"SOME OBSERVATIONS ON THE GRAZING BEHAVIOUR AND WATER CONSUMPTION OF LACTATING FRIESIAN AND JERSEY COWS."

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INTRODUCTION.

In view of the intensive grassland husbandry practiced in New Zealand and the consequent importance of pasture grass for dairy production, it is surprising that there is so little factual information about the relationship existing between grazing cows and pasture.

In particular, there is little known about animal behaviour under the free-grazing free-intake conditions of husbandry carried on in New Zealand.

It has been pointed out (1) that the special ability of ruminants to utilise grass is the result of their physiological structure, whereby the relatively coarse feedstuffs normally consumed are subjected to softening and partial fermentation before being re-gurgitated for more leisurely mastication.

This function of rumination possessed by some species of Herbivora is associated with their ability to graze rapidly and with less regard for a selective diet. The evolution of species suggests that this attribute of rapid grazing has served in a protective sense to wild life, as it has resulted in less exposure of ruminants to attack by other animals.

Domestication has entailed the exploitation of Herbivora, primarily of ruminants, which have become the great intermediary between grass and human welfare, so that sheep, beef cattle, and dairy cattle have become real economic assets.

The actual feed requirements of a dairy cow depend on many factors, among which the most important are milk and butterfat production, ability to digest and utilise ingested food, size, exercise, disease, and physiological make-up.

On the other hand, the grazing behaviour of dairy cows appears to be governed by the extent of their feed requirements in a complex environment in which the density, composition, length, dry matter content, digestability and palatability of the pasture, along with weather, season and size of paddock all play a part.

It is apparent then, that any objective data on the grazing behaviour of dairy cows would be of fundamental importance

and might at the same time be expected to throw some light on a number of pasture management and animal husbandry problems.

A survey of the literature showed that there exists very little information on grazing behaviour. Such studies as are reported have been carried out for the most part, on only a few animals over a short period, and for this reason are of limited significance.

It was therefore decided that the present study should be conducted as a preliminary survey, with the main object of establishing a standard of "normal" or"average" behaviour under New Zealand conditions, so that any subsequent investigations along the same lines couldbe interpreted against an established background of information.

In view of the popularity of Jersey cows in New Zealand, it was hoped at the same time to compare their grazing behaviour with that of Friesian cows under somewhat similar conditions.

With these broad objectives in view, data have also been collected on some other aspects of animal behaviour including water consumption, the influence of high or low production, and the behaviour of individual cows.

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SUMMARY OF LITERATURE.

Owing to the paucity of literature about the grazing behaviour of lactating dairy cows in particular, some published results obtained with grazing beef cattle and dry stock have also been included in this review.

The earliest record of the grazing habits of cattle is contained in some essays by a Scottish farmer, James Anderson in 1797 (2) who, as a result of his observations, suggested the adoption of a system of rotational grazing.

There exists in the early literature other stock management suggestions based on observations of the grazing habits of livestock (3), (4) and these early writers were evidently aware that the amount consumed by grazing animals was dependent on the amount and condition of the herbage present.

Shepperd 1921 (5) made observations simultaneously in four pastures of 100, 70, 50 and 30 acres, in each of which were 10 two year old Hereford steers. He found, as a result of only one day's observation, that the animals travelled further in a large paddock.

Shepperd 1927 (6), after one 24hr. observation with three Hereford steers on sweet clover pasture, found they spent 8½ hours grazing, 7¼ hours lying, 4½ hours sleeping and 4 hours standing.

Cory 1927 (7) reports a study made of cattle, sheep and goats under range (free-grazing) conditions at monthly intervals over a period of three years. He finds that range animals are regular in their habits, and the length of time they spend in feeding is largely determined by the length of daylight and to a lesser extent by air temperature. Mature Hereford cows spent an average of 461 minutes feeding out of 817 minutes - i.e. 56% of their time. He also records the time spent by the animals travelling, resting, licking salt, drinking, ruminating and idling.

The same author cites a Norwegian publication (8) which

he suggests is of limited significance.

Ellingboe (8) does state, however, that animals on pasture, having gone to rest, will stay at rest during the hours of darkness.

Fuller 1928, (9) who reports some observations on stall-fed dairy cows, finds a slight breed difference in time spent standing.

Mosely et al 1929 (10) report some observations made from 0500 to 2100 hours* on Holstein cows on irrigated pastures in Montana.

From four observations - two each in June and August - they show that cows on pasture graze an average of 9.16 hours per day while cows on pasture plus :- Alf-Alfa hay, limited grain ration, and full grain ration graze respectively 29%, 39% and 42% less than on pasture alone.

Hodgson 1933 (11) made observations concerning the time spent grazing by Holstein cattle under systems of rotational and continuous (unrestricted) grazing. His observations, made during daylight only from 0600 hours onwards, showed that the cows grazed $6\frac{1}{2}$ - 7 hours daily under rotational grazing and $7-7\frac{1}{2}$ hours daily under continuous grazing.

Giobel and Lindbom 1934 (12) in Sweden reported that milking cows on pasture spent approximately half their time in effective grazing, and the remainder chewing the cud and resting.

The intensity of grazing during the day and night was similar.

Levy 1935, (13) during an investigation into feed-flavour in cream, carried out some night observations on a large Jersey herd in the Waikato district.

*To avoid confusion, the international 24 hour day has been followed throughout this account. Thus, midnight is 2400 hours and noon 1200 hours.

He found little or no grazing done by well-fed cows between 0100 hours and morning milking.

Atkeson et al 1942 (14) studied the comparative time spent in grazing by milking cows on six different pastures, observations being taken during a daylight period of 11.7 hours for three consecutive days on each pasture.

Although the animals received supplementary feed, they spent 31% more time in grazing on poor pasture (average 7.3 hours) than on good pasture (average 5.6 hours).

The same authors made a more detailed study of 56 dry cows and yearling heifers depastured continuously on 30 acres of excellent Balbo rye pasture 6-10" high, and receiving no supplementary feed. They recorded the number of animals grazing, standing and lying down at 5 minute intervals during three consecutive 24 hour periods.

The animals spent an average of 7 hours grazing, 4 hours standing or walking, and 13 hours lying down during each 24 hour period.

During 14 hours of daylight, 40% of the time was spent grazing. No mention is made of the breeds of cows used in these experiments.

Johnstone-Wallace & Kennedy 1944 (15) investigated in detail the grazing behaviour of three Aberdeen Angus cows and one Hereford cow, only one observation being devoted to each animal. They report that whatever the length of the herbage, the animals spent only 7-8 hours per 24 hours in grazing, of which an estimated 5 hours is actually employed in gathering herbage, while the remainder was spent in walking short distances and in selecting the area to be grazed.

On the average 60% of the grazing was performed by day, when the distance walked was two miles, and 40% by night when the animals travelled only about half a mile.

Data was also collected on the time spent lying down, cudding, frequency of defaecation, weight and extent of droppings, frequency of urination, number of drinks.

Seath & Miller 1946 (16) have studied the effect of warm weather on the grazing performance of three Jersey and three Holstein cows during five 24 hour periods, and report that air temperatures above about 72° F. exerted a marked effect on the proportion of time spent grazing between day and night.

