where different transitions were predicted to occur. Because vibrational isotope effects are neglected in the structural work,[2] the frequency of these transitions cannot be exactly calculated; therefore, searches were carried out over several hundred megahertz on each side of the predicted frequencies. All low intensity transitions were examined for identifying Stark effects with a CAT but no transitions from I could be assigned. Since the spectrum of $H_2{}^{13}\overline{COOCH_2O}$ was seen in natural abundance during these experiments, the abundance of I must be quite low if present at all. We are conservative in setting a lower limit for the abundance of I because of the inability to precisely predict its spectrum and the possibility that its transitions may have been inadvertently overlooked. We estimate that the transitions of this species would have been readily observed if they were one-tenth as intense as those for species III. On this basis it is concluded that at least 90% of the oxygen-18 formaldehyde which incorporated into the ring went to the ether site. An independent synthesis of species I is planned in order to set a more precise lower limit for its concentration.

The amount of enrichment at the ether position was estimated from the relative intensity of transitions from species III and II.[9] A value of 0.28 ± 0.06 was obtained for the ratio of III/II. The Criegee mechanism for a statistical distribution of aldehyde and zwitterion predicts this ratio should vary from 0.21 for 100% completion to 0.27 for 50% completion of the ozonolysis. The exact amount of the ozone introduced was not determined; however, the yield was 53%. These results are not precise enough to set a definitive lower limit for incorporation at the peroxidic oxygen but they are consistent with the detection of only species II and III in the microwave spectrum.

In conclusion, the results reported here and in ref 2 imply that the Criegee mechanism satisfactorily accounts for the major products obtained in ozonizing ethylene. The lower limit set for the concentration of ozonide I in this study indicates that the aldehyde interchange mechanism as well as the proposal of Fliszar and Carles[10] to account for peroxidic ^{18}O incorporation are not very important at −78° for ethylene. While the site of oxygen-18 enrichment found for ethylene is consistent with a report on arylalkenes,[6] it differs from alkylalkenes where enrichment occurs at both positions.[7,11,12] We intend to further investigate the ozonolysis of ethylene at lower temperatures in different solvents to determine if even small amounts of oxygen-18 can be found at the peroxide site. Conformational studies of alkyl-substituted ozonides as well as studies of aldehyde insertion reactions of alkyl-substituted alkenes are also planned. These studies should establish whether the ozonolysis mechanism for ethylene is different from other alkyl-substituted alkenes.

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Book Reviews*

Chemistry for Changing Times. By John W. Hill (University of Wisconsin, River Falls). Burgess Publishing Co., Minneapolis, Minn. 1972. xiii + 272 pp. $5.50.

This is a book for a college course about chemistry for the student not majoring in any science. Its primary aim is to interest such students, in the belief they will then inevitably learn something of the subject, and, if the interest kindled is sufficiently high, that they will continue to learn after the course is over. To achieve this goal, the traditional approach of teaching a curtailed version of classical chemistry is abandoned.

The subject starts with a brief consideration of the philosophy of science, moves rapidly through general and physical chemistry, and reaches organic chemistry, "where the action is," at the end of the first quarter of the book. The viewpoint throughout is unabashedly sociological and environmental, so that there is hardly a page on which chemistry is not related to the world at large. The treatment is largely descriptive, and there is no attempt to teach the student how to *do* chemistry: how to name, how to make, how to calculate. Drawings and photographs are used abundantly. Portraits of a few prominent chemists, seemingly randomly selected, are shown where a particular accomplishment is discussed; the choice of the accomplishment is not in all instances a felicitous one, and, for example, Professor Louis Fieser might not be entirely pleased to see his chemical fame based entirely upon the invention of napalm.

The approach of this book has a definite appeal to today's youth, and it will probably be quite successful in its aim. The highly topical approach which is responsible for this, however, will probably hasten the obsolescence of the material. The problems at the end of each chapter are as much a departure from tradition as the text, and generally have no fixed answer. Examples are: "Examine the label of a can of fruit, etc.; make a list of the food additives in each; try to determine the function of each additive;" "discuss the pros and cons of a persistent pesticide." Each chapter ends with a long list of suggested readings, taken extensively from the popular paper-back literature, but also including articles from "Scientific American," "Ramparts," "Chemistry," "New Republic," and even "Boys' Life." A most useful feature is a list of visual aids for each chapter, with specific information on source and cost.

