

peroxide and does not account for the presence of riboflavin degradation products before exposure to air. However, it should be pointed out that the Nickerson scheme was proposed for solutions 0.025 mM in riboflavin and 0.05 M in acetate at pH 4.8.

Figure 1 shows three polarograms of a riboflavin solution which was 6 mM in N,N'-dimethyl-N'-benzylethylenediamine (NBD). Polarogram 1 was obtained before irradiation and polarogram 2a after a 75-sec. exposure to the mercury arc lamp. The two polarograms show that in the presence of NBD riboflavin is reduced without photolysis and as a consequence a new wave with an $E_{1/2}$ of -1.30 v. is formed. Polarogram 2b was obtained after adding benzaldehyde to the irradiated solution. It is seen that the height of the new wave was increased without change in the $E_{1/2}$. This suggests the new wave is due to benzaldehyde. The almond odor of the solution also suggested benzaldehyde.

To verify the formation of benzaldehyde in the photo-reaction, a relatively large amount of the photooxidation product of NBD was prepared. A solution, 0.3 mM in riboflavin and 0.05 M in NBD and buffered with phosphate at pH 7.8, was irradiated in the presence of air for 2 hr. After irradiation the solution, which had a strong almond odor, gave a polarogram similar to 2b except that the riboflavin wave was entirely above the zero current line and the new product wave was about ten times higher. Nitrogen was passed through the irradiated solution and expurgated photooxidation product was absorbed in a 0.1 M phosphate buffer. The ultraviolet spectrum of the phosphate buffer proved to be identical with that of a phosphate buffer to which pure benzaldehyde had been added.

Since the photooxidation of NBD by riboflavin yields benzaldehyde in the absence of air, photofission of water must occur to supply oxygen. It might be argued that oxygen is supplied by the sugar side chain of riboflavin, or through an air leak, or from the phosphate buffer. However, polarographic analysis showed no evidence of riboflavin photolysis or of an air leak during or after irradiation. To make sure that the phosphate buffer played no direct role irradiations were carried out without buffer. The results were the same as in the presence of buffer.

Measurement of the wave heights in the polarograms of riboflavin-NBD solutions showed that 1 mole of benzaldehyde is formed per mole of riboflavin reduced. It therefore appears that in the absence of air the overall reaction between riboflavin and NBD is

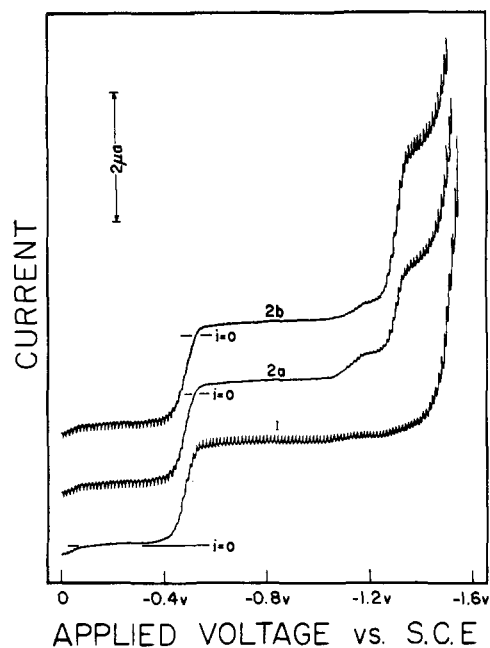
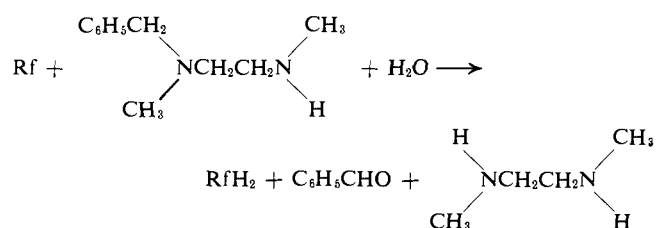


Figure 1. Polarograms of solutions 0.3 mM in riboflavin, 6.0 mM in N,N'-dimethyl-N'-benzylethylenediamine, 0.1 M in KCl and phosphate buffer, pH 7.8. (1) Before irradiation, (2a) after irradiation, (2b) after irradiation and addition of benzaldehyde.



