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OBSERVATIONS ON THE GRAZING BEHAVIOUR OF BEEF CATTLE IN TROPICAL QUEENSLAND.

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SUMMARY.

The results of a series of observations on the habits of Shorthorn steers grazing on improved tropical pastures at South Johnstone and Ayr, on the north-eastern coast of Queensland, are presented.

The average times spent per day in various activities by a group of 16 cattle observed on a total of 15 days at South Johnstone were—grazing 7.27 hours, loafing 6.52 hours, lying down 10.21 hours.

The average times for observations made on 10 days at Ayr were—grazing 7.27 hours, loafing 6.33 hours, lying down 10.40 hours.

It is concluded that high temperatures reduce the amount of daytime grazing, restrict the total grazing time, cause long periods to be spent in shade, and restrict the time spent lying down.

I. INTRODUCTION.

A recent review of the literature on the grazing behaviour of cattle made by Hancock (1953) indicates that, while much information has been collected on the habits of cattle, particularly dairy cattle, in temperate regions, very few studies have been made in tropical regions.

Seath and Miller (1946), in observations on Jersey and Friesian cows in Louisiana (U.S.A.), observed that day time grazing was greatly reduced on hot days and night grazing increased. They also observed an overall decrease in total grazing time when high temperatures prevailed.

Payne, Laing and Raivoka (1951) made a study of the behaviour of Friesian cows in Fiji and concluded that their habits were entirely different from those of European cattle in temperate regions. They found that 67% of a cow's grazing time took place at night, compared with 28% found by Hancock (1950) in New Zealand.

The author has seen no record of studies of the grazing behaviour of beef cattle of British breeds in a tropical environment.

The studies reported here were conducted at two centres in tropical Queensland—the Bureau of Tropical Agriculture at South Johnstone, and Ayr Regional Experiment Station.

The Bureau of Tropical Agriculture is situated in the wet tropical coastal belt, being located at longitude 146° 10′ E, latitude 17° 40′ S. The average annual rainfall recorded at the Bureau is 120 inches, but the precipitation varies from 80 to 180 inches per annum. Approximately 75% of the rainfall is received in the period January–July, and by far the heaviest falls are recorded in February and March. From August to November conditions are relatively dry. December rainfall is very variable, depending on storms. The maximum temperature rarely exceeds 90°F. during the summer months; temperatures may fall as low as 40° in winter. The humidity is generally high throughout the year.

The Ayr Regional Experiment Station is situated at longitude 147° 23′ E, latitude 19° 36′ S (height above sea level 34 ft.). The average annual rainfall of the area is 40 inches, of which about 30 inches are received in the period December to March, the remaining part of the year being normally dry. Summer temperatures often exceed 90°F., and each year light frosts are likely to be experienced in lowlying areas. For a tropical coastal area, humidity throughout the year is relatively low.

II. OBSERVATIONS AT SOUTH JOHNSTONE.

The observations at this station were made in October 1952, December 1952, February 1953, April 1953 and June 1953.

1. Experimental Conditions and Technique.

(a) Cattle.

Sixteen grade Shorthorn steers in store condition were selected as the experimental animals. These had been brought onto the property two months previously and were approximately 2½ years of age. During the period of two

months prior to the beginning of observations, they had settled down on the new pasture and gained appreciably in weight. Their average weight increased over the period of observation from 874 lb. to 1,164 lb.

(b) Pasture.

The pasture area was made up of a number of 2-acre paddocks which contained mixtures of grasses and legumes undergoing trial to test their suitability for use in improving tropical pastures. The pasture mixtures were grazed rotationally, each paddock being grazed for 3–4 days and then given 31–32 days' spell before the next grazing. The stocking rate was maintained at the rate of 4 beasts to 5 acres. The paddocks were served by a laneway in which shade and water were available, and to which the stock had free access.

Pasture conditions varied during the trial. There was, however, always an abundance of feed, though its quality varied. A brief account of the pasture at each observation follows. In all instances desirable pasture species constituted a complete cover.

Date.	Pasture Conditions.
28-10-52	Paddock made up of areas of para grass (*Brachiaria mutica*) and molasses grass (*Melinis minutiflora*) to an average height of 15 in., consisting of some young growth and much older material. Puero (*Pueraria phaseoloides*) in close association with the grass and mostly of older growth.
28-12-52	Young fresh shoots of molasses grass to 6 in. in height overlying a mat of dry material. Puero closely intermingled with the grass and presenting a flush of young growth.
24-2-53	Purple top guinea grass (*Panicum maximum* var. *coloratum*) presenting a substantial amount of fresh growth to 3 ft. in height. Centro (*Centrosema pubescens*) presenting abundant young growth in association with the grass.
28-4-53	Para grass in association with centro providing good feed 18 in. to 2 ft. high; otherwise paddock a dense mat of puero and centro to a depth of 15 in.
23-6-53	Leafy molasses grass to 12 in. high, with some old seedheads still evident. Calopo (*Calopogonium mucunoides*) and centro in association and in patches predominating; some leafy growth evident and both species in flower.

(c) Weather.

Weather conditions varied widely over the trial. Table 1 gives briefly some of the details.

Table 1.

WEATHER CONDITIONS AT SOUTH JOHNSTONE.

Date.	Max. Temp. (°F.)	Min. Temp. (°F.)	Relative Humidity 9 a.m.	Rainfall to 9 a.m. (in.)	Remarks.
28–10–52	91	70	71	..	Hot, light breeze
29–10–52	90	72	64	·01	Hot, humid, showers 2 a.m. and 5 a.m.
30–10–52	90	73	91	..	Hot, cool afternoon breeze
31–10–52	89	73	68	..	Hot, cool breeze at mid-day
28–12–52	86	73	75	·17	Warm—heavy rain 2 p.m. to 4 p.m.
29–12–52	86	70	91	1·70	Showery 5 a.m. to 10 a.m. Warm with cool breeze
30–12–52	88	70	64	·02	Hot with cool night
31–12–52	90	69	64	..	Hot with cool breeze in late afternoon
24–2–53	90	72	79	·61	Hot with showers at 1.30 p.m. and 3 p.m. to 5 p.m.
25–2–53	90	72	74	·24	Hot and humid, rain 10.30 p.m. to 11 p.m.
26–2–53	88	72	82	·40	Warm, no breeze. Shower at 3 p.m.
27–2–53	89	70	78	·01	Warm clear day
28–4–53	82	62	90	·01	Hot and sunny—shower at 9.45 p.m.
29–4–53	84	66	86	·07	Warm with cool breeze. Cool night
30–4–53	84	66	90	·06	Shower 12.30 a.m. and 10 p.m. Cloudy cool day
1–5–53	85	64	81	·01	Warm to hot with no breeze
23–6–53	71	43	74	..	Cool with strong breeze. Cold night
24–6–53	73	50	83	..	Cool to warm with intermittent cool breeze
25–6–53	76	52	83	..	Warm, some cloud and light breeze
26–6–53	76	54	89	..	Warm and sunny

(d) Recording Technique.

(1) Observations were made for three consecutive 24-hour periods at intervals of two months and were commenced 24 hours after the steers had access to a new paddock, which period was allowed for settling down. The observations then continued for the next three days.