Professor Hill's treatment of his subject is bound to evoke a very mixed reaction in the profession, owing to its "revolutionary" approach, but it is an experiment well worked out, notwithstanding a number of technical faults. From those for whom it is written, it is likely to receive high acclaim.

Comprehensive Chemical Kinetics. Volume 13. Reactions of Aromatic Compounds. Edited by C. H. Bamford and C. F. H. Tipper (University of Liverpool). American Elsevier, New York, N. Y. 1972. xi + 508 pp. $53.50.

Like the previous volumes in this series, this one is a valuable reference work. It consists of an enormous chapter on "Kinetics of Electrophilic Aromatic Substitution," by R. Taylor, and two small chapters (Nucleophilic Aromatic Substitution, by S. D. Ross, and Aromatic Rearrangements, by D. L. H. Williams). Some

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* Unsigned book reviews are by the Book Review Editor.

of these subjects have been reviewed in the not-too-distant past, but it seems fully justified to bring them all together with uniform treatment.

The first chapter is essentially an up-dated version of the book on the same subject by Norman and Taylor, published in 1965. Exhaustive coverage of the literature published prior to 1969 is claimed. No date is given for Chapter II, but all references are before 1969 except one (January 1969), and Chapter III is stated to cover the literature to the end of 1969. The book is very nicely produced, but it is evident that the publishers have been in no hurry to get it out.

The subjects are not only treated thoroughly, but are discussed critically; the authors have evidently thought intensely about the material with which they were dealing. Their emphasis is on an understanding of the implications of kinetics about reaction mechanism; nonkinetic data are brought in freely, and kinetics is never treated as an end in itself. The second chapter also enriches the English language with mellifluous concatenations such as "protodegermylation" and "iododeplumbylation."

There is a good subject index, but one misses an author index.

Point Group Character Tables and Related Data. By J. A. SALTHOUSE and M. J. WARE (University of Manchester). Cambridge University Press, New York, N. Y. 1972. v + 88 pp. $3.75.

The essential tables for working with group theory, usually found as an appendix to a textbook, are here made available separately at reduced cost. These tables are more complete than usual in that they include data for all the cubic and icosahedral groups and for axial groups of seven- and eightfold symmetry, as well as the transformations of the first hyperpolarizability tensor for possible use with the hyper-Raman effect.

The Origin of Life by Natural Causes. By M. G. RUTTEN (State University of Utrecht). Elsevier Publishing Co., Amsterdam, London, New York. 1971. 420 pp. $25.00.

Here is another book on the origin of life. This one is written by a geologist, providing a new and welcome emphasis. It is written for the "general reader," who is frequently advised to skip a detailed section, and for the specialist, particularly those who wish to improve their understanding of what is currently known or suspected of the primitive environment. It is well written and well organized and the material is frequently summarized. The reader is helpfully referred back to a previous section to refresh his memory on facts requisite for the ensuing section.

Rutten's coverage of what he calls the experimental checks on prebiotic syntheses is not complete, which is understandable in this rapidly expanding field. However, most of the general categories of reactants and environments have been covered. He correctly stresses the variety of conditions and the ease with which simple biological molecules can be formed but incorrectly reports that no such syntheses occur in the presence of oxygen. His treatment of initial life forms and their evolution is no more tenuous than our knowledge.

His geological perspective leads the author to ask such questions as: can laboratory syntheses be extrapolated to geological time? Will the products be conserved over any length of time or will the continuous flux of solar energy required for the formation of the simplest monomers be destructive of the more sensitive polymers and protocells? If so, how can they be isolated and protected? If isolated, how can they be accessible to other molecules for further combinations and development? Dr. Rutten's model of life's beginnings provides both isolation and mixing in alternate periods. The shallow, inland, continental basins which formed during the relatively long, stable, and topographically flat geosynclinal periods alternately acquired and lost water. Their bottoms were lined with clay, a good adsorbing and concentrating agent. The water in these basins was deep enough to protect the first forms of life or prelife from lethal uv irradiation but not so deep as to filter out the visible wavelengths for the first photosynthesis.

There is an excellent review of the various geological processes specifically related to the origin of life: the nature of the early sediments, the importance of clays, the evidence for the primitive anoxygenic atmosphere, and the constancy of the composition of seawater. It is this emphasis and its readability that make this book a welcome addition to the field.