Because of the wide variety of conditions under which all the above studies have been conducted, it is apparent that the results need not necessarily apply to the grazing behaviour of New Zealand dairy stock.

A useful paper by Hancock & Wallace 1947 (17) was read to the N.Z.Society of Animal Production in which the authors report the results of observations on six pairs of lactating monozygotic twin heifers.

They report that cows spend an average of 28% of their time grazing, of which three-fifths takes place while in the 'day' paddock and two fifths in the 'night' paddock.

They presented data showing the great similarity in grazing behaviour within sets of twins, the well defined grazing cycles - four during daylight and one during the night, the distribution of natural functions, the variation in number of bites and number of boluses chewed, the distance walked, and the influence of hot weather.

These observations were carried out on good pasture of approximately the same density and height (5-6") and represent a real contribution to our knowledge of animal behaviour.

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METHOD

(A) COLLECTION OF DATA

Twenty-six 'day-time' * and Twenty-four 'night-time' observations were carried out in the field at intervals from Jan. 7th 1947 to Dec. 1st. 1947 on lactating Friesian and Jersey cows of the Massey College herds. An observer stationed either in the paddock or in a position over-looking it recorded the number of animals grazing, standing not grazing, and lying down at either ten or fifteen-minute intervals between milkings, and any other information including weather, condition of pasture, use of shade and shelter.

A preliminary study showed, among other things, that it was physically impossible for one observer, during hot weather, to maintain a 24 hour vigil, and accordingly each 24 hour observation was carried out in two stages:-

(A) Day-time - from morning to evening milking on one day.

(B) Night-time - from evening to morning milking on the subsequent night.

While recording what has been termed 'herd behaviour' at fifteen minute intervals, wherever possible one or two individual animals were kept under continuous observation, depending on the shape of the paddock, the number of cows in the herd, and on weather conditions. The animals used for these 'individual behaviour' studies were chosen mainly on the basis of production, and also because of distinctive appearance for ease in identification. The object was to gain some idea of the variability of individuals compared with the whole herd of which they were members.

Management: The three herds on which observations were carried out comprised:-

(1) A grade Jersey herd with a few pure-breds.

(2) A pure-bred Jersey herd with a few grades.

(3) A pure-bred Friesian herd.

* Unless otherwise specified in this account, 'day-time' and 'night-time' observations refer, for convenience, to the interval between milkings rather than to the actual period of day light or darkness.

Each herd was managed separately as a unit, the Jerseys for normal seasonal production (Spring calving) and the Friesians for winter milk production. (Autumn calving).

In May, a 'combined herd' was created by including with the newly-calved Friesians any carry-over cows from the pure-bred Jersey herd (e.g. late calvers, 'empty' cows, 'strippers'). This combined herd was managed for winter production.

In August, freshly calved pure-bred Jerseys and some Friesians were added to the winter herd until enough numbers were available to justify the formation, once again, of separate Friesian and Jersey herds.

Feeding: For practically every observation period during the year, except in the late spring, the cows received one or more of the following supplements:- meadow hay, grass ensilage, chou moellier (in situ or carted out), soft turnips, and mangolds; they can be considered well fed at all times, as judged by the amount of supplements not utilised and by the pasture available. An attempt was made to record, on certain occasions, the time spent eating hay or ensilage as distinct from actually grazing. No attempt was made to estimate the wastage due to trampling and soiling.

The preliminary studies indicated that cows would not readily graze the rank patches of growth resulting from previous stock excretions, and this suggested the possibility of measuring the remaining "grazeable pasture" as an indication of the amount of herbage per acre actually available for eating.

Accordingly, on a number of occasions, sample areas of short palatable 'grazeable pasture' were selected at random over the paddock, and on each area 9 sq. ft. of herbage was cut by hand with special grass shears. This herbage was weighed, and a representative aliquot was oven-dried to determine the Dry Matter per cent and hence the "grazeable D. M. /acre". Sampling was carried out by placing a 3' x 3' square wire frame over the area selected for clipping.

Individual Behaviour: On several occasions records of the distance walked were collected using the method of Johnstone-Wallace and Kennedy. (15)

Numbered pegs were spaced systematically at 22 yard intervals, so that the observer could record on graph paper the position of the individual cow at any instant with reference to one or more of the pegs. Appendix I shows the type of information collected in the field by this method.

For individual behaviour the data recorded were:- exact times spent grazing, standing not grazing, lying down, ruminating, and the number of drinks. The rate of eating i.e. number of bites per minute was recorded for some animals at half-hourly intervals, while the number of chews per bolus was in some cases noted when animals were ruminating.

An attempt was also made, using a stop-watch to record the time spent actually eating as distinct from walking short distances and/or selecting herbage to be eaten. (15) This was later discontinued, since the only type of stop-watch procurable - the orthodox type - proved unsuitable for observations of this nature.

Attempts were also made to estimate the weight of solid excretions from individual cows by collecting freshly voided dung with a shovel and weighing, which presented some considerable difficulty. Apart from this, when many cows were present, or in larger paddocks of 5 - 6 acres, the animal in question could often defaecate without being observed; the method was therefore discontinued as being unsatisfactory after some data had been collected.

Night Observations: These were carried out between evening and morning milking, and while fairly satisfactory for herd behaviour, were less suited for observing individual animals due to the comparatively large size of the paddocks. For these observations, the observer was seated in a motor-vehicle stationed in the centre of the paddock, getting out at fifteen minute intervals to record herd behaviour with the aid of a

spotlight. Unfortunately, it was not until June that a sufficiently powerful 5-cell spotlight could be procured, and even then, complete coverage of a 5 acre paddock from one position was rarely possible. The procedure generally adapted was to walk around among the animals, which did not appear to be disturbed to any extent by the light. Some animals, because of their colouring, were extremely difficult to identify with the spotlight except at close quarters.

Production Records: These were collected as available from Group Herd Test figures, while in some cases, total milk weights across the stage at the Dairy Factory were used.

Meteorological Data: This was obtained from standard recording apparatus at the Grasslands Division adjacent to the College Farm.

Water Consumption: This was measured in the paddocks and in the yard by attaching an ordinary household water-meter to suitable troughs. Having filled the trough to a pre-determined level, the ball-cock was tied back, thus stopping the water inflow. At intervals during the day, water was introduced through the meter, and finally, when the herd was taken out, the trough was filled through the meter to the previous level. This allowed an estimate of the total free-water consumption; from which the average consumption per cow could be calculated.

General: Notes were taken on any other aspects of behaviour likely to be relevant to the investigation, including the use of shade and shelter, condition and palatability of the pasture, the effect of rain, and of animals in oestrus.

These are discussed in appropriate places in the results.

(B) DISCUSSION OF METHOD

It is desired to emphasize in connection with the method adopted that:-

(1) Farm management could not be interfered with, so that observations had in most cases to be made as opportunity offered.

(2) There are considerable practical and physical limitations when only one observer is available to conduct a study of this nature, and some of the objections discussed below could be partly overcome with adequate facilities and labour. Casual help was obtained from time to time, but could not be considered altogether reliable.

