

omary energy and enthusiasm has produced a superb account of the technicalities and potentialities of treating plants as microorganisms. He has been ably assisted in this by first-class contributions from a group of experts in specific aspects of the topic, although the editor's organising and integrating influence can be discerned throughout the book.

Approximately half of the book is devoted to a careful and comprehensive description of the many different techniques available for the culture of plant tissues and cells, beginning with an extremely useful account of the basic essentials of a tissue culture laboratory written by the editor himself. Street also provides a chapter on the apparatus and methods necessary for the successful cultivation of plant cells as suspension cultures. This includes full descriptions of batch culture chambers and of automatic chemostat and turbidostat devices. The technicalities of initiating and maintaining callus cultures are admirably covered by M. M. Yeoman, from Edinburgh, whilst E. C. Cocking and P. K. Evans of Nottingham discuss the isolation, culture and potential of plant protoplasts. The exciting topic of the production of haploid cell lines, with their obvious implications for plant genetics, receives a scholarly review by N. Sunderland, from the John Innes Institute, in a chapter dealing with pollen and anther culture. The general cytology of cultured cells is described in a long, informative chapter jointly written by Yeoman and Street, and Sunderland separately discusses the vexing question of the karyological instability of plant cultures.

The growth pattern of callus cultures and cell suspension cultures is treated in depth in separate chapters by Yeoman and P. A. Aitchison, and by P. J. King and Street. The discussion on cell suspension cultures is particularly valuable since it not only provides information on the growth and physiology of isolated plant cells, but also shows in great detail how highly synchronous populations of cells may be established. Such cultures can exhibit a remarkable synchrony of cell division for up to eight generations and, with a cell cycle of around three days long, their potential for the intensive investigation of the control mechanisms of the cell cycle must surely be greater even than that of the yeasts and unicellular algae. The book is rounded off by discussions of organogenesis and embryogenesis (J. Reinert, Berlin), the culture of plant tumour cells with special reference to crown gall (J. N. Butcher, Cambridge), and the growth of plant parasites in culture (D. S. Ingram, Cambridge).

Plant tissue culture is no longer an end in itself; it has progressed to a point at which it can be considered to be a

highly sophisticated technique capable of providing answers to problems throughout the whole of plant biochemistry, physiology, development, genetics and pathology. This beautifully produced book will be invaluable to the rapidly growing number of plant scientists who wish to use plant tissue or cell culture, but who do not wish to devote their time to becoming experts.

HARRY SMITH

Big game ecology

Wildlife Ecology. By A. N. Moen. Pp. xvi+458. (Freeman: San Francisco, 1973.) \$17.50.

SYSTEMS analysis and predictive model building in ecology are at an interesting stage in their development. More and more autecological studies pour out increasing quantities of details for synecologists to work on. This book is a synecological study of north American big game. It is unique in that it attempts to describe the physical and biotic interactions of game with their environment and to assess the importance of these interactions in terms of overall productivity. Their influence on game and range management are clearly stated. The title of the book is misleading, for only a small amount of space is devoted to wild fowl, gallinaceous birds and other wild life. Most of the data and examples are taken from studies on elk (wapiti), mule and white tailed deer and caribou.

The chief value of this book is that it brings between two covers a multitude of details regarding methods of measuring environmental parameters. Working ecologists and game managers need to know these details, but cannot afford much time ferreting them out. They will find this aspect of the book most appealing. Particularly useful in this respect are the two chapters which deal with the effects of climatic conditions on physical characteristics of the environment and on large ungulates. The functional relationships between weather and organisms are minutely analysed from the viewpoint of transference of thermal energy. The distribution of thermal energy is the commonest bond in these relationships and from this is drawn a conceptual picture of the complex nature of heat exchange involving all the basic modes of heat transfer. Anyone actively involved in game management, as well as theoretical modellers, will find this section of the book of immense value.

Physiological and behavioural interactions between game and environment are covered in the first half of the book in thorough, but not long winded, detail. The second half deals with the analysis of interactions involving both

these biotic interactions and the physical ones. Emphasis is laid on that essential statistic for range managers, the carrying capacity of the habitat. Effective calculation of this is possible only by computer simulation and integration of models of all aspects of the system being analysed. The author suggests a useful working format that such models should follow.

This book has, to my mind, two outstanding merits. The first is that it paints a detailed picture of the ecology of northern big game, in the style of Canaletto rather than that of the Impressionists. This alone should commend it to the attention of pure and applied ecologists alike. The second is that the book inspires the reader to think big; in terms of systems rather than species. For the development of ecology this seems like a good thing and for successful environmental manipulation an essential thing.

Good game management, like all ecosystem management, demands that decisions be taken on ecological bases. The benefit of step by step model building means that decisions taken can, before implementation, be tested by computer simulation. The degree of similarity between computer prediction and observed dynamic change depends on the realism of the biological models involved in the computation. No one must forget that this is the fundamental core of ecology which always has and always will depend on the skills of the individual field ecologist. As far as north American big game are concerned, this book brings us one step nearer rational management.

D. MICHAEL STODDART

Rho-sigma relations

The Hammett Equation. By C. D. Johnson. Pp. viii+196. (Cambridge University: London, October 1973). £4.50; \$13.50.

TO L. P. Hammett is owed the recognition that polar effects of aromatic substituent groups on rate and equilibrium constants of side-chain reactions are quantitatively regular. This conclusion is formally expressed by Hammett's $\rho\sigma$ relation, to which the volume under review is devoted.

The author provides an elementary, yet fairly detailed account of the role of Hammett's treatment in organic chemistry. It is intended for senior undergraduate or first-year graduate students, a formidable aim since, even for the simplest cases, general statements have to be tempered by ifs and buts. The book describes the various developments of the original $\rho\sigma$ treatment and provides a guide to the brood of modified sub-