line widths.[6] A comparison of the chemical shifts for the two concentrations shows that the ring and N-methyl protons shift to low field very markedly upon dilution. The magnitude of the deshielding is much larger, *ca.* 50-fold, than would be expected on the basis of simple concentration effects known to influence the shifts of aromatic solutes.[7] Nor can the deshielding be explained in terms of an electric field effect due to dissociation of ion pairs[8,9] since this would not account for the large changes for the 3, 4, and N-CH_3 protons. The most plausible explanation is one which invokes a disaggregation of polymeric AO species (in which the AO molecules are stacked with their planes parallel) into simpler oligomeric, dimeric, and monomeric forms. Although the existence of a monomer $\rightleftharpoons$ dimer equilibrium in the concentration range 10^{-4} to 10^{-6} M has been well established by optical measurements,[2b,g] it is likely that the deshielding observed in the present case is due largely to a dissociation of higher aggregates.[10] The present results also suggest that the most favored orientation of adjacent AO molecules in the stack is one in which the 1,9 (and N-CH_3) protons are located more nearly over the center of adjacent rings than the protons in positions 4, 5, and 6.

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(6) The relatively broad line widths (3–5 cps) are due to a combination of unresolved long-range couplings and small spectrometer instabilities.

(7) J. A. Pople, W. G. Schneider, and H. J. Bernstein, "High-Resolution Nuclear Magnetic Resonance," McGraw-Hill Book Co., Inc., New York, N. Y., 1959, Chapter 16.

(8) W. F. Reynolds and T. P. Schaefer, *Can. J. Chem.*, **41**, 2339 (1963).

(9) G. Fraenkel, *J. Chem. Phys.*, **39**, 1614 (1963).

(10) Preliminary calculations of $\Delta\sigma$, using McConnell's dipole approximation, indicate that the shift changes calculated for a dimer–monomer dissociation are insufficient to account for the observed values: H. M. McConnell, *J. Chem. Phys.*, **27**, 226 (1957).

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Book Reviews

The Proteins. Composition, Structure, and Function. Volume III. Second Edition. Edited by HANS NEURATH, Department of Biochemistry, University of Washington, Seattle, Wash. Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1965. x + 585 pp. 16 × 23.5 cm. $21.00, list; $18.50, subscription.

As the editor states, the third volume of this extensive treatise on "The Proteins" extends the central theme of the relationship between composition, structure, and function to four specific groups of proteins: the plasma proteins, antibodies and antigens, the proteins of the blood clotting system, and the virus proteins. Two general aspects are included: the fractionation of proteins and the interaction of proteins with radiation.

The first chapter, Chapter 12, on "Fractionation of Proteins" was written by H. A. Sober, R. W. Hartley, Jr., W. R. Carroll, and E. A. Peterson. They review some newer methods that have been used for the separation of proteins in solution; however, little is said about the extraction of proteins from natural sources or of older methods such as fractionation by neutral salts, organic solvents, or heavy metals. Recent work on protein fractionation by solubility, partition, chromatography, dialysis or ultrafiltration, electrophoresis, and sedimentation is discussed. There are included sections on immunological methods and auxiliary techniques such as methods for concentrating, desalting, and detection of proteins, as well as general recommendations on the criteria of protein purity.

Chapter 13 is entitled "Structure and Function of Virus Proteins and Viral Nucleic Acid" and was written by H. Fraenkel-Conrat. He first reviews his own work and that of others on tobacco mosaic virus and on the protein coats of virus which have helical symmetry. The proteins of viruses of cubic symmetry are discussed more briefly. Then the structure of bacteriophage proteins or viruses with complex structure is described in relationship to their supposed function. Finally a section on effects of viral mutation in terms of protein structure relates the amino acid exchange in chemically evoked mutants to the corresponding change in nucleic acid structure.