Intervals between observations: In view of the primary object of this study i.e. to establish a standard of behaviour, and also because each observation extending over one day and night accounted for approximately $2\frac{1}{2}$ days of the writer's time, it was decided that regular fortnightly observations for 11 months would provide reasonably complete information on animal behaviour throughout the year. For reasons of personal comfort, and because data was required under "normal" conditions, it was necessary to conduct observations during periods of reasonably settled weather. Again, only certain paddocks were of a suitable size and shape, so that for various reasons the interval between successive observations was as much as 34 days.

Recording Herd Behaviour: Since the observer was usually recording the behaviour of 1 - 2 cows continuously, along with herd behaviour, 15 minutes was found the most convenient interval to use between consecutive counts. However, as the method developed, it was found that 10 minute intervals could be adopted in the day-time without loss of accuracy, and this was done from May onwards.

To test the validity of this assumption, one day-time observation on herd behaviour at 5 minute intervals was carried out, and the times spent in various activities

were compared when calculated on the basis of 5, 10, and 15 minute intervals respectively. (TableI)

Table I:

Comparison of Herd Behaviour on the basis of 5, 10, and 15 minute intervals between counts.

35 Friesians Mar. 31

	5 MINUTE INTERVALS (1)	10 MINUTE INTERVALS (2)	AS % OF COL. (1)	15 MINUTE INTERVALS (3)	AS % OF COL. (1)
GRAZING	5.08 hrs.	5.18 hrs.	102.0%	5.23 hrs.	103.0%
NOT GRAZING	3.46 hrs.	3.42 hrs.	98.8%	3.57 hrs.	103.1%

From Table I it is seen that the accuracy lost by adopting 15 minute intervals is up to 3%, compared with 5minute intervals.

Actually, a series of counts made at, say, 10 minute intervals gives no information on herd behaviour during the intervening period of time. In analysing the data, therefore, use was made of a moving average $\frac{A+B}{2}$ during two successive intervals for example:-

		ACTUAL COUNTS		MOVING AVERAGE
A	Number grazing at 0800 hrs.	11	$\frac{A+B}{2}$ =	14
B	" " " 0810 "	17		
C	" " " 0820 "	26	$\frac{B+C}{2}$ =	21.5

Thus, an average of 14 animals were grazing for 10 minutes from 0800 hrs. to 0810 hrs. This figure was also used in compiling the per-centage of cows grazing (see Results.)

Management: It was somewhat unfortunate that, until the two Friesian and Jersey herds were combined for winter production, breed comparisons had of necessity to be made on different days and in different paddocks. It should be noted that Friesians generally had access to longer and more luscious pasture during the dry summer and autumn months. The winter policy of feeding off autumn saved grass in breaks with an electric fence made it difficult to estimate the amount of food available, since on most occasions the animals were fed chou moellier in situ for about forty minutes after morning milking, and also received hay while on the day-paddocks of autumn saved grass. On

night paddocks they received hay or ensilage and either chou moellier, turnips or mangolds. No autumn saved grass was fed on the night paddocks. Further remarks concerning management will be considered in the results.

Day and Night Observations: The discontinuity of day and night observations, due to physical limitations, had two effects:-

(A) Herd behaviour on the day-paddock could not readily be compared with behaviour on the night paddock of the same day.

(B) No total milk weights were available in respect of the day or night period studied, since evening and morning milk was mixed together for weighing at the factory. From June onwards, when assistance was obtained, a continuous 24 hour period was covered at each observation.

Feed Available: When this study was commenced in January most paddocks had many rank patches of growth as a result of previous stock excretions, and it was noticed that cows preferred to graze the remaining uncantaminated areas which were comparatively short. The estimation of this "grazeable pasture" (see "Collection of Data" above) was therefore a legitimate measure of the amount of feed available for grazing.

With the approach of dry weather in late summer, however, pastures rapidly declined in productivity, and it became almost impossible to decide, by any means, what constituted grezeable pasture. This difficulty was also apparent when stock were depastured on hay aftermath, on autumn saved grass, and on spring grass.

The procedure in estimating the feed available was to clip the grass as soon as possible after the commencement of grazing, and leave the paddock for up to 30 minutes while the samples were weighed and put in a drying-oven. From previous work it had been established that all animals in the herd could be relied on to graze continuously only for the first hour after entering the paddock. Therefore, because of the work involved in selecting and clipping sample areas, and the time limit imposed, the number of samples was limited in practice to six.

The calculation of "grazeable Dry Matter per acre" from only six random samples of 9sq. ft. (54 sq. ft. = $\frac{1}{806}$ acre) would be open to very serious objection in any critical studies of pasture yield, (18) but in view of the arbitary nature of the grazeable pasture concept and the presence of other uncontrollable complicating factors, such a measure is, in any case, no more than a guide to the quantity of pasture available. There seemed no way of overcoming the fact that the moisture content of the grass could be seriously affected by rain, dew, or frost, while an attempt made to weigh samples in the paddock proved unsatisfactory because sufficiently sensitive scales were not available.

The main criticism in interpreting the question of feed available is in the fact that on practically every observation day, the animals received some form of supplementary feed in the paddock, so that even an accurate measure of the amount of pasture present would not necessarily represent the quantity of feed available. It was not possible, under the conditions of this study, to measure the amount of supplementary feed except in the case of baled hay. Appendix II shows the average weight of a bale of hay to be 50lbs. In view of all these objections, it is concluded that estimations of the amount of food available for consumption should be interpreted with caution.

Night Observations: These were carried out on herd behaviour at 15 minute intervals and on some occasions at 30 minute intervals. Some night observations on individual cows were completed, but proved of considerable difficulty in the large paddocks with the facilities available.

Conclusion: Under the circumstance of this study, the presence of so many uncontrollable factors is unfortunate, and must detract from the significance of the results. In particular, the confusing effects of feeding supplements to cows on pasture constitutes a serious weakness in any attempt to measure objectively the behaviour of grazing animals, and while any conclusions can be applied to the conditions under which this

study was conducted, they can not, for the most part, be generalised to include other different systems of husbandry.

Although some data were collected on the time spent eating hay or ensilage, (as distinct from grass) the size of the paddocks and the number of cows in the herd generally made it necessary for the observer to regard all feeding activities - whether eating hay, ensilage, turnips, mangolds, chou moellier or grass - as "grazing".

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TABLE II: Illustrating the procedure followed in analysing the crude Data.

Per-centage of herd engaged in grazing at 10 minute intervals.

