SOME ASPECTS OF THE BEHAVIOUR OF GRAZING SHEEP

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SUMMARY

Some aspects of the behaviour of sheep grazing different pasture species are described. Grazing and ruminating times were generally higher on Ariki ryegrass and Ruanui perennial ryegrass than on Huia white clover. The results are discussed in relation to liveweight gain, and the importance of behaviour observations in nutrition studies with the grazing sheep is emphasized.

The effects of two diseases on grazing behaviour are also described. Facial eczema caused a marked drop in the grazing time of a lamb on a Manawa ryegrass pasture, while no inappetance was observed in lambs apparently suffering from ill-thrift on a Ruanui perennial ryegrass pasture. It was considered that the results of yield determinations and chemical analyses of total nitrogen, non-protein and nitrate nitrogen, total soluble sugars, cellulose and lignin of the ill-thrifty pasture could not account for the severe and prolonged failure of the lambs to gain weight. The effects of a possible subclinical infestation of internal parasites are also discussed.

It was concluded that in future ill-thrift studies it would be important to observe carefully the grazing behaviour of affected animals.

TRIBE (1955) has pointed out that primitive man could hardly have survived without an intimate knowledge of animal behaviour, although it is only in the past 30 to 40 years that the behaviour of farm animals has been studied in detail. However, much of this work has proved inadequate mainly because there was no standard technique of observation (Hancock, 1950; Tribe, *loc. cit.*).

The work of Hancock (1954) produced valuable information on the grazing behaviour of dairy cows but it is only recently that similar attention has been paid to sheep. Hunter (1960, 1962, 1964) studied many aspects of the behaviour of hill sheep on mainly extensive grazings in Scotland, while Arnold (1960, 1962, 1964) worked with more intensive grazing systems in Australia.

Although the behaviour of grazing sheep in New Zealand is clearly important both in relation to animal nutrition and to pasture management, there is no published information on the subject. Recently studies have been undertaken

at Grasslands Division, D.S.I.R., Palmerston North, and this paper presents some preliminary results of this work.

METHODS

The work was carried out on one block of a sheep growth-rate trial in the experimental area on the Massey University sheep farm described by Flux *et al.* (1960). There were three one-acre paddocks of *Lolium perenne* L. var. "Grasslands Ruanui" perennial ryegrass, *Lolium* (*multiflorum* × *perenne*) perenne var. "Grasslands Ariki" ryegrass and *Trifolium repens* L. var. "Grasslands Huia" white clover. The pastures were managed so that the growth rate of the sheep was not limited by pasture scarcity (Rae *et al.*, 1963).

The grazing behaviour of sheep on these pastures was observed during single 24-hour periods. Observations were made of three activities, grazing (including walking while grazing), ruminating, and idling (not grazing or ruminating), every five or ten minutes during daylight and every ten or fifteen minutes during darkness with the aid of a torch.

RESULTS

The results of the grazing behaviour observations and details of the type and numbers of sheep observed are shown in Table 1.

Grazing and ruminating times were generally higher and idling times lower in ryegrass than in clover pastures. There was also a tendency for grazing times to be higher in Ruanui than in Ariki ryegrass.

The distribution of sheep grazing time throughout four 24-hour periods is shown in Fig. 1, and the frequency and length of grazing and ruminating periods is shown in Fig. 2.

In general, the clover sheep grazed more at night and their periods of grazing and ruminating were more frequent and shorter than the ryegrass sheep.

