

Surely, here is a profitable field of endeavour completely neglected. Furthermore, very little effort has been put into plant nutrition work, even though the soils of Frankenwald are acknowledged as being poor. This is perhaps the lesson to be learned from a preoccupation with the climax.

Timely, perhaps, is the chapter on the philosophy of dung which graphically describes the activities of dung beetles. These remarkable insects have recently been released in several places in northern Australia and it will be interesting to see if the fascinating story which Gillard tells of their behaviour and effect on Frankenwald grasslands is duplicated here.

The intervening chapters of the book deal with a wide range of specific studies which contribute to the understanding of these grasslands. They display graphically how well the research station has served the Botany Department in providing an invaluable resource and environment for student and faculty research.

The final chapter entitled "Outlook for grass" is disappointing though we must remember that Roux was seriously ill when he was writing this book. However, one idea, which is not new, of harvesting and managing wild animals has merit, especially in Africa but also in Australia. It has generally been found that greater production can be achieved by grazing different types of animals together rather than separately because their diets do not entirely coincide.

The book is well printed, and the illustrations attractive. However, the continuous tone photographs are generally rather poor and "muddy". This is a pity for an otherwise well-produced book.

J. C. TOTHILL

Australian Grasslands, edited by R. Milton Moore. 455 pp. 1970. Australian National University Press, Canberra. Price \$15.00.

The delegates to the XIth International Grassland Congress, held at Surfers Paradise in Queensland in April 1970, had the pleasant surprise of finding a copy of this book among the many pounds of papers handed out to them. The more than 800 delegates to the Congress now possess an up-to-date and thorough review (the book covers over 1200 literature references) of Australian grasslands, and Dr. R. Milton Moore is to be congratulated on achieving the formidable task of getting 35 contributors, who represent the major organizations of agricultural research in Australia, to write 28 chapters covering the environment, a description of all types of grasslands in Australia, the important production factors, and the major livestock industries.

Grassland research has been in the forefront of scientific endeavours in Australia and has contributed greatly to the adoption of modern management techniques—including replacement of species. Especially in the last thirty years very considerable advancements in grassland technology have been made. The book under review is the first to bring together aspects of grassland production from the southern, northern and interior parts of the continent. To date, most emphasis of research has been on pasture species (introduction, selection and breeding), plant nutrition, nodulation of the legumes and grazing management. It can be expected that in the future studies of soil-plant-animal ecosystems, which are being carried out already, will receive most attention. These ecosystem studies do not get much treatment in the book and this is no criticism, because they are mostly still in the initial stages. However, because of this change in emphasis the book has come at a very opportune time. It is a comprehensive account of grassland science as it has developed in Australia up to the present.

Of the introductory chapters describing the environment, the one on climate by Fitzpatrick and Nix is more than descriptive in offering an analysis of the macro-climatic factors in grasslands. Especially welcome is the short chapter by Frith on herbivorous wild animals, both indigenous and introduced, since they are a definite and often unique part of the environment, which deserve more attention from grassland research than they get.

The introductory chapters are followed by thirteen chapters describing the grasslands of Australia. In this review the chapters dealing with temperate grasslands will not be considered. R. M. Moore provides a classification of grasslands which is useful, but like all classifications, suffers from inadequacies, because it is impossible to cram sufficient information into a three page table. However, the pasture legume siratro is more deserving of a place as a characteristic pasture species than, e.g., *Desmodium uncinatum*. Siratro rightly belongs under sub-humid tropical and some dry tropical grasslands, where only Townsville stylo is given as a characteristic species of pastures or no legume is mentioned at all (xerophytic perennial grass). Siratro has a greater distribution potential along the east coast than any other commercially available tropical legume; it ranges from coastal New South Wales to north Queensland.

W. W. Bryan writes about the pastures along the east coast and he includes a review of development in the Wallum in which he played a major role himself. The now well publicised Townsville stylo story is documented by N. H. Shaw and M. J. T. Norman, and J. E. Coaldrake devotes a chapter to the brigalow lands of Queensland, which are regarded as difficult from the point of view of pasture improvement because of the limited range of available herbaceous legumes. However, by the very nature of the original vegetation there is not the same need for a pasture legume as there is in other areas. The really difficult areas for pasture improvement—the arid and semi-arid—are well described by R. M. Moore, R. W. Condon and J. H. Leigh (Semi-arid woodlands) and by R. A. Perry (Arid shrublands and grasslands).