23 Friesian cows in Paddock 21 (Winter Grass) July 25.

TIME	NO. GRAZING (2)	MOVING $\frac{A+B}{2}$ AVGE (3)	COL.(3) AS % OF 23 (4)	TIME	NO. GRAZING (2)	MOVING $\frac{A+B}{2}$ AVGE (3)	COL.(3) AS % OF 23 (4)
0640	23	--	--	1240	5	7	30
0650	23	23	100	1250	5	5	22
0700	23	23	100	1300	8	6.5	28
0710	23	23	100	1310	9	8.5	37
0720	23	23	100	1320	6	7.5	33
0730	23	23	100	1330	7	6.5	28
0740	23	23	100	1340	8	7.5	33
0750	22	22.5	98	1350	11	9.5	41
0800	19	20.5	89	1400	10	10.5	46
0810	9	14	61	1410	9	9.5	41
0820	6	7.5	33	1420	16	12.5	54
0830	3	4.5	20	1430	12	14	61
0840	3	3	13	1440	12	12	52
0850	4	3.5	15	1450	10	11	48
0900	3	3.5	15	1500	12	11	48
0910	6	4.5	20	1510	9	10.5	46
0920	22	14	61	1520	11	10	44
0930	23	22.5	98	1530	10	10.5	46
0940	22	22.5	98				
0950	23	22.5	98				
1000	22	22.5	98				
1010	20	21	91				
1020	19	19.5	85				
1030	14	16.5	72				
1040	18	16	70				
1050	14	16	70				
1100	12	13	57				
1110	7	9.5	41				
1120	4	5.5	24				
1130	3	3.5	15				
1140	8	5.5	24				
1150	7	7.5	33				
1200	8	7.5	33				
1210	8	8	35				
1220	8	8	35				
1230	9	8.5	37				

TOTAL = 649

INTERVALS = 10 MINUTES

TOTAL MINUTES = 649 X 10
= 6490 minutes

NO. OF COWS IN HERD = 23

AVGE PER COW = $\frac{6490}{23}$
= 282 minutes
= 4.70 hours

RESULTS

METHOD OF PRESENTATION: The large volume of data collected in the field was in a form which made it difficult to summarise without obscuring the cyclic nature of grazing activities (Appendix III)

It was therefore decided to present the results in graphical form by expressing, as a per-centage of all cows in the herd on that day, the number grazing, standing * and lying down at intervals throughout the period being studied.

This enables relative behaviour to be viewed on a comparable basis.

For further economy of space, each graph has been photographed and reduced in size.

The procedure followed in analysing the crude data has been discussed above (see "Discussion of Method") and is illustrated, in the case of grazing, in Table II.

It will be observed from this Table that the moving average (column (3)) rather than the crude data (column (2)) has been used to calculate the per-centage of the herd grazing at any time. This tends to smooth fluctuations in the crude data, and results in a clearer visual picture when these per-centages are plotted against time in the graphs presented. An identical procedure has been followed for calculating the per-centages and the average time per cow spent standing and lying down.

On each graph, the area representing the per-centage of cows standing has been shaded, and is the remainder after plotting the per-centage of cows grazing and lying down. On day and night paddocks, midday and midnight respectively is denoted by a broken vertical line, while the breed is indicated by the letters (F) Friesians and (J) Jerseys.

* 'Standing' includes all other activities apart from grazing or lying down and would embrace walking, drinking, idling, scratching, fighting, licking other animals observing distractions, as well as actually standing.

SECTION I HERD BEHAVIOUR

Graphs of 62 separate observations on herd behaviour carried out on 50 different days and nights from Jan. 7, 1947 to Dec 1, 1947, are presented in chronological order.

In the legends referring to each graph, under 'Behaviour', is set out the average number of hours per cow devoted to Grazing, Standing and Lying Down, while in brackets after each activity are given the per-centage it represents of the total time in the paddock, e.g. on Jan 7 the Friesians in paddock 18 spent 59.8% of their time (9.00 hrs) in grazing. (See Graph No 1). Other information given briefly in the legends includes:-

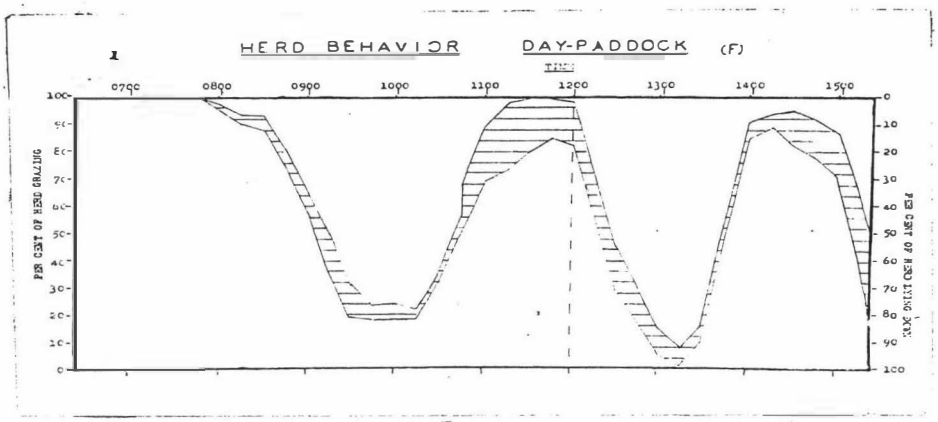
Date
Paddock number and area (where available)
Number and Breed of cows in the herd.
Notes on Feed supplies.
Notes on Weather conditions.

With reference to 'Temperature' it should be remembered that the maximum occurs between 1330 - 1430 hrs and the minimum between 0300 - 0400 hrs, subject to weather conditions, the increments being in approximately a straight line between these extremes. It should also be realised that while the duration of actual darkness is governed primarily by the times of 'sunset' and 'sunrise', season and weather conditions also play a part.

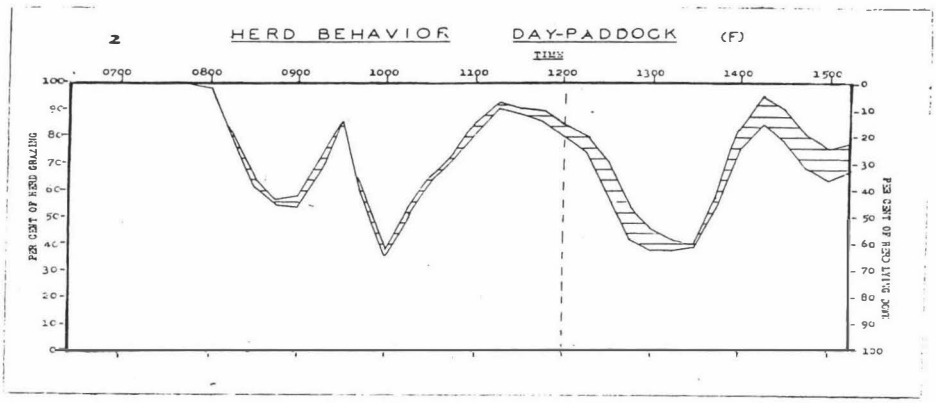
The following abbreviations have been used:-

Pad -	Paddock.
Max. temp. -	Maximum temperature.
Min. temp. -	Minimum temperature.
Gr. -	Grazing.
St. -	Standing.
Lying -	Lying Down.
Total time -	Number of hours in paddock.

