"*Forage evaluation: concepts and techniques*" Editors: J. L. Wheeler and R. D. Mochrie, 1981. American Forage and Grassland Council and CSIRO. 582 pp. $25.00.

This volume contains the proceedings of a workshop held in Armidale, N.S.W. in October 1980 under the auspices of the U.S./Australia Co-operative Science Program. It is a most up to date review of methods of forage evaluation for animal feeding as practised in the U.S.A. and Australia. However, it must be stressed that the book is strongly biased towards evaluation of forages in terms of feeding value. Readers with a plant bias will find little of interest in it.

The 45 papers are grouped into six sections:

1. *The use of forage*, with two introductory papers describing the role of forages in the U.S.A. and Australia.

2. *Evaluating forages in the laboratory*. Eight contributions deal with chemical and bio-assay techniques to determine feeding value in terms of digestibility, chemical composition and protein. This section reviews the merits and problems of well known techniques such as the Van Soest methods emphazing fibres and the Tilley and Terry approach using rumen liquid and more recently cellulase. An interesting new development is the use of infra-red reflectance spectroscopy which workers in the U.S.A. have used successfully to predict the contents of crude protein, neutral and acid detergent fibre and lignin and the *in vitro* disappearance of dry matter. There are several attempts at devising methods to predict intake by laboratory techniques—the ultimate objective. Various contenders are infra-red reflectance spectroscopy, electron microscope imaging and grinding energy index. This section is appropriately concluded with a review of the relationship between laboratory methods and animal production. It shows how complex the grazing system is and how far removed we are from the elimination of the grazing experiment. *Hamilton* concluded that "it appears unlikely that any single laboratory measurement will enable us to predict intake and production from a forage".

3. *Evaluating forage with confined animals*, by which is meant housed animals. Four papers review techniques to estimate digestibility and voluntary intake. It also includes papers on sites and extent of digestion within the animal and on energy and nutrient retention. *Corbett* presented some thoughtful considerations on energy evaluation of forages. The prospect of the use of small animals as indicator species for production animals is not very hopeful. It was agreed that rabbits and insects were not suitable, but that the meadow vole showed some promise. Even sheep, goats and cattle cannot be regarded as equivalent in determining intake and digestibility. One of the biggest problems in extrapolating from the results with pen-fed animals to grazing animals is selectivity of grazing. *Minson* referred to a recent approach by Zemmelink from Wageningen who related intake to the amount of feed offered. He found that the pattern of selection was similar to that by grazing animals. *Minson* described an alternative approach which relies on the separate feeding of leaf and stem fractions to determine their digestibility and intake, but agreed that this was still limited by technical problems of separation. However, the approach deserves merit because of the animals' preference for leaves.

4. *Evaluating forage with grazing animals*. With 21 papers this is the longest section, but also the least well defined. It contains a mixed bag of papers dealing with such unrelated topics as laboratory screening for toxic plants, the use of electronic devices to estimate pasture yield, how to weigh cattle, methods to estimate diet selection, use of natural carbon isotopes, designs of grazing experiments, energy utilization by grazing animals, etc. Papers could have been more appropriately grouped in sections and others combined. For example, the two papers describing a particular form of a capacitance meter might have been replaced by a single review on pasture yield in a section on pasture measurements, including a review on methods for estimating botanical composition. A number of papers deal with methods to estimate intake by grazing animals. Because of the difficulties and errors involved, particularly under

extensive grazing conditions, I would have liked a clear statement and warning that the best estimate of intake is animal production. Only in grazing experiments over periods which are too short, or where pasture plots are too small to obtain reliable animal production data, or in studies of supplementary feeding do I see a real need to estimate intake.

The paper by *Horn*, on the use of telemetry using pressure transducers under each hoof of the animal, the signals from which are combined and transmitted to a distant receiver, is an ingeneous application of modern technology. An even more impressive technological development is indicated by *Anderson*, *Landt* and *Salazar* who described an automatic computer-compatible electronic identification, weighing and subdermal temperature recording system. The use of these sophisticated techniques will no doubt be limited by cost and availability of skilled personnel including technicians to use and repair the gadgetery which, at present, break down frequently.

A most stimulating review by *Anderson* must have annoyed many participants at the workshop. One would have to write a lengthy essay to counter the many assumptions and unproven claims made by the author who advocated grazing systems along the lines of Voisin and Savory. In short, I have no qualms with the statement that 'optimum production . . . . can be realized from only high leaf:stem and green:dead ratios in both the standing crop and animal diets', but that this can simply be obtained by constructing more paddocks and by frequent movement of cattle between paddocks is not worth contemplating and contrary to the bulk of evidence.

The controversy over variable (put-and-take) and fixed stocking rate experiments, with American support for the former and Australian for the latter, came to the fore in various papers but each party defended its own system and it is unlikely that complete agreement will ever be reached. However, *Wheeler* (Australia), in a paper in a following section, argued that variable stocking rate experiments 'may be entirely appropriate' to test a plant's response to grazing and the animal's response to the plant, but for the final evaluation of a plant's place in commercial practice he advocated the use of a range of fixed stocking rates. It is more likely that eventually a concensus will be reached about the animal production—stocking rate relationship. *Jones*, a linear-relationship propounder, indicated and explained departures from linearity. If the curvilinear school would make a similar gesture, peace might be just around the corner.

5. *Constructing grazing systems.* The difficulties of applying results from research on components of grazing systems to complete animal production systems were the main topics of the six papers in this section. The general concensus was that simulation modelling was necessary because it is physically impossible to encompass all the combinations and permutations of components in experiments. However, the modellers lamented that experimental information is still inadequate and that decision making processes by the producer also need to be incorporated. The paper by *Freer* and *Christian* emphasises the lack of real achievements by modelling, particularly in terms of management and financial returns. *Riewe* presented a purely financial model in which net returns per ha are related to stocking rate, prices, costs and animal weights.

6. *Synthesis.* None of the five papers in this section really lived up to its name. *Anderson* discussed the results of an inadequate survey of the application of livestock and range knowledge in the U.S.A. and *Minson* theorized on the nutritionally ideal grazing plant, concluding that such objective can never be achieved. *Mochrie et al.* outlined the ideal pasture plant evaluation scheme which could take ten years of research, but did not take into account grass-legume compatibility. *Wheeler's* paper was the only one referring to the special needs for forage evaluation of developing countries, but he did not come to grips with the real problems of many developing countries, viz. lack of grazing lands, too many animals and lack of basic resources, which require a different philosophy. In the final paper *Barnes* outlined possible avenues of co-operation under the United States-Australia Agreement for Scientific and Technical Co-operation. This included more long-term exchanges of scientists, the

identification of common interests and the establishment of a newsletter. During the final discussion period a bilateral committee was formed with the charter to establish and promote further communications, to assess the need for future meetings, and to establish a liaison with the Australian-U.S. Rangeland Committee.

This book is highly recommended reading for students and scientists, is reasonably priced and well produced with only a few minor typing errors.

L.'t MANNETJE