DISCUSSION

The time spent grazing is essentially the result of the animal's desire to satisfy its appetite. Therefore, it would appear that the ryegrass sheep either had a greater appetite than the clover group, or at least required more time to satisfy it. Arnold (1960) showed a linear increase in sheep grazing time on phalaris-annual grasses-subterranean clover

TABLE 1: GRAZING, RUMINATING AND IDLING TIMES (HOURS) FOR SHEEP ON PASTURES OF ARIKI RYEGRASS, RUANUI PERENNIAL RYEGRASS AND HUIA WHITE CLOVER AT DIFFERENT TIMES OF THE YEAR

	Nov. 12, 1964		*Feb., 1965*			*March, 1965*			*April, 1965*			*Oct. 7, 1965*		
	Ariki	*Ruanui*	*Ariki*	*Ruanui*	*Huia*	*Ariki*	*Ruanui*	*Huia*	*Ariki*	*Ruanui*	*Huia*	*Ariki*	*Ruanui*	*Huia*
Grazing	8.8	10.7	10.0	10.6	8.6	8.9	9.9	7.0	8.6	9.6	8.6	11.0	10.8	7.2
d.05		1.5		0.9			0.9			0.9			1.5	
Ruminating	8.8	8.0	7.6	7.5	5.4	6.6	7.0	4.5	7.7	7.1	5.3	6.0	5.9	5.7
d.05		1.6		0.9			0.9			0.9			1.6	
Idling	6.4	5.3	6.4	5.9	10.0	8.5	7.1	12.5	7.7	7.3	10.1	7.0	7.3	11.1
d.05		1.7		1.0			1.0			1.0			1.7	
Nos. of sheep														
Romneys	9	9	5	5	4	5	5	4	5	5	4	10	10	6
Romney × Southdown			5	5	6	5	5	7	5	5	7			
	Wethers		Lambs			Lambs			Lambs			Wethers		

Note: February, March Aprii — Results for each month are the mean of three 24-hour observational periods at weekly intervals.

TABLE 2: MEAN QUANTITIES OF AVAILABLE HERBAGE (LB DRY WEIGHT PER ACRE) IN TWO PASTURE TYPES (1965)

		Live Material					*Dead Material*		
Pasture Type	*Date*	*Total*	*Ryegrass Leaf*	*Ryegrass Stem*	Poa *Spp.*	*Other Species*	*Total*	*Ryegrass*	Poa *Spp.*	*Total*
Ruanui	March 13	1883±100	746	284	144	7	1181± 80	622	80	702± 50
Perennial	March 24	1431± 90	476	203	164	11	854± 50	509	68	577± 80
Ryegrass	April 23	1259± 80	414	175	210	4	803± 60	401	55	456± 80
		Total	*Clover Leaf*	*Clover Petiole*	*Clover Stolon*	*Other Species*	*Total*	*Clover*		*Total*
Huia White Clover	March 13	1379±100	678	460	74	54	1266± 80	103		103± 50
	March 24	1058± 90	523	415	58	43	1039± 50	19		19± 7
	April 23	1007± 80	545	259	91	69	964± 60	43		43± 8