(2) Recordings were made every five minutes throughout the 24 hours, the method being to record the number of steers engaged in the various activities at the end of each 5-minute period.

These activities were classified as follows:—

(*a*) Grazing—all the time spent in gathering herbage, including the time involved in selection of the herbage.

(*b*) Loafing—all the time spent standing, walking from shade and water, rubbing, fighting and drinking.

(*c*) Lying down—all the time spent lying down.

Differentiation as to whether these three habits were pursued in or out of the shade was also made. In addition, drinking habits were observed.

No attempt was made to record the time occupied in ruminating, defecating or urinating.

In making the calculations, it was assumed that stock engaged in any activity at the end of the 5-minute period had been engaged in that activity for the whole of the 5 minutes.

2. Observations and Discussion.

(a) Grazing, Loafing and Lying Down.

The average times recorded per steer over each of the 3-day periods are presented in Table 2. Over the five observation periods, the average was:—

Grazing .. .. 7·27 hours.
Loafing .. .. 6·52 hours.
Lying down .. .. 10·21 hours.

Table 2.

AVERAGE ACTIVITIES OVER THE 3-DAY PERIOD (HOURS)—SOUTH JOHNSTONE.

Activity.	October.		December.		February.		April.		June.	
	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.
Grazing ..	6·43	0·01	6·52	0·11	7·67	0·01	7·03	0·10	8·48	..
	6·44		6·63		7·68		7·13		8·48	
Loafing ..	2·29	6·05	2·15	4·29	2·85	4·98	3·04	3·23	3·75	..
	8·34		6·44		7·83		6·27		3·75	
Lying Down	4·33	4·90	6·39	4·55	5·19	3·30	7·60	3·01	11·78	..
	9·23		10·94		8·49		10·61		11·78	

The day-to-day figures recorded for the group are presented in Tables 3, 4 and 5, and show considerable difference in average group activity from day to day.

Table 3.

AVERAGE TIME SPENT PER STEER IN GRAZING (HOURS)—SOUTH JOHNSTONE.

Day.	October.		December.		February.		April.		June.	
	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.
1	5·15 ..		6·79	0·03	9·14 ..		6·34	0·02	8·03 ..	
	5·15		6·82		9·14		6·36		8·03	
2	7·47	0·02	6·76	0·06	5·98	0·01	7·71	0·07	9·16 ..	
	7·49		6·82		5·99		7·78		9·16	
3	6·67 ..		6·02	0·23	7·89	0·03	7·03	0·20	8·25 ..	
	6·67		6·25		7·92		7·23		8·25	
Average ..	6·43	0·01	6·52	0·11	7·67	0·01	7·03	0·10	8·48 ..	
	6·44		6·63		7·68		7·13		8·48	

Table 4.

AVERAGE TIME SPENT PER STEER IN LOAFING (HOURS)—SOUTH JOHNSTONE.

Day.	October.		December.		February.		April.		June.	
	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.
1	3·33	6·77	3·37	3·56	1·83	6·01	4·20	3·75	3·49 ..	
	10·10		6·93		7·84		7·95		3·49	
2	1·71	6·25	0·98	4·50	3·57	4·94	1·83	3·33	3·23 ..	
	7·96		5·48		8·51		5·16		3·23	
3	1·84	5·12	2·10	4·80	3·14	3·99	3·09	2·60	4·52 ..	
	6·96		6·90		7·13		5·69		4·52	
Average ..	2·29	6·05	2·15	4·29	2·85	4·98	3·04	3·23	3·75 ..	
	8·34		6·44		7·83		6·27		3·75	

October.—It will be noted that during October there was a wide variation in grazing time with consequent variation in periods occupied in loafing and lying down. It may be that the sudden onset of hot weather after a long interval of mild weather was responsible for the low figure (5·15 hours) recorded for grazing on the first day. The discomfort as evidenced by the protracted period spent loafing (10·1 hours) tends to support this idea. The short grazing period was, however, offset by a long grazing period next day with a corresponding decrease in loafing time. On the third day, the cattle seemed to be more accustomed to the hot conditions, and longer intervals were spent lying down (mean 10·38 hours) with a further decrease in loafing time and a figure for grazing which was intermediate between those of the two previous days.

Table 5.

AVERAGE TIME SPENT PER STEER IN LYING DOWN (HOURS)—SOUTH JOHNSTONE.

Day.	October.		December.		February.		April.		June.	
	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.
1	3·86	4·90	7·57	2·69	4·71	2·31	7·25	2·44	12·48	..
	8·76		10·26		7·02		9·69		12·48	
2	4·55	4·01	6·57	5·13	6·25	3·25	7·13	3·94	11·61	..
	8·56		11·70		9·50		11·07		11·61	
3	4·58	5·80	5·02	5·83	4·62	4·35	8·42	2·66	11·24	..
	10·38		10·85		8·97		11·08		11·24	
Average ..	4·33	4·90	6·39	4·55	5·19	3·30	7·60	3·01	11·78	..
	9·23		10·94		8·49		10·61		11·78	

December.—During December, despite a wide difference in weather conditions, over the 3–day period there was very little difference in the day-to-day behaviour. There was a slight decline in grazing time on the third day, but this may have been due to a slightly higher temperature. The amount of grazing time in the shade on the third day (0·23 hours), although not of great magnitude, is quite considerable when compared with similar figures recorded for other months of the year.

February.—The weather in February was hot and humid, with showers making conditions quite uncomfortable. There were wide daily differences in all activities. The long grazing period of the first day was balanced by decreased grazing on the following day, with an increase in loafing and lying down. The fact that stands out most is the increased grazing time over that observed in October and December; this is associated with a decline in time spent lying down.

April.—In April, the times spent in the various activities on the first day differed greatly from the other two days, the figures for which are very similar. Generally the weather was cooler than in February. There was, however, a slight decrease in grazing time from that observed in February, but lying down time was greatly increased.

June.—In June, the weather was cooler than previously and this is reflected in the figures obtained. Times spent in grazing and lying down were the highest observed (viz., 8·48 hours and 11·77 hours respectively) and loafing time was reduced accordingly.

(b) Pattern of Activities.

