of their amino acid composition by the more rapid method of gas chromatography. It is easy to predict that gas chromatography may eventually replace existing methods for keto and hydroxy acids, carbohydrates and other non-volatile metabolites,

but the widespread use of these devices needs to be made in the recognition that speed and convenience are only one part of the criteria that justify their adoption.

The final chapter reviews some miscellaneous applications of gas chromatography as related to biochemistry. These include elemental and functional group determinations, and other aids to structural identification, as well as a brief review of its applications to studies on pesticides, herbicides and pharmaceutical products.

Thus this volume is certainly a useful technical handbook. Its virtues are that it gives to laboratory technicians a ready source of technical information in a rapidly moving and important field. Its faults are those of the times when so often jargon is mistaken for clarity and when words are not always respected as the accurate instruments which render the complex intelligible in precise and simple terms. Gas chromatography is here to stay—one wishes that this elegant tool bore a more honored or accurately descriptive name!

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**Biological Alkylating Agents. Fundamental Chemistry and the Design of Compounds for Selective Toxicity.**

By W. C. J. Ross, B. Sc., Ph.D., D. Sc., D. I. C., F. R. I. C., Reader in Chemistry, Institute of Cancer Research, University of London. Butterworth, Inc., 7235 Wisconsin Avenue, Washington 14, D. C. 1962. xi + 232 pp. 14.5 × 22.5 cm. Price, \$10.50.

Dr. Ross has written a very valuable book covering the fundamental chemistry of the alkylating agents of biological interest, as well as the principles and recent history of the design of compounds for selective toxicity. The book is beautifully written and is made especially readable by the generous use of structural formulas. Nothing of importance has been omitted beginning with theory of chemical reactivity and ending with principles of latent activity and latent inactivity in drug design.

He properly points out that many of the ideas for design of new agents, based upon the rationale that enzymatic activity will liberate a toxin or render the agent more toxic, is based upon the presence of hydrolytic enzymes or oxidative enzymes which are no more abundant in tumors than in normal cells; in fact, the reverse is more often the case. Some comfort has been afforded the chemists by the observation of inhibition of the rat Walker Tumor, but correlation with enzymatic study in human tumor is lacking. More likely to prove useful is the rationale of latent inactivity or detoxification by enzymatic activity, since these enzymes are abundant in normal vital organs of man and deficient in many human cancers. The great obstacle to advance in this area has been the absence of these protective enzymes in bone marrow, a vital tissue very susceptible to the alkylating agents.

The final chapter deals with current attempts to by-pass or protect the bone marrow in making the agents now available more useful. Not mentioned is a most recent development in drug design: *i.e.*, the development of alkylating agents with a half-life so short that intra-arterial injection may be used for regional cancer chemotherapy without concern for alkylating activity in the returning venous blood.

Particularly valuable for me was the confirmation of an earlier suspicion, gained on reading this comprehensive review, that the shortcomings in drug design are probably due in large part to the great dependence on rat and mouse tumors for evaluation of effectiveness. He cites over and over again work involving the development of ingeniously designed drugs that are remarkably effective against the Walker Tumor in the rat, but are no better than their predecessors in human cancer. Perhaps the sooner we switch from the Walker Tumor to human cancer for evaluating drugs the sooner significant advances will be made.

This excellent volume will prove useful to students, cancer chemotherapists and investigators.

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