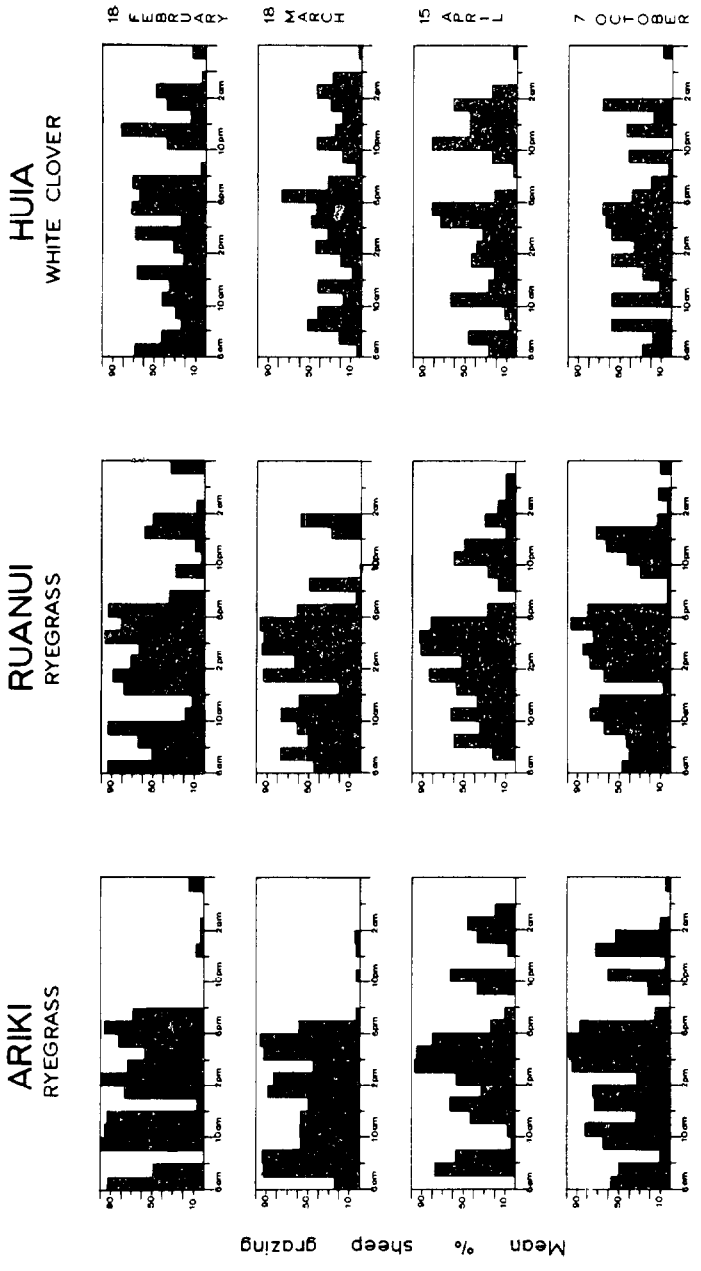

Fig. 1: Distribution of grazing time throughout 24-hour periods for sheep grazing pure stands of Ariki ryegrass, Ruanui ryegrass, and Huia white clover, at different times of the year.