The pattern depicted in Fig. 1 for each of the periods of observations is—

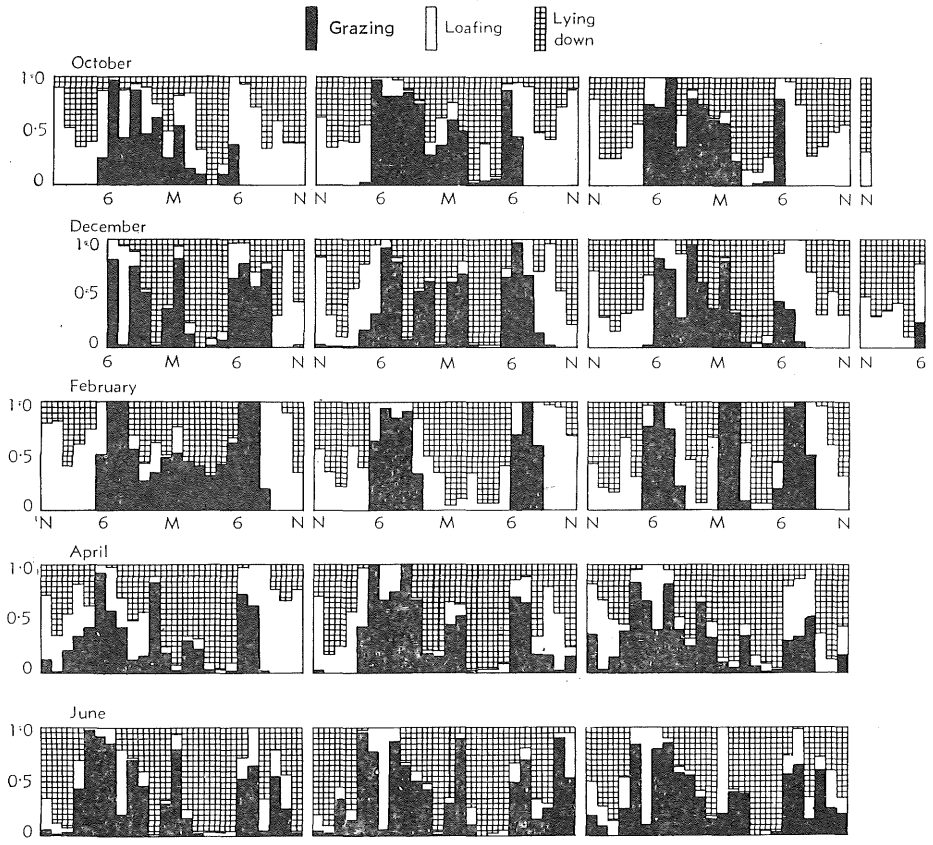

Fig. 1.

Observations at South Johnstone.

(M and N represent midnight and noon respectively.)

October.—The first day shows spasmodic periods of heavy grazing and a markedly short morning grazing period, but the second and third days differ and show three peak grazing periods—evening, night and early morning. It will be seen that very little grazing occurred in October after 6 a.m. The daytime is divided into similar periods of loafing and lying down, and at night, except on the first day, most of the time not spent grazing is devoted to lying down.

December.—For December, four main grazing cycles are present—evening, before midnight, after midnight and early morning. The intensity of these grazing periods varies over the three days. The previous general pattern of loafing and lying down is again evident.

February.—Three grazing cycles are exhibited for February. However, the midnight grazing cycle was omitted on the second day, when only two periods of grazing were observed. Generally more of the daylight hours than was observed previously were spent loafing.

April.—Very spasmodic grazing was evident on the third day of observations in April and the pattern exhibited for this occasion differs somewhat from that of the previous two days.

A further feature is the tendency for grazing to commence earlier in the afternoon.

June.—Shorter periods of loafing are evident in June and the grazing period has markedly changed. An important grazing cycle now occurs in the afternoon, while the morning cycle is divided into two shorter periods, one in the early morning and the other extending to approximately midday. Two grazing periods at night are still evident, but these are of shorter duration.

(c) Distribution of Grazing Time.

The distribution of grazing time throughout the day is a reflection of the manner in which cattle adapt themselves to high temperatures. Table 6 shows the length of time spent at grazing and the percentage of the daily grazing time for two periods of the day—from 4 p.m. to 8 a.m. and from 8 a.m. to 4 p.m. These intervals were selected because it was considered that prior to 8 a.m. and after 4 p.m., temperature in the main would not be a limiting factor to grazing.

October.—It will be seen from Table 6 that during October all grazing occurred between 4 p.m. and 8 a.m., this being attributed to the sudden onset of hot weather.

December.—In December, when the weather varied over the three days, the distribution of grazing time also varied. The first day was cloudy with showers and 21·8% of the grazing occurred between 8 a.m. and 4 p.m. Though the total grazing time on the third day was similar, no grazing occurred between 8 a.m. and 4 p.m.

February.—During February, there was a tendency for grazing to occur between 8 a.m. and 4 p.m., 10·2% of the time on one of the three days being so occupied.

April.—April saw a further increase in the tendency to graze between 8 a.m. and 4 p.m. This was partly attributable to the showery and cloudy conditions which prevailed, particularly on the third day, when over 20% of this period was devoted to grazing.

June.—In June, temperatures were much lower and a greater proportion of the total grazing occurred between 8 a.m. and 4 p.m. On one day up to 26·4% of the period was spent grazing, and the average for the three days was 22%.

Table 6.

AVERAGE TIME SPENT PER STEER IN GRAZING (HOURS)—SOUTH JOHNSTONE.

	October.		December.		February.		April.		June.	
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
Day 1 ..	5·15	..	6·02	0·80	8·94	0·20	5·63	0·73	6·61	1·42
Percentage..	100·0	..	88·3	11·7	97·8	2·2	88·5	11·5	82·3	17·7
Day 2 ..	7·49	..	6·66	0·16	5·38	0·61	7·28	0·50	6·76	2·41
Percentage..	100·0	..	97·7	2·3	89·8	10·2	93·6	6·4	73·7	26·3
Day 3 ..	6·67	..	6·25	..	7·39	0·53	5·65	1·58	6·47	1·78
Percentage..	100·0	..	100·0	..	93·3	6·7	78·1	21·9	78·4	21·6
Average ..	6·44	..	6·31	0·32	7·24	0·44	6·19	0·94	6·61	1·87
Percentage ..	100·0	..	95·2	4·8	94·3	5·7	86·8	13·2	77·9	22·1

A = 4 p.m. to 8 a.m. B = 8 a.m. to 4 p.m.

(d) Time Spent in Shade.

Cattle normally seek shade when the heat becomes uncomfortable—this often occurs in the tropics and subtropics.

Data relating to the average total time spent in the open and in the shade, irrespective of the animals' activities, are presented in Table 7.

It can be seen that over the period the average time spent in the shade varied from nearly 11 hours per day to nil.

In October, when temperatures were high, the cattle made use of shade for over 40% of the day. In December, just on one-quarter of the first day was spent in the shade; this day was showery and cloudy. On the next two days, when conditions changed, over 40% of the time was spent in the shade. During February, there was a further general decline in the time during which the cattle sought shade, and though temperature conditions were very similar to those prevailing in October, considerably less use was made of shade. The lower temperatures of April induced cattle to seek shade less than previously, though there was a day-to-day variation. In June, the steers were quite content to graze, loaf, or lie down in the paddock without attempting to seek shade.

It can be seen from a perusal of Tables 2 to 5 that very little time was spent grazing in the shade. This is understandable, as feed that was growing in the shade was soiled because of the high concentration of cattle.

Table 7.

AVERAGE TIME SPENT PER STEER IN OPEN AND SHADE IRRESPECTIVE OF ACTIVITIES (HOURS) —SOUTH JOHNSTONE.

	October.		December.		February.		April.		June.	
	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.
Day 1 ..	12·34	11·67	17·73	6·28	15·68	8·32	17·79	6·21	24·00	..
Percentage in Shade	..	48·6	..	26·2	..	34·7	..	25·9	..	..
Day 2 ..	13·73	10·28	14·31	9·69	15·80	8·20	16·67	7·34	24·00	..
Percentage in Shade	..	42·8	..	40·4	..	34·2	..	30·6	..	..
Day 3 ..	13·09	10·92	13·14	10·86	15·65	8·37	18·54	5·46	24·00	..
Percentage in Shade	..	45·5	..	45·3	..	34·9	..	22·8	..	..
Average..	13·04	10·96	15·06	8·94	15·71	8·30	17·67	6·34	24·00	..
Percentage in Shade	..	45·7	..	37·3	..	34·6	..	26·4	..	..

