pears to be especially useful in that the entries are collected under specific subject headings, as "Deposition techniques for boron," "Time-of-flight spectrometry in the range 1 ev. to 10 kev.," etc. Frequently-used neutron cross section curves, range–energy data for charged particles, and some nuclear decay schemes are included in appendices.

To summarize, this book is written for those readers who are in need of a comprehensive and up-to-date survey of the various methods of neutron counting and neutron spectrometry. It might profitably be read by those contemplating, or engaged in, neutron experiments, and by students interested in general techniques of experimental nuclear physics and chemistry.

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The Chemistry of Lignin. Supplement Volume. Covering the Literature for the Years 1949–1958. By FRIEDRICH EMIL BRAUNS and DOROTHY ALEXANDRA BRAUNS. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y. 1960. x + 804 pp. 16 × 23.5 cm. Price, $18.00.

The discovery of that component of woody plant materials now known as "lignin" is usually traced back to the pioneering experiments of the French botanist-chemist, Anselme Payen, who disproved the then prevalent notion that wood was a uniform product by successfully separating it into a series of crude, but varying fractions. His observations led Payen to postulate the presence in wood of an "incrusting material" which since has come to be known as "lignin." This work was published by Payen in the *Comptes rendus* in a series of papers beginning in 1838.

In 1960, the chemical structure of lignin was still unknown. This is certainly in no way due to any lack of attention by the researcher. The intervening century and one-quarter has witnessed the contribution by hundreds of organic and bio-chemists of thousands of papers on lignin to the chemical literature. Unfortunately, the result has been a huge volume of disorganized, unrelated, and many times, conflicting masses of observations, data, hypotheses, theories and speculations which have thus far defied a rational and unified interpretation. This status is well illustrated by the undue enthusiasm generated by K. Freudenberg's wistful analogy with the order existing in other natural polymers. The authors of this monumental treatise, of course, could not have known that this forced analogy would be followed later by a retraction (*Chem. Ber.*, 93, 2138 (1960)).

None has worked harder to bring some order to this chaotic state of the lignin literature than Friedrich Emil Brauns, formerly of the Institute of Paper Chemistry in Appleton. His first effort in this respect was "The Chemistry of Lignin," published by Academic Press Inc. in 1952. This was an exhaustive survey of the total lignin literature up to the mid-twentieth century, and it became the standard encyclopedic reference work for lignin investigators.

The new volume, coauthored by Mrs. Brauns, is subtitled "Supplement Volume. Covering the Literature for the Years 1949–1958." In addition to a review of the lignin literature of the specified decade, the work also includes reference to some papers which were unavailable for inclusion in the original volume, principally from the Japanese and Russian literature.

Students of Brauns' first book will find some innovations in the present volume. One is the authorship of the chapter on the linkage of lignin in the plant by J. W. T. Merewether of Australia. The organization of the new booki s consistent with the older work. Most of the original chapters, such as color reactions, isolation, determination, physical properties, composition, etc., have been retained and expanded with the one exception that the predominantly biochemical approach to the study of the mechanism of formation of lignin in growing plants is reflected in the change of the title of the original chapter, "Theories on the Formation of Lignin," to a more adequate one, "The Biosynthesis of Lignin." With this slight limitation, readers of the first volume will experience no difficulty in finding their way through the volume under review.

Grateful lignin chemists should have no fault with the Brauns' efforts. But if this commentator may be permitted one reservation, it must concern the Brauns' back-breaking attempt to be neutral and objective in their evaluation of recent published work. To be sure, the endeavor was a most noble one. However, in a number of instances, detailed descriptions are provided for experiments from which little or no constructive conclusions can be derived. This can be somewhat frustrating to the reader who may be seeking a critical evaluation of the really pertinent information in some specific area of lignin chemistry. This reviewer is tempted to remark that in such cases, omission would have represented the greater part of valor. Perhaps the problem can be illustrated by the observation that the first century of lignin research was summarized in Brauns' first book in 749 pages of text. Now, the most recent decade has required 751 text pages of the same size and print.

LABORATORY OF ORGANIC CHEMISTRY
AND ENZYMOLOGY (No. 372) F. F. NORD
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Liquids and Liquid Mixtures. By J. S. ROWLINSON, M. A., D. Phil., F.R.I.C., Senior Lecturer in Chemistry, The University of Manchester. Academic Press Inc., 111 Fifth Avenue, New York, N. Y. 1959. ix + 360 pp. 14.5 × 22.5 cm. Price, $12.50.