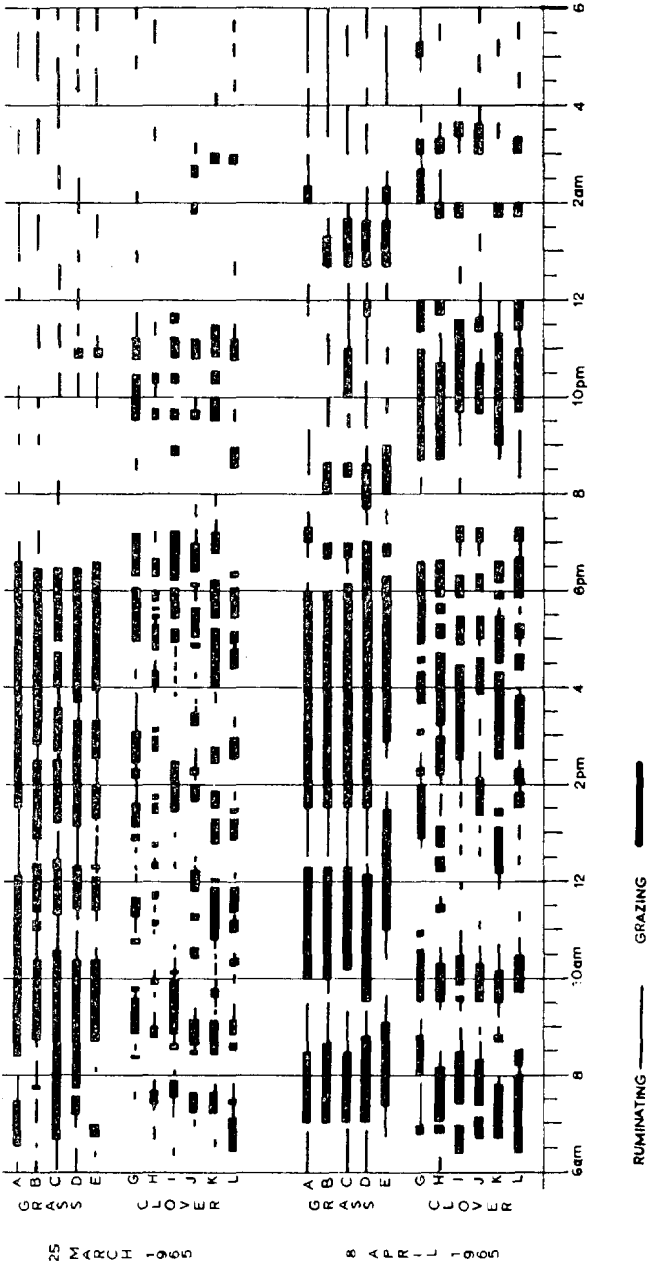

Fig. 2: Grazing and ruminating patterns for two groups of Romney × Southdown lambs grazing Ruanui perennial ryegrass, and Huia white clover pastures, during autumn, 1965.

swards as pasture availability (in terms of yield of dry weight) declined, although grazing time was more closely related to green than total plant material on offer. Hancock (1954) showed higher grazing times by dairy cows grazing "poor" (a subjective estimate of quantity and quality) than "good" pasture.

However, the amount an animal eats in a 24-hour period will be affected also by the number of bites per minute and the size of the bite, *i.e.*, rate of intake. Arnold (1964) showed that the intake per hour of grazing sheep declined rapidly as grazing time increased because high grazing time is associated with low pasture availability and the reduction in the size of the bite under these conditions is not fully compensated for by an increase in the number of bites per minute. Although neither bites per minute nor the size of the bite were measured in the present experiment, preliminary work by the writers with oesophageal fisulated lambs indicated that, in terms of herbage dry weight, the rate of intake of clover was higher than that of ryegrass.

As mentioned earlier, however, pastures in this trial were managed so that animal growth was not restricted by pasture scarcity (Rae *et al.*, 1963), and, thus, it appeared unlikely that the differences in animal behaviour were explicable in terms of differences in available pasture herbage (see Table 2).

These results were fairly representative of herbage samples obtained during the experiment, although the amount of dead matter in the ryegrass sward (30 to 40%) was somewhat higher than at other periods of the year (10 to 20%). There was generally slightly more green herbage in the clover pasture and more dead material in the ryegrass pasture.

Arnold (1964) showed that sheep will graze extremely selectively when large quantities of dead material are present in a pasture and this may cause an increase in grazing time (Arnold, 1963). However, in the short, green, leafy ryegrass pasture used in the present experiment most of the dead material consisted of leaf sheaths enclosing the base of the tillers close to ground level and was not intermixed with the green leaf on offer at the top of the profile (see Lancashire and Keogh, 1964). It therefore appeared unlikely that the selectivity factor was important in this experiment. It is also possible that the upright clover canopy is more accessible to the grazing sheep than the more prostrate ryegrass plants, but no information is available on this aspect.

It appeared more likely that the major cause of the differences in behaviour was one of pasture quality. Liveweight gain by sheep is generally better on white clover than ryegrass (Sinclair and Simpson, 1954; McLean *et al.*, 1962) on ryegrass with clover rather than ryegrass alone (Rae *et al.*, 1963; Rae *et al.*, 1964), and tends to be higher on Ariki than Ruanui ryegrass (Rae *et al.*, 1964).

Bailey (1964) pointed out that differences in carbohydrate composition, particularly cellulose, among ryegrass varieties and between ryegrass and clover may explain the differences in liveweight gain.