The very few acres under irrigated pastures in Queensland and in the Kimberleys of West-Australia are included in the chapter on 'Water and irrigated pastures' by L. F. Myers. The final paragraph of this chapter voices a warning in that economics of large scale irrigation systems need careful assessment.

Factors in productivity is the overall name given to the chapters dealing with pasture species, mineral plant nutrition, nodulation, weeds, insects, nutrition and disorders of the grazing animal, and grassland management. J. G. Davies and E. M. Hutton review the search for pasture species for the tropics and sub-tropics, which has been the major factor in the resulting success story of pasture improvement in at least the wetter areas of northern Australia.

The two major legumes in Australian pastures—subclover and Townsville stylo—have made it to Australia without the help of scientists. These species needed many years of active pushing before their value was recognised and before the enormous benefits they have brought to Australian pasture production could be achieved. It is in the selection and use of cultivars of these species that scientists played an important role.

The mineral nutrition of pastures is very creditably discussed by C. H. Williams and C. S. Andrew. It records the history-making discoveries of trace-element deficiencies in the late thirties and early forties which have been as important as the introduction of exotic species to the increase in pasture production in Australia.

D. O. Norris relates the exciting and often controversial subject of nodulation of pasture legumes. Calcium need, lime pelleting, origin and classification of *Rhizobium* are topics dealt with in the author's usual vigorous fashion. Although in Europe and the U.S.A. legume bacteriology may have come to a dead end, in Australia *Rhizobium* studies and practice are in the forefront of agricultural science. The statement, often made in the past, that tropical legumes don't fix nitrogen has now been dispelled and

it is due to Norris in the bacteriological field together with thorough nutritional studies of others that tropical legumes are being rightly judged as important suppliers of nitrogen—the stuff that makes pastures produce animal products.

P. W. Michael deals with the weeds of grasslands in all important areas of Australia. It is a pity that the troublesome *Imperata cylindrica* does not rate a mention in his well written review. This weed is mentioned by D. F. Paton and W. J. Hosking as a weed in wet temperate areas, whereas it is perhaps a greater problem in degenerate pastures on the Atherton Tableland and along the warm east coast generally.

The ruminants get their share of the book in a chapter on mineral nutrition by I. W. McDonald and one on disorders due to plants by A. W. H. Braden and I. W. McDonald. In the latter a large part is devoted to the important aspect of oestrogenic activity of pasture legumes.

In the penultimate chapter W. M. Willoughby discusses the once controversial subject of grassland management. Controversy raged when Australian workers found that continuous grazing of indigenous grasslands and of subclover based pastures gave the same animal production as various systems of deferred and rotational grazing. In contrast European and New Zealand workers had been—and still are—advocating rotational grazing to make better use of pasture growth. Recent investigations appear to lead to the conclusion that rotational grazing gives benefits in animal production only when very high stocking rates are used and where an essential pasture component, e.g. lucerne, will be eliminated unless rotational grazing is practised. It is no fault of Willoughby's that he does not discuss grazing management of tropical pastures. The fact is that very little work has been done in Australia on the effect of grazing systems on animal production where the new tropical species are being used.

Finally, F. H. G. Gruen required only 11 pages to give a well documented and readable account of the major livestock industries. However, a few more pages on the early history of Australian pastoral industries would have been welcome in a book of this nature.

Grassland science encompasses a very broad field and incorporates many disciplines. It would, therefore, be easy to point to fields of interest not covered or not given enough space. One of these is the physiology of grassland plants. Another criticism that could be raised is that there is quite an amount of repetition; e.g. the Townsville stylo story is recounted several times. However, this is unavoidable with so many authors and the job of editing would have been impossible. It is unfortunate that many of the photographs are too dark.

The book is very appropriately dedicated to the late Dr. J. Griffiths Davies, who has contributed more to grassland science in Australia than any man.

L. 't MANNETJE

Grassland Improvement by A. T. Semple. Plant Science Monographs—Leonard Hill Books, London 1970. 399 pp. Price \$21.35.

These monographs are intended to give up-to-date "accounts of the entire background and current progress in their fields", and to serve as a basis for further advances. They claim to be fully documented. As such, they must surely be directed primarily to research workers. If this is so, the book is disappointing.

It is easily and clearly written, well illustrated with six figures and 127 black and white photographs, very well produced, well indexed, and remarkably free of errors; my chief criticism is that the book is unbalanced, somewhat superficial, not sufficiently up-to-date, and expensive.

This book is a greatly enlarged successor to the author's earlier work "Improving the World's Grasslands", 1951, and its purpose is "to show how present grasslands