

library should possess a copy, however, because when Volume 4 (containing the bibliography and index) is available, the use of this book will save much time in searching the literature.

E. F. G. HERINGTON

## FROZEN FREE RADICALS

### Frozen Free Radicals

By Dr. G. J. Minkoff. Pp. ix+148. (New York: Interscience Publishers, Inc.; London: Interscience Publishers, Ltd., 1960.) 5 dollars; 36s.

**F**REE radicals are highly reactive species, but many radicals can be successfully immobilized in solid matrixes at low temperatures. In the past ten years the development of new techniques has led to a great acceleration of the study of the formation and trapping of radicals. This has been encouraged by the initiation in 1956 of a three-year programme of fundamental research at the National Bureau of Standards, where it was hoped that it would prove possible to utilize the stored energy of a high concentration of free radicals in the production of an efficient rocket fuel. Dr. Minkoff spent a year as a guest scientist at the National Bureau of Standards in connexion with this programme.

Drs. Bass and Broida of the National Bureau of Standards have recently edited a volume of sixteen contributions on the history and modern development of radical trapping, which is at present the most exhaustive review of the subject. In contrast, Dr. Minkoff's monograph can be particularly recommended as a well-co-ordinated introductory survey.

The first four chapters of the book are devoted to the history of radical trapping and a description of the modern techniques. Many of the early studies of the phenomena of light emission from the condensation products of discharges and of the reactions taking place in cold traps have been repeated. The stabilization of free radicals has been increased by the use of liquid helium as refrigerant, and descriptions are given of several Dewar vessels constructed for optical studies at liquid-helium temperature. Several methods for the detection of free radicals are given, with indication of their suitability for use when the radicals are trapped. Electron spin resonance has proved particularly valuable in this respect. Statistical predictions have been made of the maximum concentration of free radicals that may be trapped in various assumed models. However, all but one of these give limits which are much in excess of the experimentally determined maximum of a few tenths of 1 per cent as they do not allow for the nature of the matrix or the energy of recombination of the radicals.

The last three chapters of the book summarize the most important experiments published up to early 1959. Many pages are devoted to the observations on nitrogen atoms, as the repetition and extension of the early work gave much stimulus to the National Bureau of Standards programme. Atoms and small radicals have usually been produced in the gas phase and condensed at liquid-helium temperature. However, larger organic radicals are better stabilized by the irradiation of suitable solid solutions with ultra-violet or ionizing radiation. Liquid nitrogen has usually sufficed as refrigerant in these experiments,

in which the radicals may be the primary products of the irradiation or the results of reactions by the primary products. Free radicals have been found to be trapped in polymers, and are also believed to be important in biological systems. Reduced temperature is not necessary in these cases, and they are only briefly mentioned.

R. N. DIXON

## NATURAL HIGH-POLYMER CARBOHYDRATES

### The Chemistry of Plant Gums and Mucilages and some related Polysaccharides

By Prof. F. Smith and Prof. R. Montgomery. (American Chemical Society Monograph Series, No. 141.) Pp. x+627. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1959.) 144s. net.

**P**LANT gums and mucilages are complex carbohydrates and rank among the oldest articles of commerce. They are abundant and their applications are diverse, so that their use and importance are growing. The fairly recent unravelling of major parts of their complex structures provides a fascinating story, so that the appearance of this monograph is opportune.

The senior author, F. Smith, is one of the world's leading experts in the field, and the junior author is a well-known carbohydrate chemist—both of Haworth's Birmingham School—so that much was expected from them. Their labour and care are rewarded, for the book fully justifies the claim of the publishers that it contains everything that is known of these substances.

The first few chapters deal in a human and interesting manner with the function and origin of gums, their classification, isolation, detection and identification. A wealth of detail is provided, some of which, however, except for its historical importance, could perhaps have been omitted. Methods for the separation of polysaccharides generally are concisely described, and their analytical procedures are covered in a very long and exhaustive chapter. The rest of the book is devoted to the detail of the determination of the structure of the many gums, mucilages, exudates, etc., so far examined. The importance of periodic oxidation techniques and of methylation procedures, largely pioneered by the senior author, is brilliantly emphasized, and seeing the picture as a whole one is amazed at the wealth of knowledge we now have of these complex high-polymer carbohydrates.

Of particular value in connexion with structural work in the field is the provision of an appendix giving some of the physical characteristics of all the *O*-methyl derivatives of monosaccharides.

An important innovation is the account of studies of gum structure by means of specific immunological reactions which provide diagnostic micro-methods of growing importance.

The book is full of beautifully drawn formulae which make it of special value to the non-expert. It contains a most valuable series of references, and it is excellently printed and free from errors.

It will form a valuable addition to the library of every chemist, biochemist and plant physiologist, and can be highly recommended. M. STACEY