rice is 'remarkably deficient in protein', and in the article on rice itself, that rice has sufficient protein for adults but not for children. I would have liked to have seen an in-depth discussion of changing attitudes to protein requirements over the last century and its practical consequences, clearly a topic of major interest and importance in recent world food history. As a nutritionist, I found some dubious nutritional assumptions and assertions in a few of the articles.

In such a large collection of individual contributions there are bound to be variations not only in opinion, but also in approach and quality. In my sampling I found plenty of interesting and useful contributions, I nevertheless found more low points than I had hoped for. The individual essays vary not only in quality but also in their academic level and in the approach to referencing.

The publicity material and other reviewers have made great play of the mass of fascinating and sometimes bizarre anecdotes about food and nutrition that are liberally scattered through these volumes. For instance, I did not know that the availability of coconut oil was a stimulus to the development of the British fish and chip shop. My own favourite was the widespread use of the privy pig in China and Korea to process human excrement into flesh for human consumption! This certainly puts modern concerns about hygiene standards in animal husbandry into perspective. I was able to answer most of my test questions using the index but I failed on a few. I could find no reference to lycopene, despite an article on tomatoes. I found no mention of Quorn even using its Latin name, despite a long article on fungi and one on substitute foods; there is just a brief reference to single-cell protein generally. I did find the origins of the term hamburger. I did find a reference to semolina, but needed a dictionary to clarify exactly what, as a schoolboy, I had been forced to eat.

This was an ambitious project and despite some criticisms I am pleased to have these volumes on my bookshelf. They will be of great value to students of subjects ranging from food science to anthropology, and indeed to anyone with an academic interest in anthropology or the history of food, diet and culture. For me the essays dealing with individual foods and drinks together with the dictionary of plant foods will be the most useful addition to my bookshelf. The cost will probably deter many personal buyers, but any institution running food-related, anthropology or social history courses will want a copy in their library. Perhaps some of the larger public libraries might consider investing in a copy.

GP Webb

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*Forage Evaluation in Ruminant Nutrition*. Edited by D I Givens, E Owen, R F E Axford and M M Omed. Wallingford, Oxon, UK: CABI *Publishing*. 2000. pp 480. £75 ISBN 0 85199 344 3.

Recognising the quantity and the diversity of forages used in ruminant nutrition, the stated objectives of this book are to review the current status of forage evaluation and to consider new technologies and new nutritional characteristics of forage that might be important in their evaluation in the future. The book consists of twenty-one chapters grouped within six sections.

In Section 1 (chapters 1–3), the scale and importance of forage in ruminant production, worldwide, is described. This is followed by a review of the processes of forage utilisation by ruminants and an excellent critical overview of current procedures to estimate the nutritional potential of forage. (Many of these procedures are discussed in more detail in subsequent chapters.) The authors conclude that models of animal response to nutrients rather than current animal requirement models are required. Factors influencing forage intake are reviewed in chapter 3 together with the current status of the prediction of forage intake. Compared with the plethora of publications available on this topic, it is rather selective. Section 2 (chapters 4–7) considers the estimation of the energy value of forages. Building on issues raised in Section 1, the authors of chapter 4 argue that 'mathematical integration of new and existing data and concepts into mechanistic models is essential to improve the prediction of energy supply'. They also demonstrate the utility of *in vitro* techniques in this regard. In chapter 5, the impact of whole-tract digestibility on measurements of metabolisable energy concentration and the loss of energy as heat during forage digestion are discussed. This chapter suggests that consideration of energy as a single entity rather than as a combination of nutrients is a limitation to progress in forage evaluation. Chapters 6–8 consider measurement of digestibility *in vivo* and its prediction by faecal-derived inocula or commercially-available enzymes. These methodology-rich chapters should be useful to those embarking on the measurement of forage digestibility. Chapters 9 and 10 consider the measurement of rumen forage digestion using *in situ* and cumulative gas production techniques respectively. There is some repetition between the description of the *in situ* technique in chapters 9 and 12 and in the use of digestibility to predict intake in chapters 9 and 3. One application of the cumulative gas production technique which is not highlighted is as a screen for methane production from various rations, an issue of increasing concern with regard to the impact of ruminant agriculture on the environment. In addition, while the confounding effects of volatile fatty acid composition in comparisons of gas production curves is recognised, I feel this does not receive sufficient attention and no strategies to adjust for this problem are suggested. Section 3 (chapters 11–13) considers the estimation of the protein value of forages *in vivo*, *in situ* and *in vitro* respectively. In Chapter 11 purine derivative excretion as a method of estimating microbial protein flow to the small intestine is highlighted. While use of intestinally-cannulated animals together with flow markers is mentioned, the authors appear to prefer the former technique! Chapter 12 provides an excellent account of the *in situ* estimation of protein degradation in the rumen and in the small intestine while Chapter 13 summarises the current situation with regard to measurement of these processes using enzymes or rumen microbial-cell preparations. As with many *in vitro* techniques, validation against appropriate *in vivo* data is sparse and problematical.

Physico-chemical approaches to forage evaluation are described in Section 4 (chapters 14–16). Surprisingly, little comment is made in Chapter 14 on the difficulties of starch analysis that were identified as a major concern in Chapter 2. The increasing use of near i.r. spectroscopy in the assessment of forage digestibility and intake together with its potential to measure rumen digestion is reviewed in Chapter 15 and other spectroscopic techniques in Chapter 16. Section 5 (chapters 17–20) is concerned with minerals, vitamins, anti-nutritive and other factors in forage. Trace and major elements are often overlooked in comparisons of forage and the importance of these is illustrated in Chapters 17 and 18. Chapter 19 is a comprehensive review of the essential vitamins in forage and the effects of production and harvesting methods on vitamin concentrations. It is clear that the large variation in vitamin concentration in forage presents a challenge in meeting animal requirements from unsupplemented forage rations. I felt the section on the fatty acid composition of forages in chapter 21 could be more comprehensive considering the potential role of forage in increasing the beneficial fatty acids in milk and meat. The importance of absorbed amino acid supply from forage rations is also rather understated.

Nevertheless, this book provides a good synthesis of the current status of forage evaluation and largely meets its objectives. It provides a thought-provoking view of the future of forage evaluation and will be a useful and valuable addition to the bookshelves of those engaged in this field.

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