cold stress in winter especially the stags and need a lot of feed at that time. Actually, sheep suit the feed supply pattern better with a dry ewe and low feed requirement in winter and lambing in spring and the lamb marketed in autumn. Deer are more like beef cattle and calve in December. A drought then can cause trouble. They are less selective in their diet than cattle, more like sheep. They thrive on white clover-rye grass pastures.

Currently there are about 150 000 deer on farms in New Zealand. Of these 130 000 would be red deer and the closely related Wapiti and 20 000 fallow deer. The fallow, mainly used for meat production, is in the North Island around Auckland. The red deer occur all over the country, and so far have been traded live with antler velvet as a speculative by-product. New Zealand however is now heading towards a venison market and deer will be classified as game not stock for meat inspection and slaughtered in game packing houses.

The industry is fairly heavily serviced by the New Zealand Deer Farming Association which has 1000 of the 1500 deer farmers as members. The industry was started in the 1960's and 1970's by shooters hunting wild deer for a venison market in West Germany. Many shooters then began deer farming for venison but about this stage velvet production became profitable, and they changed emphasis to this. However, the market for venison is again becoming the more important one.

Antler velvet is used mainly in medicines in Korea, China and Russia. Most of New Zealand's production is marketed in Korea but China and Russia, the other major velvet producers, can unsettle the market. As a result prices are volatile, but a hind, which equals two stock units, can return up to $250 per acre per stock unit, and compares very favourably with sheep at only $20–25 per acre per stock unit, although this can be offset by the high capital investment of deer farming.

Venison production is for a lean meat market and requires careful timing for slaughter. Stags killed before the rutting season are fatty. Young males are not castrated as this reduces growth rate by 20% and causes fat production. Castration before puberty also prevents antler growth.

Management of deer is not complicated. They have a long reproductive life of up to 20 years. Usually 85% of females raise calves and there is some twinning. Stock should not be worked after the end of February as they become difficult to handle in autumn. They are quiet and easy to work in spring when the velvet is growing. Most problems and highest mortalities occur in winter due to cold stress, especially wind and rain, because deer are poorly insulated animals. Deer suffer from tick attack and a few internal parasites. The latter are controllable with modern drenches.

BOOK REVIEWS

Nitrogen Cycling in West African Ecosystems—Ed. T. Rosswall (1980). ISBN 91-7190-007-1 (SCOPE/UNEP International Nitrogen Unit, Royal Swedish Academy of Sciences) 450 pp. $US15.

This book reports the proceedings of a workshop arranged by the SCOPE/UNEP International Nitrogen Unit in collaboration with MAB (NESCO) and IITA and held at the International Institute for Tropical Agriculture, Ibadan, Nigeria, December 1978. The content of the book includes invited keynote papers (one in French), contributed papers, (five in French), reports of work group discussions of present knowledge of nitrogen (N) cycling in three major ecosystems in West Africa (savannas, forests, and agro-ecosystems) a report on research priorities and future cooperation, and a bibliography on N cycling in West African ecosystems.

The keynote papers begin with an overview of N cycling in terrestrial ecosystems (T. Rosswall), followed by the role of atmospheric chemistry in N cycling (R. Söderlund). The other keynote papers discuss N cycling in the various types of ecosystems, with most emphasis on the agro-ecosystems and savannas. Most of these

papers emphasize quantitative aspects of the input-output processes of the N cycle in West Africa. However, three of them do not deal with West African ecosystems. One of these three discusses N cycling at Katherine, Australia, which is shown to have a climate very similar to that of Kano, in the Sudan savanna zone of Nigeria. Another discusses the principles of the response to disturbance of terrestrial ecosystems, with examples taken from North American watersheds, while the third is yet another general review of soil N transformations, with no special reference to tropical soils.

The book could have been improved by placing the paper on farming systems, which also contains much information on the physical environment, climate, vegetation and soils, before the papers that discuss N cycling in detail in the various ecosystems. Division of the List of Contents into sections would have been helpful to readers.

The keynote papers are followed by 28 "contributed" papers which mostly report experiment observations on various aspects of the cycle. These include soil N status, N fixation by blue-green algal crusts, nodulation and N fixation in native and cultivated legumes, N fertilization of maize, N mineralization, nitrification, denitrification and leaching, the effects of fire on N cycling, N cycling in a teak plantation and in a soil-*Acacia* system. Curiously, there is also a paper on the introduction of ammonia into combustion stack gases to reduce sulphur dioxide emission.

The work groups undertook the formidable task of quantifying the N balance in Sahel, savanna, tropical forest, and agro-ecosystems. Even for selected examples of these ecosystems, this exercise highlighted many gaps in quantitative data. The discussion of research priorities emphasized the need for baseline data on changes in total soil N over time, and integrated studies to obtain an understanding of ecosystem dynamics. The research priorities for processes in the various ecosystems were judged according to five main criteria.

This book will interest specialists in quantitative aspects of N cycling. However, two of the keynote papers and three of the contributed papers deal with grasslands and will interest grassland scientists.

I. VALLIS

Environmental Adaptation of Tropical Pasture Plants. L. R. Humphreys, 1981. Macmillan Publishers Ltd., London. pp 220. Price $55.

Twenty years ago there was no worthwhile reference book on legume-based tropical pastures. Today there are at least twenty books devoted partly or entirely to aspects of tropical pasture science, mostly published within the last five years and mostly written by Australian authors (including four by Dr Humphreys). This proliferation reflects the tremendous advances that have been made in tropical pasture science, and also signifies a desire by scientists to examine and analyse the results achieved to date as we move out of the pioneering phase in Australia.

Dr Humphrey's new book will be welcomed by agricultural scientists and students in the tropics. It is concerned with variation between and within tropical pasture plant species and the principles of agronomic/ecological success. Many readers, particularly in developing countries, will appreciate the agronomic bias of Dr Humphreys which enables him to describe and interpret the results of experiments by specialists in a manner that is easily understood by the more general reader. They will also appreciate the extent of his literature survey (almost 700 references in a book of 220 pages), the good choice of tables, figures and photographs to illustrate the text, the summarising paragraphs at the ends of sections and chapters, the very useful cross-referencing of topics within the book, and the indices to species and subject matter. However, the price may deter many individual readers and restrict sales to libraries, and inevitably the individual reader will find some statements with which he will disagree.

The flavour of the book is very well illustrated by two quotations. The first occurs on the last text page, but is repeated in essence in the preface and in the first chapter: