BODY COMPOSITION OF GROWING SHEEP
AND ITS RELEVANCE TO PASTURE EVALUATION

T. W. SEARLE* and N. McC. GRAHAM*

Summary
Serial in vivo estimates of body composition were made on a group of cross-bred sheep during their growing period (3 weeks-22 months). All animals were in positive energy balance, but were not all growing at the same rate. At any particular body weight, more or less fixed amounts of fat and protein were present. It is concluded that in pasture evaluation experiments involving sheep, body weight change could provide a reasonable estimate of animal production if interpreted in the light of the body composition changes occurring at the same time.

I. INTRODUCTION
It is common practice to use live weight changes of the grazing animal as the criterion by which to evaluate a pasture. A more elaborate and time consuming procedure is the comparative slaughter method in which an attempt is made to assess, by carcass analysis, the changes in fat, protein and energy produced by the nutritional treatment. A method of predicting body composition in lambs and young sheep in vivo from tritiated water (TOH) space and body weight has now been published (Searle 1969). This permits serial estimates of body composition to be made on the same animal. The present paper reports the relationship between the chemical composition obtained by this method and the body weight of growing sheep, and discusses the application of this knowledge to grazing trials.

The data are derived from a study (still in progress at the time of writing) of the chemical composition and energy metabolism of sheep from birth to maturity. Some aspects of energy utilization are dealt with elsewhere in this journal (Graham and Searle 1970).

II. MATERIALS AND METHODS
Thirty male crossbred lambs (Border Leicester x Merino) of approximately the same weight (4-5 kg) were removed from their mothers at two days of age, tailed and castrated, and subsequently reared indoors in individual pens. They were bottle-fed on reconstituted, full-cream, spray-dried milk (20 per cent w/w) until three weeks of age, and then from three to six weeks of age the milk intake was reduced progressively to zero. During this time they were introduced to a pelleted ration (20 per cent crude protein, 18 per cent fibre) which subsequently made up their complete diet. From the beginning of the experiment 15 animals were fed ad libitum, and the other 15 were fed exactly half the mean daily intake of the first

*Division of Animal Physiology, C.S.I.R.O., Ian Clunies Ross Animal Research Laboratory, Prospect, N.S.W.
group. At three weeks of age TOH space was determined and body composition was estimated from it by the method of Searle (1969). Further estimates were made at intervals of about two months. The latest estimate was made when the sheep were about 22 months of age.

III. RESULTS

As the result of differences in intake between individual sheep fed ad libitum, there was a 30-40 per cent difference in body weight between the lightest and heaviest sheep at each age. In the group receiving a restricted amount of food, the comparable figure was 11 per cent.

The estimated fat and protein content of the bodies of individual sheep in relation to body weight is shown in Figure 1. The two sets of data are presented separately for the sake of clarity.

Since the TOH technique requires 24 h previous starvation and 6 h equilibration after injection, the body weights presented are those after 30 h without food or water. They are also expressed on a fleece-free basis.

![Graph showing relationships between body weights and estimated fat and protein contents.](image)

Fig. 1.—Relationships between body weights and the estimated fat and protein contents of the bodies of sheep fed ad libitum (main graph) or kept on restricted rations (insert). Individual estimates are plotted but a number are not distinguishable because they overlap. The graph lines were drawn by hand and are identical for the 2 groups of sheep.
It can be seen from the graph that at any particular body weight more or less fixed amounts of fat and protein were present, with variation in fat content being greater than in protein content. This applied within and between the two groups.

The graph lines were drawn by hand to show in a general way how the major storage components of the body change as sheep grow. Regression equations are not provided because these data are from an experiment not yet completed and the application of tentative equations for predictive purposes could not be recommended.

IV. DISCUSSION

As the result of the curvilinear relationships between these storage components and body weight, the ratio of fat to protein gain is not constant and hence the energy value of the gain also varies. At body weight above 30 kg, five to six times as much fat as protein is deposited. The energy content of the weight gains in young sheep, calculated by applying appropriate factors to the fat and protein gains (Brouwer 1965), are summarized in Table 1. It can be seen that the caloric value of weight gain increases four fold between 5-10 kg body weight and 40 kg upwards. Clearly, in relation to the nutrition of the animal, weight gains are not directly comparable. These factors should be taken into account in the interpretation of grazing or feeding trials with young sheep.

Because the relationships between the body components and body weight were virtually the same for the two groups of sheep, it follows that weight rather than age is the determinant of body composition, e.g. at 22 months of age sheep in the restricted group were 40 kg body weight and contained about 5 kg of protein and 11 kg of fat while sheep fed ad libitum had a similar body weight and composition at 7 to 9 months.

From extensive slaughter data for sheep with a wide range of breeding, age and body weights but on continuous positive energy balance, Reid et al. (1968) conclude that “the variation in the weights of the chemical components of the body were rigidly associated with the variation in the empty (and shrunken) body weights”. This conclusion is confirmed by the present evidence (Figure 1) based by contrast, on a series of estimates of body composition on the same group of animals over a period of 22 months. Reid et al. (1968) found that differences in body

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<th>Weight range (kg)</th>
<th>Energy content of gain (kcal/kg)</th>
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<td>5–10</td>
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composition at a given body weight between breeds of sheep were small, and also claimed that there were only small differences in body composition at a particular body weight between pigs of three different body types. Haecker (1920) reported similar findings for cattle.

These results therefore indicate that, unless interpreted correctly, live weight gain does not provide a meaningful estimate of animal production from pasture. However, if the animals are maintained in positive energy balance, the trends in Figure 1 provide the necessary guide. The literature contains conflicting reports as to what happens to body composition when sheep lose and then regain body weight. Meyer and Clawson (1964) state that the gain contains more fat and less protein, while Keenan and McManus (1969) report the opposite result. It is suggested that when evaluating pasture, young animals be used because of their ability to grow rapidly for long periods of time, and that comparison between treatments be made on the basis of fat and protein, or energy gains, rather than on weight gain alone.

V. REFERENCES