1


HERD BEHAVIOR
DAY-PADDOCK
(F)
TIME
0700
0800
0900
1000
1100
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

2


HERD BEHAVIOR
DAY-PADDOCK
(F)
TIME
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0800
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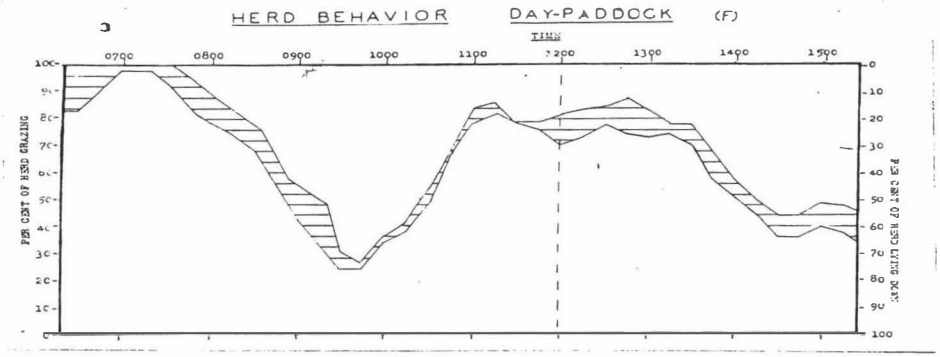
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

3


HERD BEHAVIOR
DAY-PADDOCK
(F)
TIME
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0800
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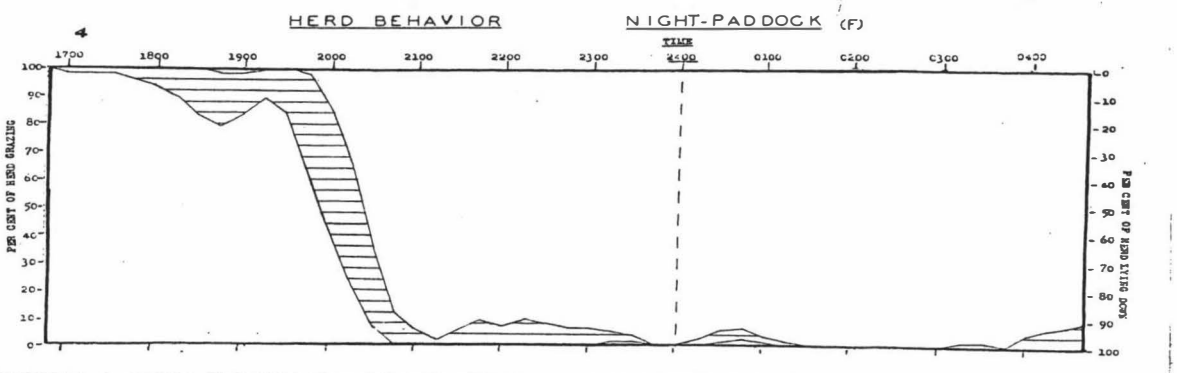
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

4


HERD BEHAVIOR
NIGHT-PADDOCK
(F)
TIME
1700
1800
1900
2000
2100
2200
2300
2400
0100
0200
0300
0400
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

GRAPH NUMBERS

LEGENDS.

(1) Jan 7 ; Pad. 18 (7.65 acres); 42 Friesians.

Feed: Pasture 3 - 4" high. Hay aftermath of rye-grass and clover. Classed as excellent.

Weather: Fine and sunny, mild, with light northerly wind Max. temp. 62.9F

Behaviour: Gr. 5.38 hrs (59.8%); St .87hrs (9.7%); Lying 2.75 hrs (30.5%); Total time 9.00 hrs.

---

(2) Jan 8; Pad 21 (5.65 acres); 42 Friesians.

Feed: Pasture 2 - 3" high. Hay aftermath of rye-grass and clover. Classed as good.

Weather: Overcast with a keen N - W wind, such that cows preferred to remain in the shelter of a boxthorn hedge. Max. temp. 63.7F

Behaviour: Gr. 6.33 hrs (71.7%); St. .36 hrs (4.1%); Lying 2.14 hrs (24.2%); Total time 8.83 hrs.

Animals distracted by other stock at 0900 hrs.

---

(3) Jan 15; Pad 28 (5.57 acres); 41 Friesians.

Feed: Pasture 2 - 3" high. Hay aftermath of ryegrass, cocksfoot and clover. Classed as good.

Weather: Overcast, with rain showers at 0850 hrs and at 1030 hrs. Max. temp. 58.5F

Behaviour: Gr. 5.55 hrs (61.1%); St. .68 hrs (7.5%); lying 2.85 hrs (31.4%); Total time 9.08 hrs.

Animals distracted by several bulls in adjacent paddock.

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(4) Jan 16 - 17; Pad 4 (6.24 acres); 41 Friesians.

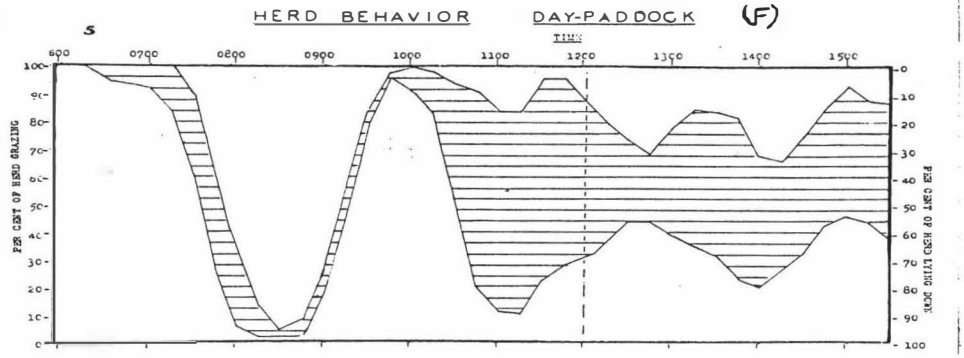
Feed: Pasture 2 - 5" high, with much clover. Many rank patches, but classed as good cow pasture.

Weather: Cloudy and mild, with light N - W wind dying away. Moderate dew. Min temp. 42.0F (Air) 37.2F (Grass) Sunset 1955hr

Behaviour: Gr. 2.76 hrs (23.2%); St. .89 hrs (7.5%); Lying 8.26 hrs (69.3%); Total time 11.91 hrs.

