DISCUSSION

PROF. I. L. CAMPBELL: The additional data from which estimates have been made of the energy requirements of grazing animals, presented in the first three papers of this symposium, will be of great interest to all concerned with the nutrient requirements of livestock.

There was a considerable measure of agreement between the first three speakers in that their estimates of the maintenance requirement of grazing animals were high, but in all cases the technique used for the measurement of grazing intake was the same. Thus the errors inherent in this technique should be clearly set out in order that the results presented can be seen in true perspective.

Woodman in Bulletin 48, Ministry of Agriculture, estimates that the grazing bullock requires an additional 1, 2, or 3 lb of starch equivalent for the "effort of grazing". Since he had no data on which to base this estimate, it is interesting to note the contrast between Woodman's speculation and Dr Wallace's findings.

Dr Wallace refers to Morrison's feeding standards. These are usually given as a range of values and it would be useful to know whether Dr Wallace used the upper or the lower figures in that range in the comparisons made in his paper.

One of the reasons suggested for the differences between the estimates of maintenance requirements made by various workers is that there may be an increased metabolism in the lactating animal compared with the non-lactating animal. When the feed requirements per gallon of milk are computed from the difference between the total requirements of a lactating animal and the maintenance requirements of the same animal when not lactating, the assumption is made that the maintenance requirement is the same in both states. If, in fact, the maintenance requirement is higher in the lactating state, the extra feed requirement is set against milk production and not maintenance.

Most of Dr Wallace's estimates for maintenance are based on data obtained from milking cows, but the method used to partition food intake between maintenance and milk production is different from that used by the majority of workers whose results are contrasted with his own.

DR L. R. WALLACE: The Morrison feeding standards do give a range of values both for maintenance and for milk production requirements. In my paper the higher figures given in the 22nd edition of Morrison's *Feeds and Feeding* were used in making the comparisons.

I agree with Professor Campbell that, when feed requirements for milk production are determined by subtracting the maintenance requirement of a non-lactating animal from the total requirement of the same animal when lactating, the estimates will be inflated because the whole of any increase in metabolism that may accompany lactation automatically becomes a charge against milk production. With the statistical approach that I employed to partition total intake between maintenance and production, one would expect the estimate of the requirement for maintenance to be rather higher and that for milk production rather lower, for the reason that any general increase in metabolism and of any reduced efficiency of feed utilization at the higher levels of intake normally associated with the lactating state will affect the estimates of both the maintenance and milk production requirements.

Q: *Assuming high utilization of a highly productive pasture producing 20,000 lb dry matter per acre, would Dr Wallace care to estimate the potential production of butterfat?*

DR. WALLACE: The potential production will very much depend upon the nutritive value of the D.M. produced and the dairy merit of the cattle used. However, if the pasture is assumed to provide, say, two-thirds of a pound of D.O.M. per pound of D.M., if the whole of it is both directly and completely utilized, if the cattle carried are all milking cows which average about 850 lb liveweight, gain about 150 lb from after calving one year to before calving the next, and produce annually about 400 lb butterfat per cow from milk of 5% test, then the 20,000 lb of pasture D.M. should yield about 700 lb of butterfat.

Q: *Dr Wallace attributed part of the cost of grazing to the fact that cows under* ad lib. *grazing consumed more than they really needed. Yet Mr Lambourne has shown that on restricted intake the cost of grazing increases. How can these views be reconciled?*

L. J. LAMBOURNE: Perhaps my wording was clumsy. When we controlled weight by reducing pasture *availability*, maintenance costs rose. When we controlled weight by allowing short grazing times on good pasture, maintenance costs fell again. When intake rises, digestibility and net energy value of the feed may fall, but this is not important on fresh pasture herbage at levels round maintenance. Dairy cows fed at full production levels may show this.

DR WALLACE: Mr Lambourne has been concerned with the amounts of feed required to maintain sheep at constant body weight under different conditions and has shown that, on sparse pastures where animals have to graze for long periods in order to gather their food, the energy expended in grazing is considerable. I have suggested that, with fully fed lactating dairy cows, the feed eaten for maintenance purposes is high partly because of the increased metabolism associated with the process of lactation and partly because, at the very high levels of intake normally associated with *ad lib.* feeding during lactation, the efficiency of feed utilization is reduced, so that more feed is required to supply each unit of the net energy needed.

DR P. J. BRUMBY: Would Mr Lambourne comment on the way in which he selected the three groups of animals in the trials he discussed. If the animals differed in liveweights prior to the start of the experiment, it is possible that they also differed in metabolic efficiency.

If that were the case, comparisons between groups would be upset. The interpretation of the maintenance requirements recorded for grazing animals might then become rather more sensible in that one would suppose that the small animals had a lower metabolic efficiency for genetic reasons, and would have a high maintenance requirement in relation to body weight.

MR LAMBOURNE: Groups were selected at random from a flock of reasonably uniform sheep, and were then grazed so that they diverged to the desired weights before the experiment proper began. Differences in weight were differences in fatness between sheep of the same age and size—we used fat and thin, not large and small, sheep. Differences between the groups in metabolic efficiency were environmental rather than genetic, I think.

Q: *Would it be permissible to extrapolate from Mr Lambourne's data, obtained on sheep of one age group, to other age groups having similar weight ranges?*

MR LAMBOURNE: The homogeneity of Professor Coop's results for several age groups and breeds suggests this might be permissible within one specified environment. In our experiments, weight has been confounded with condition and pasture availability, as it is in reality for adult animals.

Q: *Would Mr Lambourne expand upon his belief that emotional stress appears to increase maintenance requirements?*

MR LAMBOURNE: I would not call it a "belief". It is rather that, of the several possibilities put forward by Professor Coop and myself to explain our results, this is the one which appeals to me experimentally, and which is perhaps more likely to be involved in the situation we studied. Professor Coop examined a rather different question, and the relative importance of the three or four avenues of energy dissipation might be quite different in his case.

Adrenal hyperactivity has been shown to occur in, and perhaps to precipitate, some cases of pregnancy toxaemia, and adrenal hormones are known to cause a marked reduction in wool growth as well as a general stimulation of metabolic and nervous activity. We have observed enhanced maintenance requirements after thyroxine treatment, after the development of "facial eczema" symptoms, and after summer shearing—these all suggest that it is not necessarily conditional upon the performance of external mechanical work, except in the sense that hyper-ventilation is external work of a kind.

Q: *Do any of the speakers have information on differences between animals in overall or net efficiency when treated alike?*

PROF. I. E. COOP: There are almost certainly differences between animals in efficiency. Australian workers have shown this to be so for wool growth, but it is obviously much more difficult to measure efficiency in animals where intake must be partitioned between maintenance, gain, and milk production simultaneously.

MR LAMBOURNE: We have recorded differences of 20 to 30% between sheep, but it is hard to know whether these are genuine, or represent errors in measurement of intake due to individual idiosyncracies of nitrogen metabolism.

DR WALLACE: The information provided in my Table 4 which shows the agreement between actual and predicted intakes of individual cows gives some indication of the variability between animals in respect to over-all efficiency of food conversion. The figures show, on the one hand, the total amount of feed each of the animals might have been expected to eat had they all had similar requirements for the maintenance of each unit of (liveweight)$^{0.73}$ for each pound of F.C.M. produced and for each pound of liveweight increase, and, on the other, the amount of feed they did in fact consume.