In the present experiment, the clover sheep appeared to satisfy their appetites in a short time, apparently digested their food quickly and then, after a rest, grazed again, presumably in response to renewed appetite. The ryegrass sheep attempted to satisfy their appetite on the poorer ryegrass pasture by increasing grazing time, but the fact that they were unable to compensate sufficiently, possibly owing to fatigue or a limitation imposed by the bulk capacity of the rumen, must have contributed to their poorer liveweight gain.

When food is eaten by a sheep it is broken down by chewing, microbial digestion in the rumen, and the mechanical act of rumination. Pearce and Moir (1964) have emphasized the importance of rumination in determining the rate of passage of food, extent of digestion, and thus the animal's food intake. Freer and Campling (1965) have stressed the importance of the rate at which particles are reduced to a size small enough for transference from the rumen through the reticulo-omasal orifice to the omasum, as this largely determines the time of retention of food residues in the digestive tract. Many studies have shown that ruminating times increase as the proportion of fibre in the diet rises (see Pearce and Moir, 1964), but it should be pointed out that most of the reported work on rumination has been carried out with animals fed diets of roughage, dried grass, or concentrates. However, it seems probable that at least part of the increased ruminating times in the present study was due to the higher level of relatively indigestible carbohydrate, such as cellulose, in the ryegrass herbage (Bailey, 1964).

Two other aspects of these behaviour studies are of interest. First, during "idling" time there was far more "play", *i.e.*, rubbing fence posts, chewing wire, butting, etc., and general boredom in the clover than the ryegrass sheep. Presumably this was a reflection of the fact that the rye-

grass sheep worked (in terms of grazing and ruminating times) much harder than the clover group in satisfying their appetites, and thus had less energy available for "play". The second point is that the increased "work" load of the ryegrass sheep will probably increase the energy required for maintenance. Lambourne (1961) and Coop (1961) have suggested that maintenance of grazing sheep increases as harvesting of feed becomes more difficult in very short pastures, but it appears that the possibility of a similar effect occurring with feed apparently adequate in terms of quantity but inadequate in terms of quality must also be considered.

Clearly, further work on the voluntary intake of various feeds under grazing conditions is essential for a fuller understanding of the factors involved in the nutritional quality of herbage. However, it is evident that the behaviour results obtained in the present study may explain in part the different liveweight gains recorded on the various pasture species. They also emphasize the importance of animal observations in nutritional trials of the type described by Rae *et al.* (1963) and in estimates of energy expenditure (Graham, 1964).

Animal behaviour in relation to two sheep diseases, facial eczema and ill-thrift, will now be discussed.

Facial Eczema

During the course of these behaviour studies it became evident in the autumn of 1965 that some lambs on an adjacent paddock of *Lolium perenne* L.×*Lolium multi-*

Table 3: The Effect of Clinical Facial Eczema on Grazing and Ruminating Times (hours) During Autumn, 1965

	One Lamb which Developed Clinical Facial Eczema between March 11 and 18		*Mean of 7 Lambs on Same Paddock which did not show Clinical Signs of the Disease*	
	Grazing	*Ruminating*	*Grazing*	*Ruminating*
February 18	10.8	5.8	11.2	7.5
March 11	6.1	3.9	8.3	7.2
March 18	0.5	—	8.9	6.8
March 25	0.4	—	8.5	6.5

florum Lam. var. "Grasslands Manawa" ryegrass were suffering from facial eczema. As a group of these sheep were individually marked, it was possible in one case to compare behaviour before and after the development of clinical symptoms of the disease.

The animal that eventually developed severe facial eczema showed a marked drop in grazing time between February 18 and March 11, although no clinical symptoms were evident. However, a considerably higher proportion of its grazing time was carried out at night and this was probably a response to mild photosensitization which was not obvious to the observer.

On March 18 and 25, the diseased animal showed moderately severe clinical symptoms, hardly grazed at all, and finally died on March 30. In general, these field observations confirm results obtained by Mortimer and Taylor (1962) with sheep given different dose levels of sporidesmin. A point of interest is that the diseased sheep apparently ate very little for at least the last fortnight of its life and appeared to have virtually starved to death.