The only tendency for the group to graze in the shade to any extent was on the third day of observation in December.

There does not appear to be any relationship between the amount of time occupied in loafing or lying down in the open and that in the shade.

(e) Number of Drinks.

The average number of drinks taken per steer on each day is recorded in Table 8.

Table 8.

NUMBER OF DRINKS PER STEER—SOUTH JOHNSTONE.

Day.	October.	December.	February.	April.	June.
1	1·75	0·88	0·31	0·75	0·56
2	1·56	1·13	0·88	0·50	0·88
3	2·06	1·00	1·00	0·75	0·88
Average ..	1·79	1·00	0·73	0·67	0·77

The highest figures were for October, when temperatures were high. The difference in drinking habits between February and October is quite marked despite the fact that similar temperature conditions prevailed; the

occurrence of some showers of rain and heavy dews in February may account for this difference.

Drinking habits over the months of February, April and June were comparable.

III. OBSERVATIONS AT AYR.

Observations were made at Ayr Regional Experiment Station in November 1952, January 1953, March 1953, May 1953 and June 1953.

1. Experimental Conditions and Technique.

(a) Cattle.

A group of 6–7 grade Shorthorn steers in store condition, from two to three years of age and of the same origin as those selected in the South Johnstone trial, were used. Before observations commenced, the cattle had settled down and were making good weight gains. Liveweights are given in Table 9.

Table 9.

LIVEWEIGHT OF CATTLE (POUNDS) AT TIME OF OBSERVATIONS—AYR.

Steer No.	November.	January.	March.	May.	July.
52 ..	..	790	816	..	..
56 ..	873	944	1,005	1,067	1,150
29 ..	948	1,026	1,110	1,150	1,185
43 ..	809	839	897	959	993
51 ..	807	904	949	1,010	1,048
41 ..	979	1,092	1,131	1,158	1,142
54 ..	880	966	1,005	1,032	1,055
Average ..	883	937	988	1,063	1,096

(b) Pastures.

The pasture consisted of a mixture of guinea grass (*Panicum maximum* var. *typica*) and stylo (*Stylosanthes gracilis*), under irrigation. Rotational grazing was practised, allowing one week of grazing and three weeks of rest. A minimum stocking rate of 6 beasts per 5 acres was held, this being increased when the pasture was lush.

The area was divided into paddocks of 1·25 acres, and water was available in troughs. In November and March, no shade was provided, but a brush shelter provided shade during January, May and July.

Brief details of the pasture follow.

Date.	Brief Description.
26-11-52	Guinea grass giving good ground cover and carrying up to 20 in. of thick, soft young flush. Stylo mainly confined to interstool spaces and carrying 6–10 in. of young growth.
28-1-53	Heavy growth of guinea grass 3–4 ft. high, some of which is coarse growth. Stylo soft and leafy, giving a mat-like ground cover and mixed with the grass stools.
25-3-53	Heavy growth of guinea grass with seedheads to 5 ft. high, the more palatable material being only 2 ft.–2 ft. 6 in. high. Soft leafy stylo giving good ground cover and mixed with the grass stools.
27-5-53	Fresh guinea grass growth 12–15 in. long arising from coarse tussocks 12–15 in. high. Stylo giving good bulky growth of green material up to 14 in. high.
22-7-53	Young guinea grass growth 12–14 in. high arising from and around the coarse tussocks. Stylo confined mainly to interstool spaces and carrying 6–10 in. of young growth.

Table 10.

WEATHER CONDITIONS AT AYR.

Date.	Max. Temp. (°F.)	Min. Temp. (°F.)	Rainfall to 9 a.m. (in.)	Remarks.
26–11–52	88	71	..	Warm to hot. Variable breeze
27–11–52	89	75	..	Warm to hot. Cool afternoon breeze
28–11–52	96	70	..	Hot, intermittent light breeze
28–1–53	85	73	3·29	Warm to hot, light S.E. breeze, cloudy
29–1–53	85	72	·01	Warm, cloudy, cool S.E. breeze
30–1–53	81	73	·03	Cool, cloudy, showery from 9 a.m.
25–3–53	84	65	·09	Overcast, warm sunny afternoon
26–3–53	87	65	..	Hot and humid—rain 3.45 p.m. to 4.30 p.m.
27–3–53	81	73	·28	Rain 4 a.m. Cloudy and cool with S.E. breeze
27–5–53	79	42	..	Warm with light breeze—cold night
28–5–53	81	42	..	Warm to hot—gusty breeze—cold night
29–5–53	82	59	..	Warm to hot—variable S. breeze
22–7–53	77	46	..	Warm and sunny—cool to cold night
23–7–53	79	49	..	Warm, strong E. breeze—cool to cold night
24–7–53	77	48	..	Warm, with cool variable breeze

(c) Weather.

The weather varied somewhat during the course of the trial. Tables 10 and 11 provide some information on temperature, rainfall, humidity, etc.

Table 11.

RELATIVE HUMIDITY AT VARIOUS TIMES DURING THE DAY—AYR.

Month.	Day.	Noon.	6 p.m.	6 a.m.
November ..	1 (26–27)	53	62	73
	2 (27–28)	59	59	90
January	1 (28–29)	68	78	90
	2 (29–30)	68	78	86
March	1 (25–26)	76	86	95
	2 (26–27)	66	95	86
May	1 (27–28)	34	87	92
	2 (28–29)	38	69	100
July	1 (22–23)	54	73	100
	2 (23–24)	38	73	92

(d) Recording Technique.

The following technique was followed:—

(1) Recordings were made for two consecutive 24-hour periods at intervals of two months and were commenced 24 hours after the cattle entered a new paddock.

(2) The individual animals were observed continuously, using the method described by Hancock (1950) with the modification that the path traversed by only one member of the group was recorded.

An endeavour was made to study urinating habits but the tall nature of the pasture precluded accurate observation.

2. Observations and Discussion.

(a) Grazing, Loafing, Lying Down.

The average period occupied by each activity over the five observation periods was:—

Grazing .. .. 7·27 hours.

Loafing .. .. 6·33 hours.

Lying down .. .. 10·40 hours.

In Table 12 are recorded the average activities of each 2-day observation period. These figures are the mean values calculated for six steers in November, May and July and for seven steers in January and March. The individual day-to-day activities of each steer are presented in Tables 13–15.

Table 12.

AVERAGE ACTIVITIES (HOURS AND MINUTES) FOR 2-DAY OBSERVATION PERIOD—AYR.

Month.	Grazing.	Loafing. Open.	Loafing. Shade.	Lying Down. Open.	Lying Down. Shade.
November*	6 23	8 05	..	9 32	..
		8 05		9 32	
January	6 12	3 36	2 43	10 20	1 9
		6 19		11 29	
March*	5 05	9 53	..	9 02	..
		9 53		9 02	
May	9 55	1 44	1 39	9 11	1 31
		3 23		10 42	
July	9 22	2 10	1 13	10 36	0 39
		3 23		11 15	

* Shade not available.