M. W. Neuman, *University of Rochester*

Submillimetre Spectroscopy. By G. W. CHANTRY (National Physical Laboratory). Academic Press, London and New York. 1971. x + 385 pp. $18.00.

This book deals with the stubborn region between 1 and 0.1 mm (10–100 cm^{-1}, 300–3000 GHz) which has long been acknowledged as one of the most difficult parts of the electromagnetic spectrum for experimentalists to work in. Recent advances from both the microwave and the infrared sides of the region have now made it accessible to investigation, and the methods and results are summarized in this book.

After two brief introductory chapters, the book is divided into three roughly equal sections. The first consists of two chapters dealing with the theory and present state of development of the Michelson interferometer as used in the submillimeter region. This is followed by a chapter showing application to the study of a wide range of subjects including absorption in crystals, liquids, polymers, clathrates, plasmas, and submillimeter aspects of superconductivity. The final section, and perhaps the most interesting one, deals with submillimeter masers and lasers and other nonlinear phenomena.

Because of the very wide range of topics covered, many sections of the book have the flavor of a review rather than an integrated exposition. The subtitle of the book, "A guide to the theoretical and experimental physics of the far infrared," is a valid description: the book serves as a travel guide through a large territory and should aid the prospective tourist in selecting areas for closer study.

James E. Boggs, *University of Texas*

Advances in Chemical Physics. Volume 22. Edited by I. PRIGOGINE and S. A. RICE. John Wiley & Sons, New York, N. Y. 1972. ix + 436 pp. $22.50.

This volume contains five articles, two of which are strictly theoretical dealing with advanced mathematical techniques ("Functional Integrals and Polymer Statistics" by Karl F. Freed and "An Introduction to C*-Algebraic Methods in Physics" by Gerard G. Emch). Freed's discussion will be of interest to those whose work involves polymer statistical mechanics, and the article by Emch will be of interest primarily to theoretical physicists but probably not to many chemists.

The three remaining articles are "Equilibrium Denaturation of Natural and Periodic Synthetic DNA Molecules" by Roger M. Wartell and Elliot W. Montroll, "The Lattice Vibrations of Molecular Solids" by O. Schnepp and N. Jacobi, and "Radiative and Nonradiative Processes in Benzene" by C. S. Parmenter. These articles are very clearly written, presenting a wealth of material on the experimental and theoretical aspects of these subjects, and providing a valuable introduction to the recent literature. The book would be a useful addition to the personal library of those who are or who anticipate working in any of these fields of research.

Richard D. Burkhart, *University of Nevada, Reno*

Perspectives in Structural Chemistry. Volume IV. Edited by J. D. DUNITZ (ETH, Zurich) and J. A. IBERS (Northwestern University). John Wiley & Sons, New York, N. Y. 1971. x + 425 pp. $24.95.

According to the editors' preface, this will probably be the last volume of the series. Like its predecessors, it treats a limited number of diverse topics in considerable depth and, consequently, should appeal primarily to specialists in the particular areas covered.

The first of the three reviews in the present volume is also the shortest (59 pp, 110 references): "Heteropoly and Isopoly Complexes of the Transition Elements of Groups 5 and 6," by H. T. Evans, Jr. Following very brief surveys of the historical background and chemistry of the poly complexes, Evans describes the known crystal structures of the heteropoly and isopoly complexes and some closely related polyanions, beginning with the so-called "Keggin molecule," the dodecatungstophosphate ion. Each crystal structure determination is graded with respect to quality—a feature of no little importance to a chemist who has not been trained in structure analysis. Unfortunately, this area of chemistry still seems as bewildering as ever to the nonspecialist. Indeed, as Evans points out, predictions and speculations concerning it have met with remarkably little success, perhaps because little good structural information is available relative to the large size of the complex family.

The scope of the review of "Conformational Equilibria in the Gas Phase" by O. Bastiansen, H. M. Seip, and J. E. Boggs is considerably broader (106 pp, 435 references). The authors provide a brief summary of the fundamental principles of conformational analysis and a somewhat more detailed survey of the experimental methods employed (gas electron diffraction, microwave and vibrational spectroscopy), followed by a short review of the more important methods for theoretical calculations of molecular geometry