This reaction is consistent with the Nickerson scheme for the irradiation of riboflavin solutions in the presence of M.

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Book Reviews

Essays in Coordination Chemistry. Edited by W. SCHNEIDER, G. ANDEREGG, and R. GUT. Birkhauser Verlag, Basel, Switzerland. 1964. 305 pp. 17 × 25 cm. 48.--s Fr.

It is particularly fitting that a group of his students and associates should have chosen to honor Professor Gerold Schwarzenbach on his sixtieth birthday through the compilation and publication of

this series of papers in the area to which he has contributed so significantly. It is perhaps too soon to assess completely the importance of Professor Schwarzenbach's work to all areas of chemistry, both practical and theoretical, but all persons will agree that his work has influenced substantially the pattern of current research in coordination chemistry and related topics and has led to developments

that will affect such patterns for many years to come. All will agree, too, that his work has indicated clearly the importance of coordination in many seemingly otherwise unrelated areas of the science. Professor Schwarzenbach's application of quantitative techniques to coordination chemistry alone has been a major factor in charting its progress.

The volume is introduced by a summary of Professor Schwarzenbach's contributions, ranging from "the proton to the metal ions." There follows an intriguing discussion by Professor L. G. Sillén on "Thoughts during a Walk in Lapland," after which there are papers dealing with a wide variety of topics—from stabilities of complex species to bonding, from structures to reaction mechanisms, from analytical applications to chromophores, from physical measurements to biochemical implications, to cite but a few. The roster of authors is a listing of the names of many of the important workers in coordination chemistry from around the world. The styling and referencing are uniform, but each contributor has been given freedom to include what he deemed desirable. Articles are in either English or German.

It is neither possible nor profitable to attempt a detailed criticism of every contribution. The reviewer's general impressions are excellent. The individual papers are well conceived and executed. Many tabulations and carefully prepared drawings appear throughout the volume. The referencing appears to be up to date and adequate. The printing, binding, and other mechanical details have been handled with unusual care. Errors are few and quite generally insignificant.

In the opinion of the reviewer, this volume is not only a fine memorial but also a significant contribution which every scientist who is concerned with coordination chemistry will wish to consult.

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The Macromolecular Chemistry of Gelatin. By ARTHUR VEIS, Department of Biochemistry, Northwestern University, Chicago, Ill. Academic Press Inc., 111 Fifth Ave., New York, N. Y. 10003. 1964. x + 433 pp. 16 × 23.5 cm. \$14.50.

This is the latest in a series of volumes being published by Academic Press under the general title "Molecular Biology: An International Series of Monographs and Textbooks." The subjects covered to date have ranged from protein structure through polyelectrolytes, fluorescence assay methods, and molecular genetics, to gelatin chemistry and structure. This divergence of topics certainly testifies to the breadth of molecular biology, but provides little in the way of a detectable theme to interrelate the books themselves.

In the Preface, Dr. Veis states that he had two primary objectives in writing this monograph. He intended "... to analyze the outstanding attributes of the gelatins in terms of specific chemical or structural features ... and to point out those areas of study concerning the gelatins which may be used to further our understanding of the parent, biologically significant, collagen fiber systems. ..." Dr. Veis, by virtue of his years of experience in many aspects of gelatin research, is uniquely qualified to write such a book, and he has succeeded impressively in attaining his announced goals. Numerous books and reviews, focused primarily on collagen and dealing only tangentially with gelatin, have appeared in recent years. But this is the first major monograph in some time which is addressed to a general audience, and in which gelatin holds the center of the stage.