Table 13.

TIME (HOURS AND MINUTES) SPENT PER STEER IN GRAZING—AYR.

Steer No.	Day.	November.*	January.	March.*	May.	July.
52	1	..	5 59	5 21	..	..
	2	..	6 04	5 34	..	..
56	1	6 38	5 46	5 45	11 14	8 39
	2	6 41	6 51	4 10	8 09	9 12
29	1	6 12	7 02	6 39	10 01	9 52
	2	7 13	7 25	4 16	9 23	9 06
43	1	6 16	5 26	4 23	10 36	10 56
	2	6 43	7 18	5 20	11 13	10 45
51	1	7 01	5 43	5 27	9 24	10 03
	2	6 17	6 29	4 03	9 25	8 07
41	1	4 33	6 14	5 11	10 36	10 00
	2	6 36	6 08	5 26	9 36	6 59
54	1	5 51	4 46	5 19	9 58	10 21
	2	6 34	5 27	4 18	9 19	8 17
Average	1	6 05	5 51	5 26	10 18	9 59
	2	6 41	6 32	4 44	9 31	8 44

* Shade not available.

Table 14.

TIME (HOURS AND MINUTES) SPENT PER STEER LOAFING—AYR.

Steer No.	Day.	November.*		January.		March.*		May.		July.	
		Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.
52	1	..	..	3 52	2 25	10 58	..	..	..	..	..
				6 17		10 58					
	2	..	..	5 57	0 28	7 51	..	..	..	..	..
				6 25		7 51					
56	1	7 27	..	4 27	2 40	11 39	..	1 17	1 09	3 17	1 19
		7 27		7 07		11 39		2 26		4 36	
	2	7 59	..	4 58	2 52	9 11	..	3 46	1 03	1 14	1 40
		7 59		7 50		9 11		4 49		2 54	
29	1	7 36	..	2 37	3 45	11 11	..	0 57	2 01	1 58	1 49
		7 36		6 22		11 11		2 58		3 47	
	2	8 52	..	3 11	3 19	9 05	..	3 01	1 41	0 59	1 43
		8 52		6 30		9 05		4 42		2 42	
43	1	7 28	..	3 03	3 11	11 36	..	0 35	0 59	1 20	0 26
		7 28		6 14		11 36		1 34		1 46	
	2	8 21	..	2 37	2 14	7 40	..	2 16	1 15	1 13	0 49
		8 21		4 51		7 40		3 31		2 02	
51	1	6 45	..	2 54	2 34	12 29	..	0 49	1 35	2 16	0 50
		6 45		5 28		12 29		2 24		3 06	
	2	8 33	..	3 41	2 33	8 54	..	1 55	2 16	1 52	2 10
		8 33		6 14		8 54		4 11		4 02	
41	1	7 45	..	2 21	2 48	10 41	..	0 48	1 48	2 48	0 51
		7 45		5 09		10 41		2 36		3 39	
	2	8 19	..	3 59	2 00	6 48	..	2 30	0 37	3 41	2 44
		8 19		5 59		6 48		3 07		6 25	
54	1	8 33	..	2 44	3 50	11 42	..	0 49	2 21	2 42	0 08
		8 33		6 34		11 42		3 10		2 50	
	2	9 29	..	4 12	3 13	8 35	..	2 07	3 02	2 43	0 04
		9 29		7 25		8 35		5 09		2 47	
Average	1	7 36	..	3 08	3 02	11 28	..	0 52	1 39	2 23	0 54
		7 36		6 10		11 28		2 31		3 17	
	2	8 35	..	4 05	2 23	8 18	..	2 36	1 39	1 57	1 32
		8 35		6 28		8 18		4 15		3 29	

* Shade not available.

November.—The group average figures for November show a slight increase in grazing time from the first to the second day, but the main change in activities between these two days is a reduction in time occupied in lying down and the increase in loafing time on the second day. It is considered that the higher temperatures prevailing on the second day may have been responsible, particularly as no shade was available.

January.—A longer lying down period was noted in January, though the day-to-day group activities did not vary to the same extent as in November.

Table 15.

TIME (HOURS AND MINUTES) SPENT PER STEER IN LYING DOWN—AYR.

Steer No.	Day.	November.*		January.		March.*		May.		July.	
		Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.	Open.	Shade.
52	1	..	..	10 50	0 54	7 41	..	..	..	..	..
				11 44		7 41					
	2	..	..	11 26	0 05	10 35	..	..	..	..	..
				11 31		10 35					
56	1	9 55	..	8 55	2 12	6 36	..	9 15	1 05	9 59	0 46
		9 55		11 07		6 36		10 20		10 45	
	2	9 20	..	7 26	1 53	10 39	..	10 00	1 02	9 19	2 35
		9 20		9 19		10 39		11 02		11 54	
29	1	10 12	..	10 11	0 25	6 10	..	9 53	1 08	9 57	0 24
		10 12		10 36		6 10		11 01		10 21	
	2	7 55	..	8 51	1 14	10 39	..	7 55	2 00	10 03	2 09
		7 55		10 05		10 39		9 55		12 12	
43	1	10 16	..	12 20	..	8 01	..	10 04	1 46	11 18	0 00
		10 16		12 20		8 01		11 50		11 18	
	2	8 56	..	10 36	1 15	11 00	..	8 34	0 42	10 57	0 16
		8 56		11 51		11 00		9 16		11 13	
51	1	10 14	..	12 49	..	6 04	..	10 23	1 49	10 51	0 00
		10 14		12 49		6 04		12 12		10 51	
	2	9 10	..	10 03	1 14	11 03	..	8 58	1 26	11 04	0 47
		9 10		11 17		11 03		10 24		11 51	
41	1	11 42	..	10 55	1 42	8 08	..	8 28	2 20	10 21	0 00
		11 42		12 37		8 08		10 48		10 21	
	2	9 05	..	8 44	3 09	11 46	..	8 11	3 06	9 38	0 58
		9 05		11 53		11 46		11 17		10 36	
54	1	9 36	..	12 00	0 40	6 59	..	9 37	1 15	10 49	0 00
		9 36		12 40		6 59		10 52		10 49	
	2	7 57	..	9 30	1 38	11 07	..	8 56	0 36	12 56	0 00
		7 57		11 08		11 07		9 32		12 56	
Average	1	10 19	..	11 09	0 50	7 06	..	9 37	1 34	10 32	0 12
		10 19		11 59		7 06		11 11		10 44	
	2	8 44	..	9 31	1 29	10 58	..	8 45	1 29	10 40	1 07
		8 44		11 00		10 58		10 14		11 47	

* Shade not available.

The grazing period was very similar to that observed previously, but lying down time was increased at the expense of loafing time. This is considered to be a direct result of the slightly lower temperatures which prevailed, together with the availability of shade.

March.—March temperatures were comparable with those of January, but average humidity was slightly higher. Shade was not available and a reduction in average grazing time, particularly on the second day, was evident.

Loafing and lying down periods for both days were very varied. The extended loafing periods observed during this month were a direct result of high temperature and humidity.

Lying down time was markedly reduced on the first day as a direct consequence of high temperatures and humidity. Increased lying down time on the second day was mostly due to a longer period being spent lying down at night than on the previous day.

