this hypothesis was explored by submitting 1,3,6-cyclononatriene (VIII)[9,12] to the isomerizing conditions used in the earlier experiments (144 hr., 70°). Quite surprisingly, this substance is not isomerized under these conditions and can be recovered essentially quantitatively. It therefore must be concluded that VIII is probably the most stable of the isomeric cyclononatrienes and that it is certainly not an intermediate in the isomerization of V to VI.

(12) This substance was unexpectedly obtained from an attempt to prepare 1,2,4-cyclononatriene from 9,9-dibromo[6.1.0]non-2-ene.[9] It has b.p. 62° (20 mm.), $\lambda_{max}^{EtOH}$ 205 mμ, ε 3920, and yields oxalic acid, malonic acid and succinic acid on ozonolysis. Catalytic hydrogenation (3 mole-equivalents) afforded cyclononane.

It has been established that VI precedes VII in the isomerization sequence.

While identification of the two intermediates in the V → VI conversion has not yet been successful, examination of the n.m.r. spectrum of an isomerization mixture which was quenched before the appearance of VI (2 hr., 27°) suggests that they are also bicyclo[4.3.0]-nonadiene isomers. The assignment of their structures is necessary before it will be possible to determine the nature of the bridging reaction leading to VI.

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# BOOK REVIEWS

**Shock Waves in Chemistry and Physics.** By JOHN BRADLEY, Lecturer in Inorganic and Physical Chemistry at the University of Liverpool. John Wiley and Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 1962. xiv + 370 pp. 16 × 24.5 cm. Price, $11.00.

Shock waves, the discontinuities in pressure, temperature and density which form when waves of finite amplitude propagate through gases, were of little interest and largely unknown to chemists prior to the last war. As a matter of fact very little had been done with them by aerodynamicists either. The wartime interest in shock waves produced by explosives, as well as the development of high speed aircraft and missiles, changed that and both the theory and the experiments advanced rapidly. By 1950, the shock wave, usually produced in a remarkably simple apparatus, the shock tube, had become a powerful tool for the study of energy transfer processes of all sorts as well as for the study of elementary chemical kinetics over a wide range of temperatures. This volume is an excellent introduction to the subject.

Almost a third of the book is devoted to the theory of shock waves. Included are not only the theory of ideal one-dimensional flows in shock tubes, including the effects of relaxation, chemical reaction and ionization, but a welcome discussion of some of the effects which complicate the behavior of real experimental apparatus. These include the growth and properties of the boundary layer, the attenuation of shock waves, the behavior of the contact surface and the difficulties which arise in the use of reflected shock waves.

Another sixty pages describe the experimental techniques which have been used in shock wave investigations. The discussion is a good one, beginning with a description of the construction of shock tubes and going on to the various methods which have been used to measure density, pressure, temperature and gas flow velocity in the very short times, usually measured in microseconds, available for measurement. It goes on to discuss methods of following the chemical composition, a critical problem in kinetic experiments.

In the last half of the book some of the new results which have been obtained with the aid of shock waves are outlined. These include the measurement of thermodynamic properties, vibrational and rotational relaxation, ionization and a variety of chemical reactions, such as dissociation, pyrolysis, oxidation of hydrocarbons and so forth. The discussion gives an excellent picture of what has been done and what is possible.

This book is a welcome successor to the earlier work in German by Toennies and Greene. The field has been moving very rapidly and there have been many developments which make an expanded volume desirable. The bibliography is reasonably complete through 1959 and includes some work published in 1961. No major new developments seem to be omitted. This work should be on the reference shelf of any one contemplating or beginning work with shock waves and will, indeed, be useful to most chemists already utilizing them.

PROFESSOR OF CHEMISTRY
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**Advances in Chemistry Series. Number 36. Free Radicals in Inorganic Chemistry.** Papers presented at the Symposium on Inorganic Free Radicals and Free Radicals in Inorganic Chemistry, Division of Inorganic Chemistry, 142nd National Meeting of the American Chemical Society, Atlantic City, N. J., September 10–12, 1962. Robert F. Gould, Ed. American Chemical Society, 1155 Sixteenth Street, N.W., Washington 6, D. C. 1962. vi + 175 pp. 15.5 × 23.5 cm. Price, $7.00.

This volume is a collection of the 17 papers presented for general discussion by chemists interested in the preparation, detection, properties and reactions of inorganic free radicals. The papers run over a broad range from such topics as "Mass Spectroscopy of Inorganic Free Radicals" by S. N. Foner and R. L. Hudson and "Experimental Determination of the Electron Affinities of Inorganic Radicals" by F. M. Page to "Inorganic Free Radicals in Solution and Some Aspects of Autoxidation" by N. Uri and "A New Deep Violet Compound $(O_2ClF_3)_n$, Dioxygen Chlorine Trifluoride" by A. G. Streng and A. V. Grosse. About half the papers are concerned with studies using classical chemical methods and approaches and the other half of the papers discuss results in which use has been made of more physical methods and tools. Somewhat brief and sketchy reviews are given of several physical methods of studying radicals and their properties. However, even these papers are not meant by the authors to be reviews; they are primarily papers meant to inform the audience of some interesting results and methods. The main appeal of this volume is to those who are new to the field and who want a partial summary of work in an expanding and changing field.

I believe that this book is a glaring example of the absurdity of publishing in book form a collection of talks loosely connected by a general topic. The error is further compounded by including the book in a series, "Advances in Chemistry," which implies a cohesiveness and generality not possible from 17 diverse topics. The papers would separately be good articles in several journals or even collected together in a single issue of one journal. Such publication would make for a more rapid and a more widespread use of the information contained in these papers. However, I see little excuse for publication as an expensive book with a paper cover.

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