not completely free of angle strain.[2] The synthesis employed was chosen on the basis of its *not* proceeding *via* carbonium ions (with their concomitant uncertainty as to the occurrence of skeletal rearrangements).

Lithium aluminum hydride reduction of **1a**[3] (Fig. 2) afforded a quantitative yield of **1b**,[4] b.p. 109–110° (10 mm.), n^{25}D 1.5060, which on reaction with methanesulfonyl chloride in pyridine to afford methanesulfonate **1c**, then reaction of **1c** with sodium cyanide in dimethylformamide (110°, 12 hr.) gave an 85% yield of nitrile **1d**, b.p. 115–118° (9 mm.), n^{25}D 1.4943. Hydrolysis of **1d** with potassium hydroxide in ethylene glycol (155°, 1.5 hr.) gave a 92% yield of a pasty mixture of stereoisomers of **1e**, m.p. 39.0–40.8° after repeated recrystallization from pentane at −70°. Iodolactonization[5] of **1e** afforded a 68% yield of iodolactone **2a**, m.p. 127–129°, $\lambda_{\max}^{\mathrm{CHCl_3}}$ 5.80 μ, which on catalytic hydrogenolysis (platinum plus one equivalent of triethylamine in ethyl acetate, 40 p.s.i. of hydrogen) afforded a 79% yield of δ lactone **2b**, m.p. 67–69°, $\lambda_{\max}^{\mathrm{CHCl_3}}$ 5.80 μ. Similarly, γ lactone **7b**, m.p. 205–206°, $\lambda_{\max}^{\mathrm{CHCl_3}}$ 5.86 μ, was prepared by hydrogenolysis of **7a**,[6] m.p. 80–81°. Structural correlation of the two lactones **2b** and **7b** was achieved by conversion of **2b** into its hydroxymethylene derivative (**9**), m.p. 109–110°, then ozonization of **9** to afford **7b**. Lithium aluminum hydride reduction of **2b** afforded diol **3a**, m.p. 82.2–83.1°, in 90–92% yield. Esterification of **3a** with one equivalent of methanesulfonyl chloride in pyridine gave the oily diol monomesylate (**3b**)[7] which was directly oxidized[8] to **4**, m.p 62.8–64.3°, in 87% yield. Cyclization of **4**, effected by treatment with an excess of sodium hydride in anhydrous dimethylformamide at 60° for 8 hr., afforded a 90% yield of tricyclo[4.4.0.$0^{3,8}$]decan-2-one (**5**), m.p. 198–199.5°, $\lambda_{\max}^{\mathrm{CCl_4}}$ 5.79 μ, which afforded a 2,4-dinitrophenylhydrazone, m.p. 186–187°, and except for a trace of **8** was homogeneous by vapor phase chromatography. Consistent with this formulation is the observation that reduction of **5**, employing either lithium aluminum hydride or sodium and alcohol, afforded high yields of a single alcohol (**6**), m.p. 214.4–216.4°. Wolff–Kishner reduction of **5** afforded a 23% yield of tricyclo[4.4.0.$0^{3,8}$]decane (twistane), m.p. 163–164.8°, characterized by its elemental analysis, very simple infrared spectrum, n.m.r. spectrum[9] (three peaks at 8.37, 8.45 and 8.65 tau in the expected ratio of 1:2:1), and great volatility.[10,11]

Solvolysis of suitable derivatives of **6**, with their interesting multiplicity of possible Wagner–Meerwein rearrangements, extension of the intramolecular alkylation reaction to give more highly strained *trans*-bridged systems of the general type **10**, and less lengthy (although more ambiguous), syntheses of tricyclo[4.4.0.$0^{3,8}$]decanes are currently being investigated.

---

(2) This unfortunately renders twistane of uncertain value for determination of the energy difference between chair and twist boat cyclohexane rings by comparison of its heat of combustion with that of adamantane. The angle strain can be seen clearly by bridging bicyclo[2.2.2]octane (Dreiding models) between C-2 and C-5 with a two carbon unit.

(3) R. Skeda and O. Tramposch, *Chem. Ber.*, **75**, 1379 (1942), 85% *endo*-carbethoxy as shown by vapor phase chromatography.

(4) K. Alder, S. Hartung and O. Netz, *Chem. Ber.*, **90**, 1 (1957). All new compounds were characterized by spectral data and, except for **3b** and **4**, by elemental analyses.

(5) C. S. Rondestvedt and C. D. Ver Nooy, *J. Am. Chem. Soc.*, **77**, 3583 (1955).