May.—Temperatures, particularly during the night time, were lower than in March, and there was a marked increase in grazing time, mostly at the expense of loafing time.

July.—The average grazing time in July was slightly less than in May, but it was still longer than any recorded during the hotter months. Loafing time was not greatly different, but lying down time increased at the expense of grazing time.

(b) Pattern of Activities.

The average pattern of activities for the group at each observation is shown in Fig. 2.

In November, four main grazing periods are shown—midday, late afternoon-evening, night, and early morning. Much the same pattern is shown for both days. The pattern of loafing and lying down time varies somewhat, in that on the first day a large part of the morning was spent lying down and on the second day much longer was spent lying down during the night hours.

The afternoon-evening grazing period increased in January, whilst the morning and midday periods decreased. Grazing during the night also increased. All activities show a similar pattern for the two days.

There are extensive loafing periods in March, while grazing comprises two major phases with only a minor peak during the night. Increased lying down time on the second night is very evident, as also is the period spent lying down between 6 a.m. and noon, when cool cloudy conditions prevailed.

The patterns for May and July are very distinct in that loafing periods are very short and lying down periods correspondingly longer. Morning and afternoon grazing is most marked in May, with one or two minor peaks during the night hours. In July, intermittent grazing from 6 a.m. to 6 p.m. was recorded, with peaks in grazing activity occurring in the early morning, noon and afternoon. Night grazing was consequently reduced. Most of the night hours in May and July were occupied in lying down.

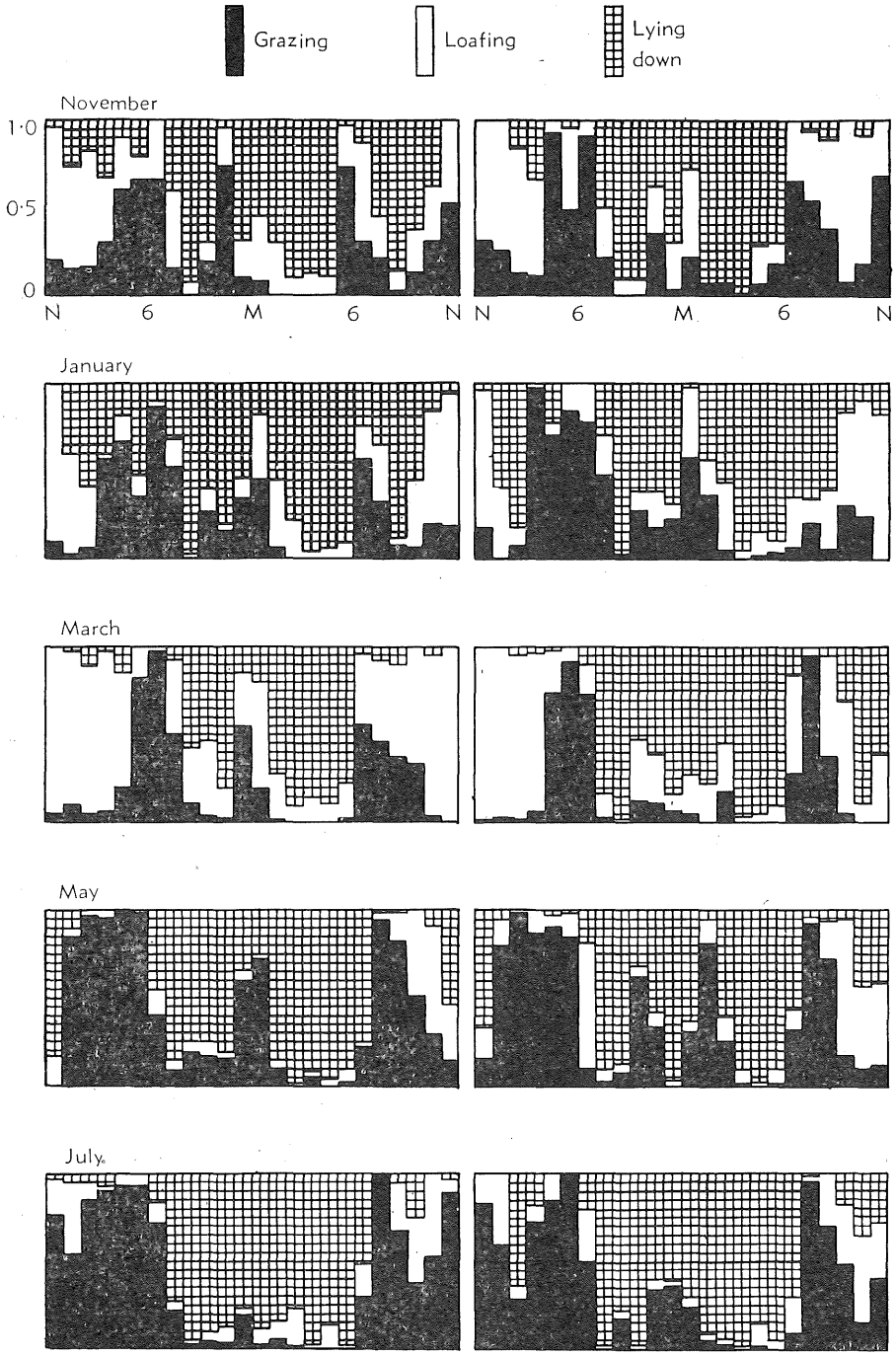

Fig. 2.

Observations at Ayr. (M and N represent midnight and noon respectively. Shade was available in January, May and July only.)

(c) Distribution of Grazing Time.

When considering the distribution of grazing time, it is seen that prevailing weather conditions exercise some influence (Table 16.)

Table 16.

AVERAGE TIME (HOURS) SPENT PER STEER IN GRAZING—AYR.

	November.		January.		March.		May.		July.	
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
Day 1 ..	4·44	1·65	4·58	1·27	4·51	0·93	5·71	4·60	4·48	5·50
Percentage	72·8	27·2	78·3	21·7	82·9	17·1	55·4	44·6	44·9	55·1
Day 2 ..	4·59	2·09	4·73	1·79	4·17	0·56	5·57	3·94	4·57	4·17
Percentage	68·7	31·3	72·5	27·5	88·2	11·8	58·6	41·4	52·3	47·7
Average..	4·52	1·87	4·66	1·53	4·34	0·75	5·64	4·27	4·53	4·84
Percentage	70·7	29·3	75·3	24·7	85·3	14·7	56·9	43·1	48·3	51·7

A—4 p.m. to 8 a.m. B—8 a.m. to 4 p.m.

The day-to-day figures show, in some cases, considerable variation, but the effects of high temperatures are obvious. In November and January, approximately 70% of the grazing period occurred during the 4 p.m. to 8 a.m. period, with an increase in March to 85%, and it was at this stage that heat distress was marked. With the cooler weather in May and July, grazing in the same period was reduced to 56·9% and 48·6% respectively, with corresponding increases in grazing time during the 8 a.m. to 4 p.m. period.

(d) Time Spent in Shade.

Shade was not available to these animals in November and March, but was made available in January, May and July. Its absence materially influenced the behaviour of the cattle, particularly during the summer.

The provision of shade in January influenced lying down time during the daylight hours and, in conjunction with slightly lower temperatures, was a factor in causing more time to be devoted to lying down in January than in November.