This book should give benefit and pleasure to all physical chemists who have maintained an interest in one of the classical areas of their science. It is concerned with the bulk equilibrium properties of pure liquids and of non-electrolyte solutions, exclusive of liquid helium and of high polymers. Surface and transport phenomena are not treated.

The work fulfills a need that is well stated in the author's preface. Significant theoretical developments of the last few years have emphasized the desirability of studying the behavior of liquid mixtures in close juxtaposition to that of pure liquids, a view which was largely obscured during the heyday of the lattice model.

Rowlinson divides his text into three parts, each comprising three chapters. The first part is a phenomenological account of the thermodynamic properties of pure liquids. After a brief introductory chapter on the nature of the liquid state, the author presents a thorough collection of thermodynamic relations, including those for changes of thermodynamic functions along the saturation curve. A valuable feature is the tabulation of critically selected (often recalculated) data for some common liquids. The section on pure fluids is completed by a chapter on the critical state, in which the unresolved problems are clearly set forth.

In the second section, the macroscopic discussion is extended to mixtures. Chapters 4 and 5 deal with mixtures under ordinary pressures, and include a well chosen and up-to-date selection of the experimental data for binary mixtures, expressed in terms of the excess thermodynamic functions. The sixth chapter describes liquid mixtures at higher pressures, including critical phenomena, and is somewhat reminiscent of the classical work of Kuenen. Here again, the author's collection of thermodynamic formulas is catholic (Random example: dp/dT along a binary critical solution curve, which is *not* given in the works of Guggenheim, Hildebrand–Scott or Lewis–Randall–Pitzer–Brewer), and there are many illustrative diagrams. Very little attention is paid to systems of more than two components.

The third section is an economical and masterly discussion of intermolecular forces and of the equilibrium statistical mechanics of liquids pure and mixed. The emphasis here is on corresponding states and on conformal mixtures, following the path traversed by Longuet-Higgins, Scott, Brown, Prigogine and others. Molecular distribution functions are introduced at an early stage in the discussion of pure liquids, and recur in the classification of the various approximate treatments of mixtures by means of Brown's molecular fluctuation integrals. The older theories, including those based on lattice models, are given scant attention in such a non-historical account, but they appear as special cases.

Inevitably the last section of Rowlinson's work will invite comparison with the corresponding parts of the book by Prigogine with Bellemans and Mathot, which contains more of the theoretical details and proceeds more inductively, but at some expense of final unity. Rowlinson, in addition to correcting several practically significant errors

in the equations of the earlier work, effects an esthetic improvement by favoring neither component of a binary mixture in applying corresponding states; his reference substance is a defined equimolal hybrid of the two pure components, so that the resulting equations are both simpler and completely symmetrical. From the final confrontation of theory with experiment, one sees clearly why more experimental data on mixtures of the simplest molecules are imperative and now actively being obtained, and also that the old ignorance about forces between unlike molecules is still very much with us.

As might be guessed, the thermodynamic symbols used are *U, H, F, G,* By now we have no trouble in reading that language, but it is much harder to get used to the inflationary though legitimate joule as the energy unit. The reader will find that Rowlinson has adopted yet another definition of "regular solution," a harmless pastime which can be expected to infuriate certain of his predecessors. He will also find the inevitable boner in a footnote on page 6, but he will perhaps be surprised to find almost nothing about volume fractions as concentration units, for the author argues that they are rarely worth the trouble. The reader may also feel that inordinate amounts of history and priority have been ignored.

This book could well be used in a graduate course, although one would skip over some of the compilatory sections. As a reference work, it is highly recommended to both research scientists and engineers whose basic thermodynamics and statistical mechanics have been previously acquired and not allowed to rust very long. In no other single volume can they find such an authoritative and well-balanced account of the present experimental and theoretical state of this perpetual part of chemistry.

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X-Ray Metallography. By A. TAYLOR, Advisory Physicist, Westinghouse Research Laboratories, Pittsburgh, Pennsylvania. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1961. vii + 993 pp. 16 × 23 cm. Price, $27.00.

If anyone has the slightest doubt of the spectacular growth of X-ray science in all branches, and of X-ray metallography in particular, he has only to compare Taylor's 1961 version (written in Pittsburgh) with his introductory text (written in England) published about 15 years ago. Both were written with the same objectives of providing the metallurgist an appreciation of X-ray methods as they apply to his particular field of work, in a book which "can be studied without prior knowledge of the subject, and particularly directed to the student reading for a degree and to research workers in university and industrial laboratories."