(6) W. Boehme, E. Schipper and W. E. Scharpf, *ibid.*, **80**, 5488 (1958), have reported the formation of two iodolactones from **1f**. In our hands this reaction invariably afforded only the one isomer, m.p. 80–81°.

(7) Diol monomesylate **3b** was unstable, cyclizing to ether 8 on standing.

(8) H. C. Brown and C. P. Garg, *J. Am. Chem. Soc.*, **83**, 2952 (1961).

(9) Obtained at 60 Mc. on a Varian Associates A-60 nuclear magnetic resonance spectrometer purchased with funds provided by the National Science Foundation, grant G19108.

(10) An alternative structure for the hydrocarbon, 2,6-ethanobicyclo[2.2.2]octane, which would arise if the original iodolactonization proceeded abnormally, is rendered unlikely by the data contained herein.

(11) Molecular weight 136 by mass spectroscopy. The author thanks Professor C. Djerassi of Stanford University for this determination.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF WISCONSIN
MADISON 6, WISCONSIN
H. W. WHITLOCK, JR.

BOOK REVIEWS

Biological Structure and Function. Proceedings of the First IUB/IUBS International Symposium Held in Stockholm, September 12–17, 1960. Volume I. Edited by T. W. GOODWIN, Department of Agricultural Biochemistry, Institute of Rural Science, Penglais, Wales, and O. LINDBERG, The Wenner-Gren Institute for Experimental Biology, University of Stockholm, Sweden. Academic Press Inc., (London) Ltd., 17 Old Queen Street, London, S. W. 1, England. 1961. xii + 363 pp. 16 × 23.5 cm. Price, $10.50.

This volume is in three sections of quite widely different nature. The first, Macromolecular Structure and Function, contains nine papers, most of which are quite short but of high quality. A brief review by Kendrew on myoglobin structure is accompanied by discussion, followed by a review of nucleic acid structure as derived from X-ray diffraction studies (Wilkins). Several other papers in this section deal with nucleic acids: nucleotide sequence (Chargaff), polynucleotide sequence (Davidson), and synthesis of soluble RNA (Canellakis and Herbert). Of particular interest was the paper by P. Reichard on the Enzymic Formation of DNA from Ribonucleotides, in which it is suggested that the reduction of ribose to deoxyribose (as nucleotide) may be a rate-controlling step in DNA synthesis.

The second section is the largest, containing 12 papers, and represents more closely the primary objective of the symposium. It is entitled Microsomes and Protein Synthesis. An excellent review of the Endoplasmic Reticulum and its functions is presented by Keith R. Porter, with numerous electron micrographs. This is followed by a critical discussion of the intriguing process of Pinocytosis by H. Holter of Copenhagen. More specialized papers on structure–function relationships in the mammary gland (Haguenau and Hollmann) and the pancreas (Hirsch) are followed by a series of papers on various aspects of protein synthesis. Hultin, *et al.*, describe experiments on amino acid incorporation by liver microsomes and ribonucleoprotein particles which appear to demonstrate that gross effects of various agents on protein metabolism in the whole animal are retained in the microsome function. A study of RNA and protein association in the ribonucleoprotein particle was presented by P. Siekevitz, particularly his work on the effect of spermine on this particle. Among other reports, including one by Chantrenne on the effect of 8-azaguanine on the specificity of protein synthesis in *B. cereus*, is an excellent paper by V. G. Allfrey on protein synthesis in isolated cell nuclei. It appears that this cell fraction contains the necessary amino acid-activating enzymes and RNA, and that amino acid uptake is accelerated by DNA and inhibited by histones.

The last short section of the volume deals with polysaccharides in three papers. The synthesis of cellulose by bacteria (S. Hestrin) and mucopolysaccharides in connective tissue (Dorfman and Schiller) pose a number of interesting problems, including that of the extracellular production of polysaccharide.

The volume is a mixture of fairly specific research reports and brief but critical reviews, which is inevitable in a symposium. There are sufficient reviews of lasting value in the volume to recommend it for a place on library and personal book-shelves.

School of Medicine
University of Rochester E. Stotz
Rochester 20, N. Y.

Quantum Mechanics. By Eugen Merzbacher, University of North Carolina. John Wiley and Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 1961. xii + 544 pp. 15.5 × 23.5 cm. Price, $12.00.

This book is an introductory text to non-relativistic quantum mechanics, covering the standard topics, with perhaps more emphasis on methods than the historical applications. Topics treated especially thoroughly, in comparison to comparable textbooks, are one-dimensional wave mechanics, spin matrices, linear vector spaces and rotations. The book also has a section on the formal theory of scattering, and shows also in many other places a modern viewpoint. There are many good problems which should lead the student to deeper insight.