With no shade available in March and more trying conditions than in previous months, grazing time was reduced below the November and January figures.

Reduced grazing on this occasion was a direct consequence of the unavailability of shade. Normally, when shade is available and temperature and humidity are high, cattle will loaf or lie down in the shade, and, as was observed at Ayr and particularly at South Johnstone, will compensate for time

lost grazing during the 8 a.m. to 4 p.m. period by grazing for long periods during the 4 p.m. to 8 a.m. period. On this occasion, cattle were uncomfortable during the day and did not graze or lie down. By nightfall they had become fatigued from incessant standing during the day and from increased metabolic efforts in their endeavour to maintain normal body temperature, and therefore preferred, as happened in this case, to lie down for most of the night.

In March, heat distress was very evident, being shown by increased respiration, protrusion of the tongue, excess salivation, aimless wandering and a perference for standing instead of lying down.

Less use was made of the shade in May than in January; this is understandable, as conditions were cooler. A further decrease was also evident in July, and on this occasion the use of shade by individuals showed a wide variation in that some steers did not seek shade at all on either day, whereas their companions spent up to $2\frac{3}{4}$ hours in the shade.

Whilst shade when made available was not used to the same extent as at South Johnstone, its importance as an influencing factor is stressed by the results observed. Figures presented in Table 17 show a reduction in the average daily use of shade from 3.88 hours in January to 1.87 hours in July.

Table 17.

AVERAGE TIME (HOURS) SPENT PER STEER IN OPEN AND SHADE IRRESPECTIVE OF ACTIVITIES —AYR.

—	November.	January.		March.	May.		July.	
		Open.	Shade.		Open.	Shade.	Open.	Shade.
Day 1 ..	No shade	20·13	3·87	No shade	20·77	3·23	22·91	1·09
Percentage in shade			16·1			13·5		4·5
Day 2 ..	No shade	20·13	3·87	No shade	20·87	3·13	21·35	2·65
Percentage in shade			16·1			13·0		11·0
Average ..	No shade	20·13	3·87	No shade	20·82	3·18	22·13	1·87
Percentage in shade			16·1			13·3		7·8

(e) Number of Drinks.

It will be seen from Table 18 that there were daily variations in the number of drinks taken, with most in November and fewest in July. The high average figure for the second day in May is due to the fact that steers Nos. 56 and 29 drank frequently, but at each time for a shorter period than was the case with other cattle.

Table 18.

NUMBER OF DRINKS RECORDED PER STEER—AYR.

Steer No.	Day.	November.	January.	March.	May.	July.
52	1	..	1	6	..	..
	2	..	4	1	..	..
56	1	4	2	3	2	3
	2	7	3	3	5	2
29	1	3	1	3	1	1
	2	5	4	2	6	1
43	1	2	..	2	..	2
	2	4	2	1	1	1
51	1	3	1	5	2	2
	2	3	3	1	2	1
41	1	3	1	2	2	2
	2	4	2	2	3	2
54	1	3	1	2	2	2
	2	2	2	1	2	1
Average	1	3·00	1·00	3·29	1·50	2·00
	2	4·17	2·86	1·57	3·17	1·33

Most drinks were taken between noon and 6 p.m., with occasional animals drinking during the morning or during the night. The usual procedure followed was to drink before commencing to graze after having been loafing or lying down or else to interrupt grazing for a short period to take a drink.

Table 19.

NUMBER OF DEFECATIONS RECORDED PER STEER—AYR.

Steer No.	Day.	November.	January.	March.	May.	July.
52	1	..	10	8	..	..
	2	..	9	9	..	..
56	1	9	14	7	7	6
	2	10	6	3	12	8
29	1	14	9	2	8	5
	2	14	9	8	8	3
43	1	8	8	9	7	5
	2	7	7	8	9	5
51	1	10	10	10	5	4
	2	11	12	5	10	4
41	1	11	8	6	6	10
	2	8	5	7	7	9
54	1	10	12	5	9	6
	2	9	9	8	12	8
Average	1	10·33	10·14	6·71	7·00	6·00
	2	9·83	8·14	6·86	9·67	6·17

The temperature of the drinking water was recorded after each steer drank. High water temperature did not prevent stock from drinking, as the highest temperatures—generally in the range of 80°-90°F. but sometimes as high as 100°F.—were recorded when most drinks were taken. Only a small proportion of drinks was taken during the night and early morning, when water temperature was as low as 61°F.

(f) Defecations.

The average number of defecations recorded per steer over the course of these observations was 8.05 per day. Considerable variation is evident in the figures presented in Table 19.

The variations over the different months are most marked. The lowest figure recorded was in July, with approximately 6 per day. A low figure was also recorded in March, when as a result of high temperatures and humidity a higher figure might have been expected. The reduced grazing period and consequent lowered feed intake may have been responsible. Individual and daily variations were most noticeable in the months of March, May and June.

(g) Distance Walked by Steer No. 54.

The average distance walked daily by steer No. 54 during the 10 days on which observations were made was 1,789 yards. Details are given in Table 20.

Table 20.

DISTANCE (YARDS) WALKED BY STEER NO. 54—AYR.

Day.	November.	January.	March.	May.	July.
1	2,282	966	1,621	2,045	1,845
2	2,752	1,142	1,358	2,238	1,643
Average ..	2,517	1,054	1,489	2,142	1,744

Over any period, quality and quantity of a pasture will vary, and the distances registered from month to month as shown in Table 20 can be attributed to these factors.

Pasture growth in January and March was so abundant that the stocking rate was increased from 6 to 7 beasts per 5 acres. Even though pastures were then a little coarse owing to the rank growth of the "wet" season, the distance walked was at a minimum. In the other months, the pasture was not so abundant but was possibly of a higher quality, in that the main feed available was the flush growth produced by irrigation.

Figure 3 gives some idea of the coverage of the paddock made by this animal whilst grazing and walking about.

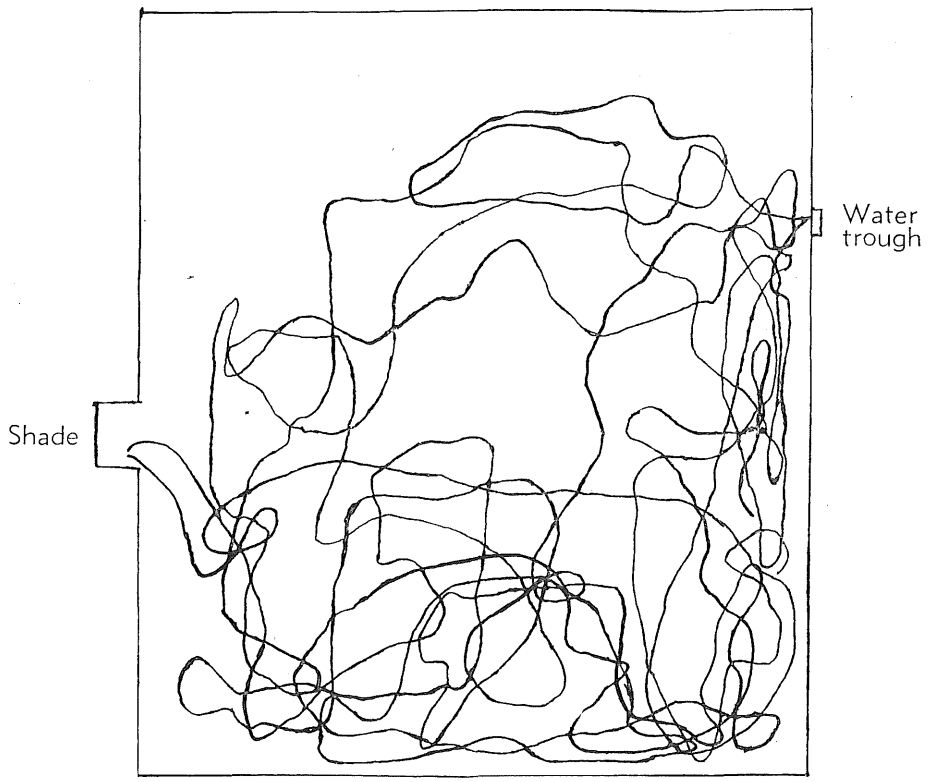

Fig. 3.