Ill-thrift

In February, 1965, it became evident that the lambs grazing the Ariki ryegrass and Ruanui perennial ryegrass swards were in an unthrifty condition, whereas lambs on the white clover pasture were thriving. The lambs were placed on these swards in mid-December, weighed at approximately monthly intervals and slaughtered in early May. All lambs were drenched with thiabendazole in mid-December and mid-April. The liveweights of the lambs on Ruanui perennial ryegrass and white clover are shown in Table 4.

The lambs on the white clover showed fairly consistent weight gains over the experiment, whereas those on ryegrass showed little gain between January 20 and February 24, a loss of weight of 6.3 lb per animal in the next period, and a tendency to regain weight in April. This latter pattern of weight change is very similar to that shown in ill-thrifty hoggets by Clarke and Filmer (1958).

Post-mortem examination showed that the ryegrass sheep were generally in poor condition and some were slightly anaemic. Nematode parasites were absent and one ryegrass lamb showed slight liver damage owing to facial eczema (Reid, pers. comm.).

The results of a chemical analysis of the pasture are shown in Table 5.

None of the nitrogenous fractions were abnormally high (Butler, 1959), and, in particular, nitrate nitrogen was well below the generally recognized danger level of 0.3% of dry weight of herbage for ruminants (Garner, 1963). The values for total soluble sugars were lower and values for cellulose higher in the Ruanui perennial ryegrass pastures than those recorded by Bailey (1964) on similar swards although the order of difference in cellulose levels (2 to 2½ times greater in ryegrass than clover) was similar.

Data on grazing behaviour and herbage yields at this time were presented earlier (Tables 1 and 2, respectively).

The circumstances surrounding the unthriftiness of the lambs on the Ruanui perennial ryegras pasture differed slightly from the typical characteristics of hogget ill-thrift as described by Clarke and Filmer (1958) in that the outbreak occurred without a pronounced autumn flush growth period. Herbage growth continued throughout the summer and autumn because of fairly even distribution of rainfall.

In addition, unpublished observations by E. A. Clarke at Ruakura Agricultural Research Centre (A. M. Bryant, pers. comm.) showed that, during daylight hours, ill-thrifty sheep grazed almost twice as long as did the thrifty sheep, but it was suggested that much of this "grazing time" was spent searching for suitable feed. However, although the present results (see Fig. 2) support Clarke's observations, the unthrifty animals on ryegrass in the trial were definitely eating during their grazing time.

Another factor which may have affected the rate of liveweight gain was the level of parasites in the lambs. This is generally highest in the autumn in New Zealand (Whitten, 1963). It was not possible to estimate the level from the post-mortem examinations because the animals were drenched with thiabendazole a fortnight before slaughter and any nematode parasite burden was probably eliminated. However, it appears that the single drenching in mid-December may not have been sufficient to keep nematode parasites at a low level. Workers in nutrition experiments have frequently drenched at fortnightly or three-weekly intervals in an attempt to eliminate nematode parasites as a factor in animal growth (McLean *et al.*, 1962; Hight and Sinclair, 1965).

However, Large and Spedding (1965) showed poor growth rates of "worm-free" lambs in the autumn, so it is evident that other factors may affect weight gain at this time of the year. Although none of the clinical signs of a heavy parasite infestation, *e.g.*, inappetance (Gibson,

TABLE 4: MEAN LIVEWEIGHT (LB) OF LAMBS AT EACH WEIGHING DATE ON TWO PASTURE TYPES (1964–5)

	Dec. 18	*Jan. 20*	*Feb. 24*	*April 2*	*April 28*
Huia white clover	66.3±2.3	77.1±1.7	86.1±2.3	88.5±2.9	94.5±2.5
Ruanui perennial ryegrass	65.7±2.3	72.5±1.8	73.8±2.2	67.5±3.0	70.5±2.6
	N.S.	(*)	**	**	**