It is a tribute to this eminent authority that so much material is contained in about a thousand pages which might well have required several volumes. With a characteristically clear, conversational style, even the novice will find reading of descriptive matter surprisingly effortless, interesting and genuinely rewarding. There are, of course, some chapters presenting rigorous mathematical derivations, essential to the X-ray diffraction process, which will be tough going and discouraging for those "without prior knowledge of the subject" for whom the book is intended; but at least an incentive is provided for intensive further study. Instead of compromising by "writing down" to his readers, the author indeed sets a high standard for them. If they are to become able research X-ray metallographers, not just technicians, they see here clearly what mastery of the science entails.

The order of topics, upon which there might be a considerable divergence of opinion by readers and by experts, depending upon their specific backgrounds and interests, is briefly as follows: scope and history of X-ray metallography; generation and absorption of X-rays; radiography, microradiography and X-ray microscopy in general; external and internal symmetry of crystals; diffraction of X-rays by a simple primitive lattice; experimental diffraction methods; X-ray tubes; intensities of X-ray reflections; crystal structures of elements; thermal equilibrium (phase-rule) diagrams; crystal chemistry of alloys; precipitation hardening, complex alloys and steels; orientation textures; size and perfection of grains; internal stresses in metals and alloys; chemical analysis by X-ray procedures; applications to refractory materials, oxides and corrosion products. A hundred-page appendix presents in condensed form useful tables and information on techniques, and there are many tables closely related to the text throughout the volume.

What, then, are the distinctive qualities of this contribution? In the unreserved opinion of this reviewer, after 40 years of experience in the general field, this is the most complete coverage of X-ray science, in fundamental aspects as well as in metallurgical, chemical, physical and engineering applications, ever accomplished in a single volume by a single author. A check on 1959–1960 developments (such as the Lang diffraction–microradiograph technique, p. 766; the Land–Polaroid instantly-developed X-ray film; new findings in neutron radiography, etc.) reveals that the author has kept abreast of progress. Beyond any doubt this is the most completely documented manuscript ever published in this field, for the Bibliography at the end of each chapter is truly complete and accurate. While inevitably some topics are more adequately treated than others, perhaps because of space limitations, the admiration of the reviewer grew page by page during reading of long familiar subject matter. Especially masterly in treatment were such items as the powder diffraction method in general (of course of principal interest in metallurgy), the design (by the author) of high-intensity rotating-target X-ray diffraction tubes, order-disorder phenomena in alloys, dislocations, analysis of ternary and more complex alloys, the martensite phase in steels, evaluation of texture by pole figures, grain sizes and internal stresses. Oversights or omissions in such a wealth of material are surprisingly few. There is no mention of the rad, the unit of dosage which is largely displacing the older roentgen; or the Buerger precession goniometer. Though briefly mentioned in several places there is a feeling that the concept and usefulness of the reciprocal lattice are slighted while some other features, especially mathematical, are overweighted.

The book is well printed with only 4 minor errors noted, and the 416 figures are clear and useful. The 27-dollar price, almost prohibitive for the "student reading for a degree," makes one wonder when will these spiraling costs of books level off. Suffice it to say, however, to the author—well done and a genuine service to science. Chemists who read this evaluation will find this book just as applicable and useful and challenging as will the metallographers.

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Cahiers de Synthèse Organique. Méthodes et Tableaux d'Application. Volume VI. Rearrangement et Migration. By JEAN MATHIEU and ANDRÉ ALLAIS. Published under the direction of Lèon Velluz. Masson et Cie., 120 Boulevard Saint-Germain, Paris 6, France. 1960. 417 pp. 15.5 × 22 cm. Price, 120 NF.

Of the 417 pages in this volume, 276 are devoted to an up-to-1959 review of contributions related to rearrangements and isomerizations. The selection is largely from the area of synthetic organic chemistry and appears reasonably comprehensive from the point of view of reaction types. References to transformations in the field of natural products are only incidental.

In the manner of the earlier volumes in this series, an attempt is made to codify the various reaction types. Considerable success was achieved judging from a few tests made by the reviewer to locate references to reactions. The review should prove useful to those with only a very rudimentary knowledge of the French language since throughout extensive use in made of the universal language of structural formulas.

The organization of each of the four chapters involves first a synopsis of the coding system with reference to page numbers. This is followed by undocumented sections on principles, mechanisms and application. Thereafter, the above-mentioned reviews are presented. The sections relating to principles are merely brief explanations of the