Chapter 14 by F. W. Putnam is entitled "Structure and Function of the Plasma Proteins." The plasma protein system is described and the problem of resolution, identification, fractionation, purification, and characterization of the different components discussed. The use of fractionation procedures such as electrophoresis, ultracentrifugal analysis, chromatography, or gel filtration for the characterization of plasma proteins is reviewed. Then data on the molecular structure and function, molecular properties, chemical composition, end groups, and terminal sequence of the plasma protein are presented. Current knowledge of the structure and function of the major plasma proteins is summarized. This section includes discussions of the structure and function of serum albumin, glycoproteins, α- and β-lipoproteins, transferrin, haptoglobulins, ceruloplasmin, fetuin, clotting components, and γ-globulins.

Considerable progress has been made in the last decade on the "Structure and Function of the Antibody Proteins," which is reviewed in Chapter 15 by S. J. Singer. The chemical properties of antigens and antibodies are described, and the antigen–antibody reaction is discussed in detail. This is followed by sections on the structure of protein antigens including antigenic determinants and the new concepts of the structure of antibodies with a discussion of the structure and chemistry of the antibody-combining sites. Finally, current theories of antibody formation are reviewed.

Chapter 16 is a review of "The Proteins of Blood Coagulation" by E. W. Davie and O. D. Ratnoff. Our knowledge of the complex process of blood coagulation has grown rapidly and is well reviewed by these authors. They discuss fibrin formation in mammalian blood and describe in considerable detail the properties of 13 clotting factors. Current ideas on mechanism of blood coagulation are reviewed, and the role of intrinsic and extrinsic clotting systems is summarized. The known inhibitors of blood coagulation and the properties and function of plasmin and plasminogen are discussed.

The last chapter, Chapter 17, deals with "Interaction of Proteins with Radiation" and was written by G. Weber and F. W. J. Teale. This chapter is a physical–chemical examination of the interaction of protein molecules with radiation that does not result in irreversible change. The authors discuss the infrared absorption spectra of proteins and the ultraviolet absorption spectroscopy of proteins largely from a theoretical point of view. A section on emission spectroscopy is included that deals with fluorescence of amino acids, proteins, and protein conjugates. Finally, the scattering and retardation of both light and X-rays by protein solutions and the optical rotary dispersion and birefringence of protein solutions are discussed.

Volume III maintains the high standards set by the preceding two volumes of this authoritative four-volume treatise. The topics considered in this volume are more restricted than those in the preceding two volumes, and the authors have been able to develop critically their topics in greater detail and to include much more than a mere review of published data. Each chapter has a long list of references to original papers. This volume will be of particular value to those research workers and advanced students of biochemistry, biology, physical chemistry, biophysics, and related fields who want to keep well informed on current progress in protein chemistry and particularly in the proteins of blood or viruses.

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Order-Disorder Phenomena. By H. S. Green and C. A. Hurst, Department of Mathematical Physics, The University of Adelaide, Adelaide, South Australia. Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1964. x + 363 pp. 15.5 × 23.5 cm. $15.00.

Within the past several years theoretical research into the mathematical structure and physical implications of models exhibiting critical phenomena has attained a fashionable vigor. Motivation for this increased activity has been twofold: Onsager's brilliant solution of the two-dimensional Ising model a generation ago still retains an awesome beauty in spite of its complicated sophistication, and the surprisingly unorthodox singular behavior of thermodynamic functions at critical points (revealed in part by Onsager, and more recently and completely by the Domb school in England) for both two- and three-dimensional models constitutes a frustrating and exciting challenge to the intuition.

The monograph under review was, according to the preface, solicited by Professor I. Prigogine as Volume 5 in his Monographs in Statistical Physics series, mainly on account of the impressive body of elegant mathematical results that have been accumulated in solving order–disorder problems. In acceding to that request, the authors have succeeded in conforming to the high standards of previous volumes in the series.