* P = <0.05 (*) P = <0.10 ** P = 0.01 N.S. = not significant

TABLE 5: CHEMICAL ANALYSIS OF HERBAGE FROM TWO PASTURE TYPES (% DRY WEIGHT) 1965

	March 13				*April 9*				*April 21*			
	Huia White Clover	*Ruanui Perennial Ryegrass*	*S.E.*		*Huia White Clover*	*Ruanui Perennial Ryegrass*	*S.E.*		*Huia White Clover*	*Ruanui Perennial Ryegrass*	*S.E.*	
Total nitrogen	4.20	2.89	0.10	**	3.87	3.03	0.09	**	4.37	3.23	0.08	**
Non-protein nitrogen	0.49	0.36	0.03	*	0.47	0.37	0.02	*	0.53	0.41	0.012	**
Nitrate nitrogen	0.064	0.058	0.010	N.S.	0.037	0.094	0.010	*		Not done		
Cellulose	8.86	21.93	0.59	**	8.18	20.59	0.74	**	7.45	19.64	0.61	**
Total soluble sugars	4.75	5.89	0.26	*	5.18	7.18	0.33	*	5.33	6.90	0.27	*
Lignin	2.88	4.09	0.52	N.S.	4.70	4.32	0.64	N.S.	7.25	5.02	1.30	N.S.

* P = < 0.05 ** P = < 0.01 N.S. = not significant

1962), persistent diarrhoea and a desire for water (Ewer and Sinclair, 1951), were seen in this experiment, the possibility that a subclinical infestation reduced the rate of liveweight gain (Spedding and Brown, 1957) cannot be ignored.

Gibson (1962) has pointed out that a high plane of nutrition may reduce the number of parasites that becomes established in the animal, or may reduce the effects of large numbers which do become established. Therefore, in the present experiment it is possible that, because of their higher quality diet, the clover sheep were able to avoid the worst effects of any parasite infestation rather better than the ryegrass group.

Although these results have not implicated any single factor in the ill-thrift syndrome, they do suggest that, in future ill-thrift studies, attention could usefully be paid to the characteristics of the grazing behaviour of affected animals, to the measurement rather than the observation of herbage growth and to the effects of subclinical infestations of internal parasites.

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DISCUSSION

E. A. CLARKE (COMMENT): The grazing behaviour observations on ill-thrift carried out at Ruakura were on long, mature feed versus short, lush, rapidly-growing pasture.

DR J. P. JOYCE: *We have found higher intakes of perennial ryegrass than white clover when these feeds were dried and fed to sheep. How do these results fit in with those obtained by Mr Lancashire?*

J. A. LANCASHIRE: It would be interesting to know whether Dr Joyce's results apply to fresh feed grazed *in situ.*

K. DREW (COMMENT): We have found great variation in recovery of ingested feed from oesophageal fistulated sheep.

J. A. LANCASHIRE: We also found variation, but this is mainly related to the size of fistula. In work extending over three years, we have obtained repeatable results with 5 to 6 animals per treatment on a wide range of pasture types.

K. DREW (COMMENT): There appear to be other factors involved than the size of the fistula.

J. E. RUDMAN (COMMENT): At Hurley, high-grazing times were not necessarily associated with high intake. One must be careful in the interpretation of grazing behaviour studies.

DR J. B. HUTTON (COMMENT): I question the value of grazing behaviour studies particularly when the results are extrapolated to a discussion of intake.

J. A. LANCASHIRE: It is agreed that grazing behaviour observations in isolation may be of limited value. However, we have attempted to relate animal observations to measures of quantity and quality of pasture on offer, and we feel this approach will provide a greater understanding of the nutrition of the grazing sheep. However, it is only a part of the problem and there is a need for a co-operative approach on a broad front. While New Zealand remains dependent on animals grazing outside, studies of their behaviour are fundamental.