Department of Physics
The University of Wisconsin C. J. Goebel
Madison, Wisconsin

Metabolic Pathways (Second Edition of Chemical Pathways of Metabolism). Volume II. Edited by David M. Greenberg, Department of Biochemistry, School of Medicine, University of California, San Francisco, California. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y. 1961. xiii + 814 pp. 16.5 × 23.5 cm. Price, $24.00.

The enormous growth and development of the field of intermediary metabolism necessitated a new edition of the book, "Chemical Pathways of Metabolism." To achieve this end the editor has brought together a group of experts who deal thoroughly but concisely and critically with their respective fields.

This second edition constitutes not only an impressive extension and revision of the first edition's eight chapters in intermediary metabolism, namely, Nitrogen Metabolism of Amino Acids, Carbon Catabolism of Amino Acids, Biosynthesis of Amino Acids and Related Compounds, Metabolism of Sulphur Containing Compounds, The Synthesis of Proteins, Purines and Pyrimidines, Nucleotides and Nucleosides, and The Metabolism of Chlorophyll, but also presents four new and authoritative chapters: Thiamine, Metabolic Pathways Involving Niacin and Its Derivatives, The Biosynthesis of Flavine Derivatives, and The Biogenesis and Catabolism of Folic Acid and Vitamin B_{12}.

This second edition contains not only a valuable highly annotated survey of fields of intermediary metabolism but in many instances presents a stimulating critique of some more controversial areas. An outstanding example of this is found in the chapter on protein synthesis.

Although any text on metabolic pathways is subject to more or less rapid obsolescence, this book meets a well defined need for special and authoritative surveys in metabolism and should receive the eager and welcoming approval of graduate students, research workers and academicians.

Departments of Radiation Biology
and Biochemistry Leon L. Miller
University of Rochester School of
Medicine and Dentistry
Rochester 20, New York

Elektrochemische Kinetik. By Dr. Klaus J. Vetter, Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin-Dahlem, Apl. Professor für Physikalische Chemie an der Freien Universität Berlin. Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf, Germany. 1961. xv + 698 pp. 17 × 23.5 cm. Price, DM. 156.

For many years following the initial work of Tafel, Butler, Frumkin, and others in the field of electrode kinetics, research centered primarily around the hydrogen evolution reaction. To those who have followed developments in electrochemical theory, the sudden shift of emphasis from hydrogen evolution kinetics to the general area of electrochemical kinetics is quite striking, as are the rapid developments during the last 15 years. With the publication of "Electrochemische Kinetik," the subject has now moved from a chapter or two in electrochemistry textbooks to a comprehensive treatment in a single book devoted exclusively to this subject.

The treatment by Vetter is unusually thorough. Since nearly all of the theoretical aspects of electrochemistry have a general direct bearing on electrode kinetics, they must be brought into the discussion in some manner. The author has done a good job in seeing that the discussion of these points is directed toward the role they play in the kinetics, and thus avoids wandering off into extended irrelevancy. The only criticism which might be raised in this regard is the length of the thermodynamic treatment, which is given adequately in most electrochemistry texts, and need not be treated so extensively in connection with kinetics.

The bulk of the book is devoted to a detailed account of the many different forms of polarization and overvoltage phenomena, methods by which electrochemical reaction mechanisms may be determined, and a description of the experimental information available on redox, metal ion and gas electrodes. It is doubtful that any significant research on electrochemical kinetics has been omitted from the contents.

The book is not a text. However, since there are few, if any, courses devoted exclusively to electrochemical kinetics, there is no need for a text in this area. As reference material for persons engaged in electrochemical research, the book is a valuable addition to the working literature.

Texas Research Associates
1701 Guadalupe Street R. M. Hurd
Austin, Texas

Abundance of Chemical Elements. By V. V. Cherdyntsev. Translated by Walter Nichiporuk. The University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Ill. 1961. x + 304 pp. 16 × 24 cm. Price, $10.00.

Interscience Monographs and Texts in Physics and Astronomy. Volume VII. The Abundance of the Elements. By Lawrence H. Aller, The Observatory of the University of Michigan, Ann Arbor, Michigan. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1961. xi + 283 pp. 15.5 × 23.5 cm. Price, $10.00.

The composition of the universe has interested man since ancient times, and is still one of the fundamental questions of science. There are two main sources of information: samples of terrestrial and meteoritic material which can be analyzed chemically, and light received from extra-terrestrial bodies. The first source has been exploited mainly by chemists and geologists, and the second by astronomers. Important assistance has been provided by, respectively,