The book's major emphasis rests upon the authors' own research into the method of evaluating order–disorder partition functions by means of Pfaffians (triangular arrays of numbers). The method is spelled out in great detail, not only for the standard rectangular, triangular, and hexagonal lattices, but also for lattices with (generally) highly decorated bonds and sites. Although it is probably fair to say that the Pfaffian method in the last analysis cannot cope with any models that are beyond the capability of alternate approaches (the original Onsager method in any of its various guises, or the Kac-Ward combinatorial technique), it does, nevertheless, provide a nicely systematic scheme for handling especially the soluble models with high degrees of decoration complexity. In addition it becomes rather clear in the Pfaffian method which mathematical features prevent solution of the physically interesting models with non-nearest-neighbor potentials, external fields, or dimensionality greater than two.

As an aid to the reader there is a mathematical appendix containing information that is relevant and useful in the preceding text, on determinants, matrices, Pfaffians, and hyperbolic trigonometry.

The unsuspecting potential buyer deserves warning on at least two accounts. The rapid pace of advances in the theory of phase change, compared with the traditional torpor of book publishing schedules, has antiquated some of the procedures contained in this work; in particular, the difficult and lengthy long-range order calculation is superseded by the simpler approach of Schulz, Mattis, and Lieb. In addition, the reigning philosophy clearly is mathematical, rather than physical or chemical. Although there are short sections in the beginning on applications to magnetism, alloys, and liquids, the novice would do well to initiate his training in order–disorder phenomena with some other source, such as Hill's "Statistical Mechanics" (1956). For the serious student of phase-transition theory, who must be willing to follow each of the separate analytic approaches to his field to its furthest limits, this book, however, represents an indispensable contribution.

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The Solvent Extraction of Metal Chelates. By Jiří Starý, D.Sc., Department of Nuclear Chemistry, Faculty of Technical and Nuclear Physics, College of Technology, Prague. Edited, with a foreword by H. Irving, Professor of Inorganic and Structural Chemistry, University of Leeds. The Macmillan Co., 60 Fifth Ave., New York, N. Y. 1964. xiv + 240 pp. 15.5 × 23.5 cm. $8.50.

The "Solvent Extraction" of the title is the currently popular designation of liquid–liquid extraction in which the two phases are aqueous solution and organic solvent.

One-fourth (50 pages) of this monograph is devoted to general aspects of chelate extraction: composition and stability of metal chelates, theory of their extraction, and analytical applications (separations, substoichiometric determinations, extractive titrations). The section that follows deals with individual chelating reagents finding use in analytical extractions. Good use is made of tables to summarize the optimum conditions for extraction. Lastly, one or two concise procedures, considered to be the most selective of those available, are given for each of almost 50 elements. It will be realized that some of these chelate extractions are inferior to extractions of ion-association compounds (which do not fall within the scope of the book). A collection of almost 1100 references is included.

Dr. Starý has been successful in compressing much information into a small volume and providing a book which can be recommended for reference when questions concerning chelate extractions arise.

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The Acyclic Aliphatic Tertiary Amines. By Leonard Spialter, Head, Organic Chemistry Section, Aerospace Research Laboratories, Wright-Patterson Air Force Base, Ohio, and Joseph A. Pappalardo, Associate Professor of Chemistry, University of Dayton, Dayton, Ohio. The Macmillan Co., 60 Fifth Ave., New York, N. Y. 1965. xiii + 512 pp. 16 × 24 cm. $18.00.

In this book the authors have given a remarkably thorough coverage of the acyclic aliphatic tertiary amines, containing carbon, hydrogen, and nitrogen only. The literature survey includes the amines of this type reported in the original literature and indexed in *Chemical Abstracts* through June of 1961. Monoamines and polyamines are included with saturated and/or unsaturated hydrocarbon groups from C_3H_9N to $C_{87}H_{177}N$ for monoamines and from $C_5H_{14}N_2$ to $C_{21}H_{50}N_6$ for polyamines, representing more than 700 compounds.

The following statement given in the preface should be emphasized: "Although *Chemical Abstracts* and Beilstein's 'Handbuch der organischen Chemie' provided excellent initial guidance, it