Four main types are recognized: good natural grasslands, cool mountain grasslands, semi-arid grazings and the savannahs of hot climates. The good natural grasslands are largely tick-free and are found in temperate zones. They vary widely in nature and management, the lucerne ley, for example, being an outstanding feature of the Argentine pampa, whereas it is exceptional in Uruguay or southern Brazil. Of the cool, mountain grasslands, many are usable in the summer only. Increased attention is being paid to their improvement by the introduction of suitable grasses and legumes, and there seem to be good prospects for the expansion of the wool trade in the Peruvian highlands and Ecuador, where llamas, alpacas and sheep do well. The grazings classed as semi-arid are found in both hot and cold climates. Here the herbage is poor, and the sheep and store cattle derive much of their food from trees and shrubs. Improvement is unlikely unless expensive irrigation schemes could be carried out. The savannahs are confined to the regions with hot climates, alternately excessively dry and excessively wet. They are of the least agricultural value and are very liable to flooding and animal pests and diseases.

The next five chapters deal with special aspects or problems connected with grassland, such as the temporary ley, the utilization of browse plants, soil erosion, animal and plant health, and general management and improvement. Though lucerne is the classic example of a plant successfully introduced for supplementary feeding, cereal leys are a characteristic feature of some regions, and the suitability of other grasses and legumes is being tested. The dangers of soil erosion, which in many regions has assumed serious proportions, are fully realized, and the help of the United States Soil Conservation Service has already been sought. From the concluding chapter it is evident that the Governments of the Latin American countries are fully alive to the need for scientific study in the development of their natural resources, and a spirit of co-operation exists which augurs well for their future.

References naturally form an important feature in a publication of this nature, and nearly nine hundred are supplied. The bulletin also contains a number of maps and photographs, some botanical analyses of pastures and a list of browse plants, and concludes with a special index of more than thirteen hundred genera and species.

K. WARINGTON

12

Dr W. A. Waters

MOLECULAR ORBITALS AND ORGANIC REACTIONS

The Electronic Theory of Organic Chemistry

By M. J. S. Dewar. Pp. xi + 324. (Oxford: Clarendon Press; London: Oxford University Press, 1949.) 30*s*. net.

THE advent of a new British book dealing with the electronic mechanisms of organic reactions merits special attention, even apart from Sir Robert Robinson's commendation in a four-page foreword, and the Clarendon Press is to be congratulated in having published one of the most stimulating volumes on modern chemistry.

Dr. M. J. S. Dewar boldly introduces electronic theories in terms of wave-mechanics; and, having represented simple covalencies by wave-functions for molecular orbitals, he explains non-mathematically the differences between the *sp*-orbitals of single bonds and the *p*—*p*, or π-orbitals of double bonds, and develops his theme to conjugated and aromatic systems without using Pauling's conventional 'canonical state' formulæ for resonance systems. He shows that this molecular orbital representation has great advantages, for it can be used to explain in the phraseology of wave-mechanics the true intention of the well-known 'curved arrow' (↷) symbolism of Robinson. In this respect Dr. Dewar has rendered organic chemists good service by breaking away from the static approach to chemical reactivity which has been forced on us so much by Wheland and other American writers, and stressing again the essential British point of view—dating from the time of Lapworth—that significant, and predictable, electronic *changes* occur *within* molecules during the course of their reactions.

The main chapters of Dr. Dewar's book deal with examples of organic reactions in a way which so closely follows Sir Robert Robinson's (alas, often unwritten) teaching, that a harsh critic might say that he has done little more than to reproduce Robinson's theories with fresh examples in a new jargon. Actually, so many of the examples deal with newer reactions of current interest and importance that the volume will greatly stimulate organic chemists who already possess a good background of factual knowledge. The book, however, may be confusing to the undergraduate, for he would find in it neither a detailed treatment of many simple reactions of major importance, nor the key references which are essential to anyone who wishes to trace back theories to their originators, or facts to the actual experimental reports.

Dr. Dewar explains away these omissions on grounds of space; but it is only too evident that he has written his book over-hastily. Those conversant with the subject will encounter examples of misquotation of fact and of misrepresentation of ideas of other chemists (for example, in connexion with the benzidine re-arrangement).

The most controversial feature of the whole book is undoubtedly the use of his "π-*bond*" formulation of both structures and reaction processes; but this novel theoretical outlook of the author himself should not be judged too critically until a much larger body of diagnostic factual evidence is available. It is evident, however, that in this book the term "π-*bond*" is used very broadly to denote any structure of a molecule, or transition intermediate, in which easily polarizable *p*—*p* electron-pairs are involved. Viewed in this light, all electromeric changes do undoubtedly involve π-bonds, though one may often question the necessity of introducing a special new symbolism for what may often be a mere transition state of a reaction which includes, at some part, a triangular system of three atomic nuclei and four electrons, two of which are mobile. Molecular re-arrangements, for example, are all explained in terms of π-*bonds*, and here it is a great pity that Dr. Dewar has overlooked the simple and adequate treatment of them given by Hughes and Ingold in 1940 on the basis of their S_N1 and S_N2 reactions, for this provides a clear and straightforward interpretation of both the kinetics and the crucially important stereochemistry of all cases of intramolecular change.

Nevertheless, as food for thought, and for its clearly written, daringly put argument, this book is certainly very well worth reading.

W. A. WATERS