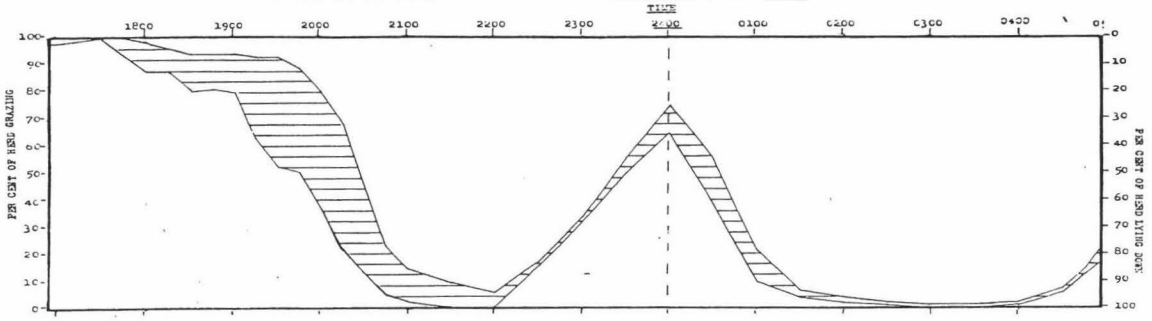
5

HERD BEHAVIOR DAY-PADDOCK (F)



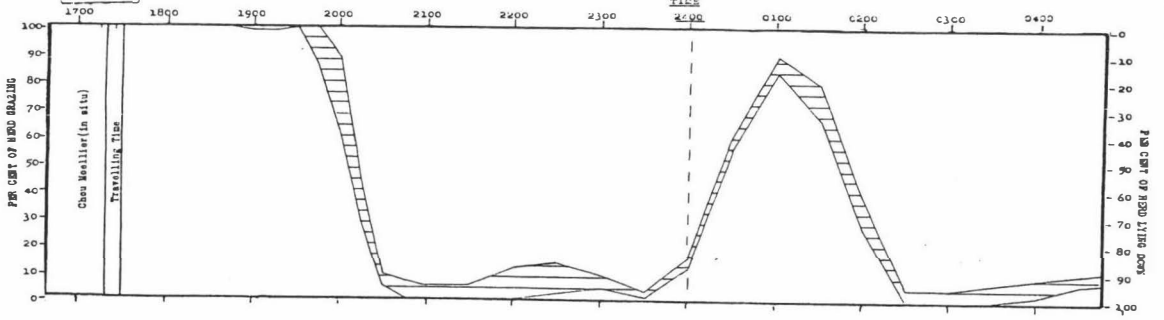
6

HERD BEHAVIOR NIGHT-PADDOCK (F)



7

HERD BEHAVIOR NIGHT-PADDOCK (F)



5) Jan 30; Pad. 4 (6.24 acres); 41 Friesians.

Feed: Pasture 2 - 3" high of ryegrass and much clover. Some rank patches, but classed as good. Several animals "bloated" by 0930 hrs.

Weather: Cloudy and mild, later becoming very hot and sunny. Light westerly breeze. Most animals stood in the shade of some trees when not grazing. Max. temp. 76.0F.

Behaviour: Gr. 3.98 hrs (42.7%); St. 3.16 hrs (33.9%); lying 2.19 hrs (23.4%); Total time 9.33hrs.

---

6) Jan 31 - Feb 1; Pad 11 (7.10 acres); 41 Friesians.

Feed: Pasture 2 - 6" high, mainly of ryegrass and white clover with some cocksfoot and red clover. Many rank patches, but classed as good.

Weather: Clear sky and mild after a hot day. Heavy dew. Min. temp. 49.2F (Air) 42.2F (Grass) Sunset at 1945 hrs.

Behaviour: Gr. 3.64 (30.5%); St. 1.20 (10.1%); Lying 7.08 (59.4%); Total time 11.92 Hrs.

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(7)Feb 6 - 7; Pad 5 (5.00 acres); 41 Friesians.

Feed: Pasture 2 - 4" high. Hay aftermath of ryegrass and cocksfoot with much clover. Classed as good. All cows turned into chou moellier for 40 minutes.

Weather: Cloudy and mild. Light westerly wind. Full moon, but partly obscured by clouds. Min. temp. 59.8F (Air) 53.0F (Grass). Sunset at 1935 hrs.

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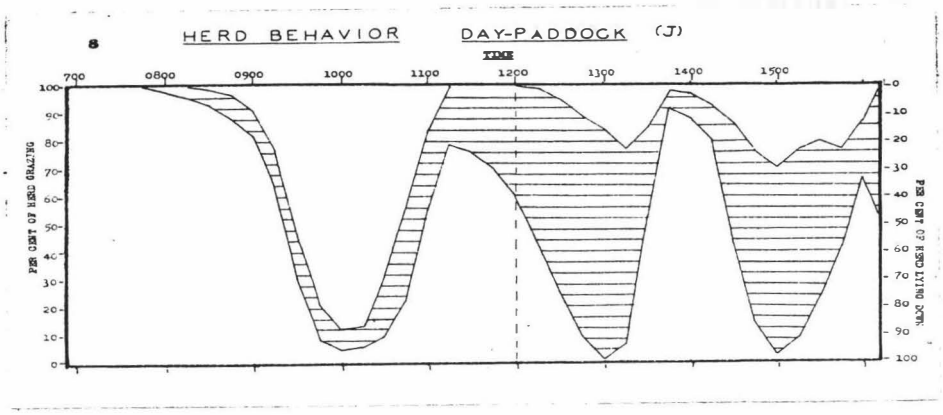
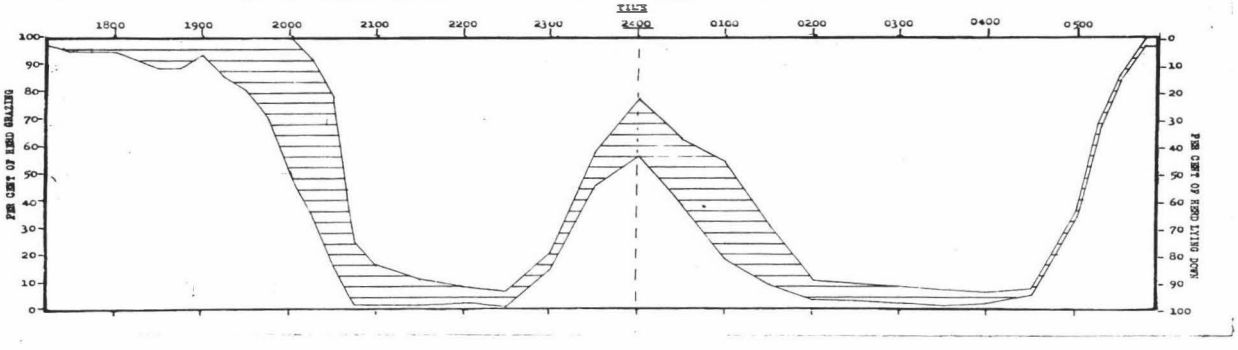
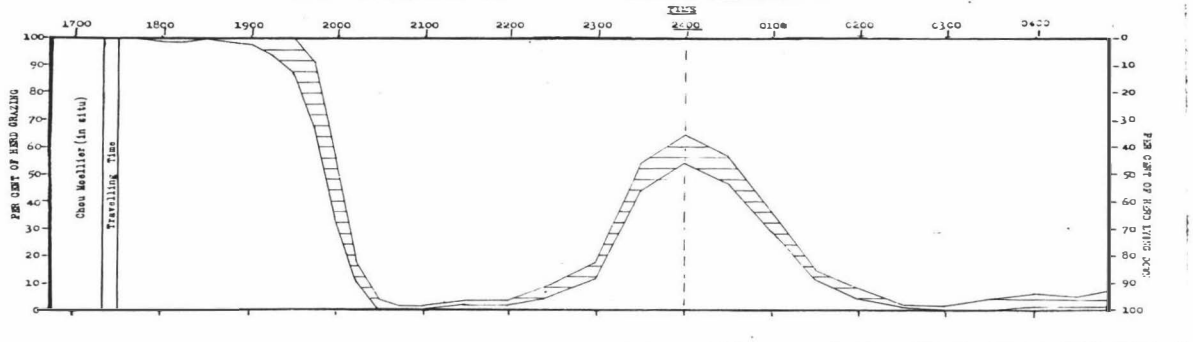
8 HERD BEHAVIOR DAY-PADDOCK (J)