Track of Steer No. 54 on July 22-23, 1953.

(h) Individuality.

Wide variations were noted in the individual behaviour of different animals. This is emphasised in the summary (Table 21) of Tables 13-15, and the data presented in Tables 18 and 19.

The greatest variations between individuals in any one activity on any one day were:—

Grazing	.. ..	3 hours 46 minutes.
Loafing	.. ..	4 hours 23 minutes.
Lying down	.. ..	2 hours 34 minutes.

Whilst certain herd instincts apply generally, the actual distribution of activities over any one specific interval of time is influenced by idiosyncrasy.

Table 21.

RANGE OF TIME (HOURS AND MINUTES) DEVOTED TO VARIOUS ACTIVITIES ON EACH DAY OF OBSERVATION—AYR.

Month.	Day.	Grazing.	Loafing.	Lying Down.
November	1—A	4 33 7 01	6 45 8 33	9 36 11 42
	B	2 28	1 48	2 06
	2—A	6 17 7 13	7 59 9 29	7 55 9 20
	B	0 56	1 30	1 25
January ..	1—A	4 46 7 02	5 09 7 07	10 36 12 49
	B	2 16	1 58	2 13
	2—A	5 27 7 25	4 51 7 50	9 19 11 53
	B	1 58	2 59	2 34
March ..	1—A	4 23 6 39	10 41 12 29	6 04 8 08
	B	2 16	1 48	2 04
	2—A	4 03 5 34	6 48 9 11	10 35 11 46
	B	1 31	2 23	1 11
May	1—A	9 24 11 14	1 34 3 10	10 20 12 12
	B	1 50	1 36	1 52
	2—A	8 09 11 13	3 07 5 09	9 16 11 17
	B	3 04	2 02	2 01
July ..	1—A	8 39 10 56	1 46 4 36	10 21 11 18
	B	2 17	2 50	0 57
	2—A	6 59 10 45	2 02 6 25	10 36 12 56
	B	3 46	4 23	2 20

A—Range.

B—Variation between extremes.

Note: 6 steers in November, May, and July, and 7 steers in January and March.

(i) Comparison of of Methods of Observation.

From the field observation sheets, it has been possible to compute figures similar to those which would have been obtained had the group of 6 or 7 head used in this trial been observed at 5-minute intervals on a group basis (the method employed in the South Johnstone trial).

Figures obtained for average daily activities of the group computed from individual continuous observations and group observations at 5-minute intervals are given in Table 22.

There are only small differences between the figures obtained by each method. The greatest variation was 18 minutes (day 2, January) and in the main the variation is of the order of 1-5 minutes.

IV. CONCLUSIONS.

The results obtained indicate clearly that cattle vary their habits from day to day. Whether this is due to idiosyncrasy and/or variation of weather, or a combination of both, is not known. The extrinsic conditions which showed most variation were pasture and weather.

Table 22.

COMPARISON OF METHODS OF OBSERVATIONS—AYR.

(Times in Hours and Minutes.)

Month.	Day.	Grazing.	Loafing.	Lying Down.
November	1—A	6 09	7 33	10 18
(6 head)	B	6 05	7 36	10 19
	2—A	6 40	8 35	8 45
	B	6 41	8 35	8 44
January ..	1—A	5 52	6 03	12 05
(7 head)	B	5 51	6 10	11 59
	2—A	6 14	6 44	11 02
	B	6 32	6 28	11 00
March ..	1—A	5 25	11 32	7 03
(7 head)	B	5 26	11 28	7 06
	2—A	4 46	8 25	10 49
	B	4 44	8 18	10 58
May ..	1—A	10 13	2 33	11 14
(6 head)	B	10 18	2 31	11 11
	2—A	9 33	4 13	10 14
	B	9 31	4 15	10 14
July ..	1—A	10 04	3 13	10 43
(6 head)	B	9 59	3 17	10 44
	2—A	8 48	3 33	11 39
	B	8 44	3 29	11 47

A—Group observations at 5-minute intervals.

B—Continuous individual observations.

Pastures varied in quantity and quality, but the amount of grazing available was always more than adequate. The effect of continuous grazing of small areas on a rotational basis would be to reduce the amount of fodder available on succeeding days. However, from the data obtained there does not seem to be any evidence to suggest that grazing time increased from day to day as a result of this. It does seem, though, that the quantity of pasture available at any period influences the distance a beast will walk to eat its fill. It is not possible to draw conclusions as to the effect of quality of pastures on the grazing habits of cattle.

Weather was the major variant. The effect which changes in the weather may exert would seem to be quite considerable, with temperature and humidity being the most important.

From the observations reported and from a consideration of the results obtained in temperate climates, it would appear that high temperature has the following effects on cattle of the British breeds.

(1) It reduces the amount of grazing time between 8 a.m. and 4 p.m., with a consequent increase between 4 p.m. and 8 a.m.

(2) It restricts total grazing time despite the change from day to night grazing.

(3) It causes long periods to be spent in the shade.

(4) It restricts the time occupied lying down, thus causing an increase in loafing time.

The influence of high temperatures in causing cattle to spend long periods loafing during the heat of the day is very evident, and it is quite definite that cattle prefer to stand or walk about on hot days rather than to lie down for protracted periods. This reaction is logical, as dissipation of body heat, with resultant bodily comfort, would be greater while the beast was standing up than if lying down.

Excessive periods of discomfort due to heat during the day may result in fatigue and so reduce night grazing.

The importance of shade in a tropical environment is emphasised by the amount of use made of it by animals in these trials. Further, the availability of shade influences greatly the distribution of activities and the general reaction to hot conditions.

Idiosyncrasy is very evident, and in any work of this nature the reactions of a group of comparable animals should be the criterion.

Observation of a group of at least six head at 5-minute intervals gives results comparable with those obtained by continuous observation of individuals. The group method of observation permits more cattle to be employed and hence minimises differences due to individuality.

From the results obtained in the course of this work it appears that a study of the grazing habits of various classes of cattle could be of considerable help in selecting animals suited to a tropical environment. This type of investigation could to a large extent provide some explanations as to why one class of cattle is more suited to an environment than another.

V. ACKNOWLEDGEMENTS.

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