The book is divided into five major chapters. The first, entitled "Collagen," provides a brief, clear, and elegant synopsis of what is currently known of the chemistry and structure of collagen in solution and in fibers. This chapter serves the rest of the book as a point of reference to relate the various properties of gelatin to the parent material. The second chapter, on "The Molecular Characterization of Gelatin," is an extensive description of the numerous physico-chemical measurements which have been made on gelatin in solution. Discussion of the results obtained with each method (e.g., osmotic pressure, light scattering, viscometry, sedimentation analysis, and so forth) is prefaced in each case by a three- or four-page summary of the principles of the technique. These summaries, unlike those found in most books of this type, are genuinely helpful in that they really pinpoint and clearly describe the physical essence of each approach. This section also contains an interesting, though far too brief, description of the uses of complex coacervation in fractionating gelatins. A good deal of the most

useful work in this area has been done in the author's laboratory, and it is a pity that he has not taken the opportunity to deal more extensively with this potentially very useful, but very little known, technique. However, taken all together and despite the intrinsic interest of the subject matter, the over-all impression left by this chapter is a sense of frustration at how little (per unit effort invested) the methods of solution physical chemistry have added to our knowledge of gelatin structure.

Chapter III deals with "The Conversion of Collagen to Gelatin" in terms of two extreme starting materials: the acid-soluble monomeric collagen macromolecule and the completely insoluble collagen fabric of mature mammalian connective tissue. The chapter concludes with an interesting introduction to the principles of the commercial manufacture of gelatin. There are many facts in the industrial gelatin literature which would be of considerable interest to the molecular biologist concerned with collagen, if only he were aware of them. This section provides a useful point of departure for looking into this literature.

Chapter IV concerns "The Degradation of Gelatin," and considers both chemical and enzymatic methods of cleaving the peptide backbone of the gelatin molecule, and of modifying various of its functional groups.

Chapter V, which comprises the last third of the book, covers in detail "The Gelatin → Collagen Transition"; that is, it deals with the problem of how random coil gelatin, on cooling, gets itself part-way or completely back to the native collagen structure. This subject is of particular interest because it is the partial return to the collagen structure which is responsible for many of the unique properties of gelatin, including its gelling behavior, its ability to function as a glue, and so forth. In addition, studies of the kinetics of the reversion process offer particularly useful insights into the mechanisms by which the collagen structure is set up and stabilized *in vivo*. In terms of structure (both molecular and literary) this chapter closes the ring, bringing us back again to the original collagen with which we started Chapter I.

Taken as a whole, the book is very well written and profusely illustrated. The extensive bibliographies alone (ranging well into 1963) make it invaluable to workers in the field. However, it should be pointed out that this book is *not* a definitive compendium dealing only with well-established principles. Rather, it is a highly personal document in which the field (including currently controversial areas) is described as seen through the eyes of one highly qualified, but not infallible, individual. This statement is not intended as criticism, especially since this approach makes the book very readable, and since the author himself announces in the Preface that he intends to proceed in just this way. But it is a fact of which the reader should remain aware, in that this approach sometimes leads Dr. Veis to views and interpretations which are by no means universally accepted. One case in point (particularly jarring to this reviewer since it concerns his own work) begins with the erroneous assertion that melting (phase transition) temperatures, measured in solution on cooled gelatins which have not attained their final degree of helicity, differ from those obtained at equilibrium. This misconception tends to confuse some of the ensuing (pp. 374-384) discussion of mechanisms of the effects of neutral salts on the collagen-type helix.

However, this is a minor point, and it should be reiterated in closing that Dr. Veis has written a very interesting and important book which should be in the library of every research worker seriously concerned with the structure and properties of collagen and gelatin.

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Guide to Activation Analysis. Edited by WILLIAM S. LYON, JR., Leader, Nuclear-Radiochemical Group, Analytical Chemical Division, Oak Ridge National Laboratory. D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 1964. xix + 186 pp. 16 × 24 cm. \$5.95.

Radioactivation has become a standard method of analysis, not only for the determination of trace elements, but also for rapid non-destructive analysis of minor and even major constituents in appropriate matrices. The technique is of great value in such diverse fields as biology, metallurgy, geochemistry, crime detection, solid-state physics, and space science.

The idea for a Guide to Activation Analysis was first proposed by the Advisory Committee on Isotope and Radiation Development of