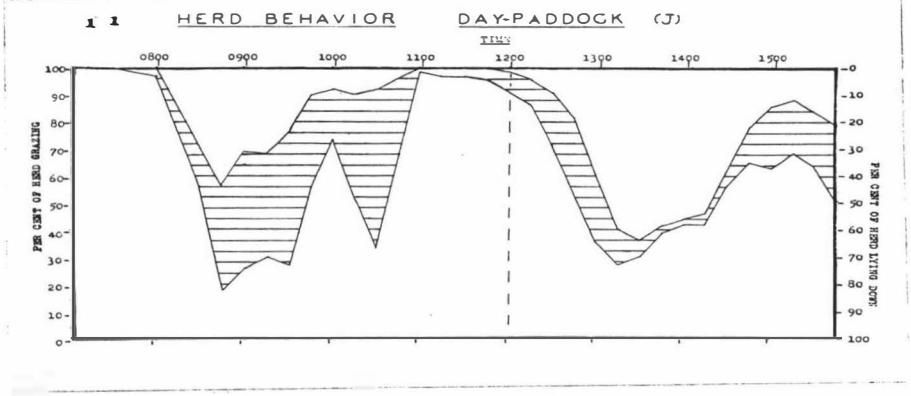
9 HERD BEHAVIOR NIGHT-PADDOCK (J)



10 HERD BEHAVIOR NIGHT-PADDOCK (F)



11 HERD BEHAVIOR DAY-PADDOCK (J)



(8) Feb 7; Pad 18 (7.65 acres); 64 Jerseys.

Feed: Pasture 1½ - 3" high. Aftermath, of ryegrass, cocksfoot and considerable clover. Classed as good.

Weather: Sunny and warm with light N - E wind. Becoming hot at 1130 hrs, when many animals sought the shade of some trees. Max. temp. 73.2F.

Behaviour: Gr. 4.73 hrs (51.1%); St. 2.76 hrs (29.8%); Lying 1.76 hrs (19.0%); Total time 9.25 hrs.

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9) Feb 8 - 9; Pad 11 (7.10 acres); 64 Jerseys.

Feed: Pasture 1½ - 4" high. Many rank patches of ryegrass and clover. Classed as average. Approx. 8 cwt. of soft turnips fed in the paddock.

Weather: Overcast and mild after a hot day. Full moon partly obscured by clouds. Min. temp. 61.1F (Air) 57.0F (Grass) Sunset at 1932 hrs. Sunrise at 0536 hrs.

Behaviour: Gr. 4.38 hrs (34.6%); St. 1.51 hrs (11,9%); Lying 6.77 hrs (53.5%); Total time 12.66 hrs.

) Feb 8 - 9; Pad 12; 41 Friesians.

Feed: Pasture 2 - 4" high. Aftermath of ryegrass, cocksfoot and clover. Classed as average. All cows allowed on chou moellier for 40 minutes.

Weather: Same as (9) above.

Behaviour: Gr. 3,91 hrs (32.8%); St. .59 hrs (5.0%); Lying 7.42 hrs (62.2%); Total time 11.92 hrs.

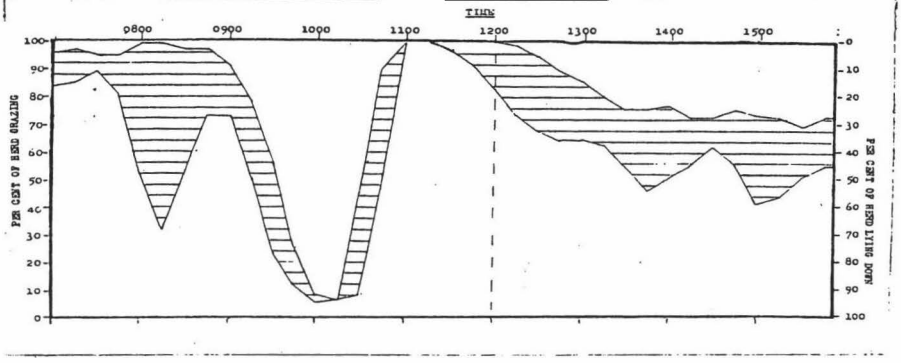
)Feb 21; Pad 30 D.R.I. (1.9 acres); 39 Jerseys.

Feed: Pasture 2 - 7" high of ryegrass and much clover. Classed as good. 655 lbs D.M./acre "grazeable pasture". Approx. 8cwt chou moellier fed at 1045 hrs.

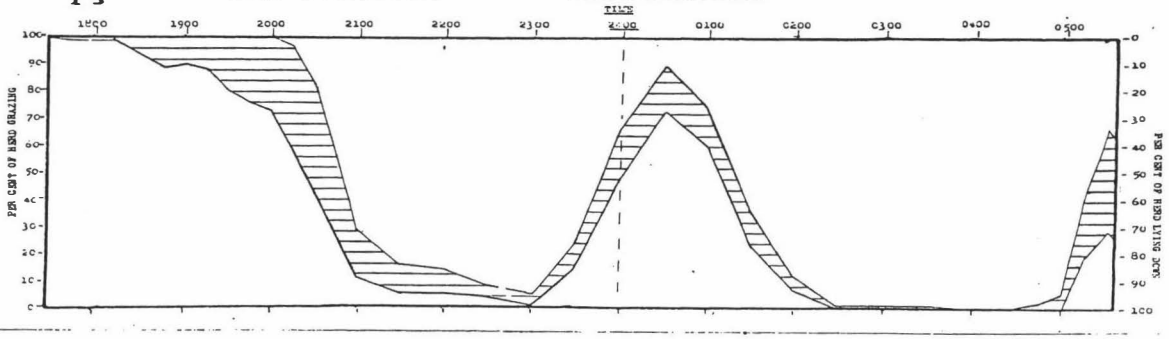
Weather: Bright sunshine, moderate N - W wind and mild temperature. Max. temp. 69.5F.

Behaviour: Gr. 5.30 hrs (61.1%); St. 1.56 hrs (18.0%) Lying 1.81 hrs (20.9%); Total time 8.67 hrs.

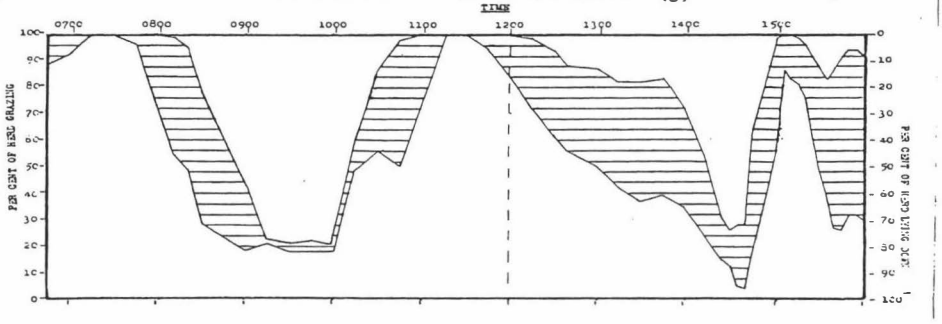
12 HERD BEHAVIOR DAY-PADDOCK (J)



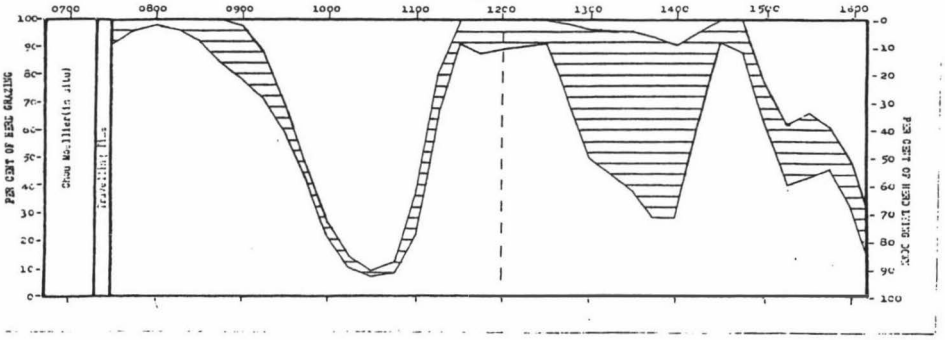
13 HERD BEHAVIOR NIGHT-PADDOCK (J)



14 HERD BEHAVIOR DAY-PADDOCK (J)



15 HERD BEHAVIOR DAY-PADDOCK (J)



12) Feb 25; Pad 10 D.R.I. (1.24 acres); 39 Jerseys.

Feed: Pasture 2 - 5" high of ryegrass, cocksfoot and clover. Uneven, but classed as good. 605lbs D.M./acre of grazeable pasture. Approx. 8 cwt. chou moellier and a few turnips fed at 1030 hrs.

Weather: Overcast, light N - W wind, slight rain from 1730 hrs 0820 hrs. Max. temp. 68.0F

Behaviour: Gr. 5.10 hrs (57.5%); St. 1.91hrs (21.5%); Lying 1.86 hrs (21.0%); Total time 8.87 hrs.

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13) Feb 26 - 27; Pad 14 D.R.I. (1.40acres); 39 Jerseys.

Feed: Pasture 2 - 5" high, of ryegrass, cocksfoot and clover, with some Yorkshire fog and seed-heads. Classed as average. 490lbs D.M./acre grazeable pasture. Approx. 6cwt. chou moellier fed in paddock.

Weather: Clear sky, light easterly wind, light dew, slight frost. Min. temp. 38.5F (Air) 30.0F (Grass) Sunset 1911 hrs, Sunrise 0558 hrs.

Behaviour: Gr. 3.92 hrs (32.4%); St. 1.38 hrs (11.4%) Lying 6.80 hrs (56.2%); Total time 12.10 hrs.

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14) Mar 4; Pad 30 D.R.I. (1.9 acres); 39 Jerseys.

Feed: Pasture 3 - 4" high with ryegrass and much clover. Classed as good. 840lbs D.M./acre of grazeable pasture. Approx. 8cwt. chou moellier fed at 1100 hrs.

Weather: Fine and sunny, light westerly breeze. Max. temp.71.0

Behaviour: Gr. 4.79 hrs (52.3%); St. 2.28 hrs (24.9%); Lying 2.08 hrs (22.7%); Total time 9.15 hrs.

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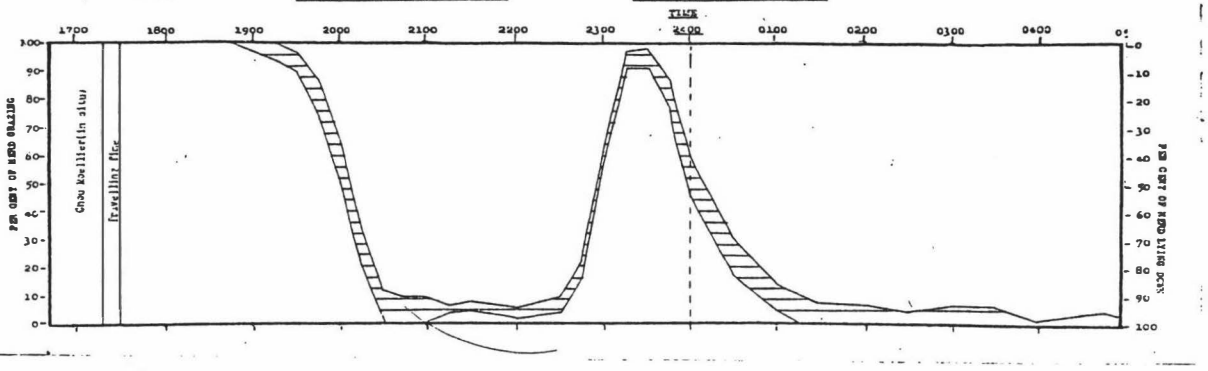
15) Mar 7; Pad 19 (5.74 acres); 58 Jerseys.

Feed: Pasture 2 - 4" high, ~~of ryegrass~~ and cocksfoot, and very dry. Classed as average. 870lbs. D.M./acre grazeable pasture. All cows had 35 minutes on chou moellier.

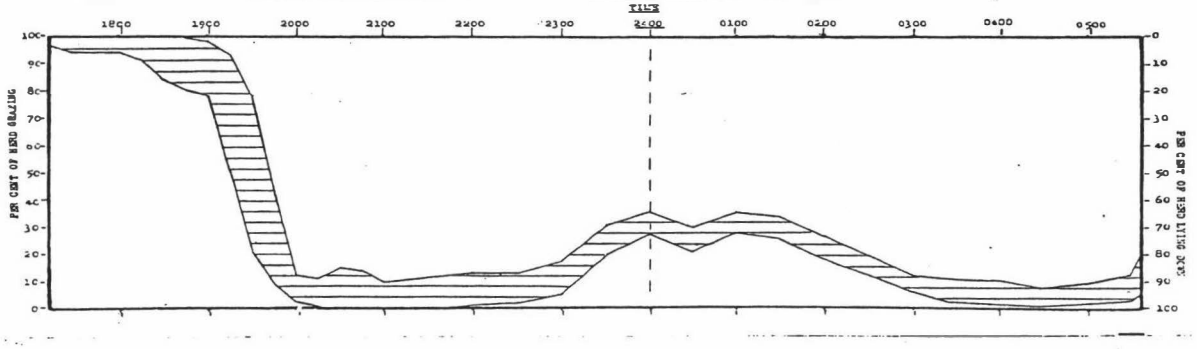
Weather: Sunny, calm, becoming very hot by 1230 hrs. Max. temp. 76.0F

Behaviour: Gr. 5.66 hrs (61.3%); St. 1.62 hrs (17.5%) Lying 1.96 hrs (21.2%); Total time 9.24 hrs.

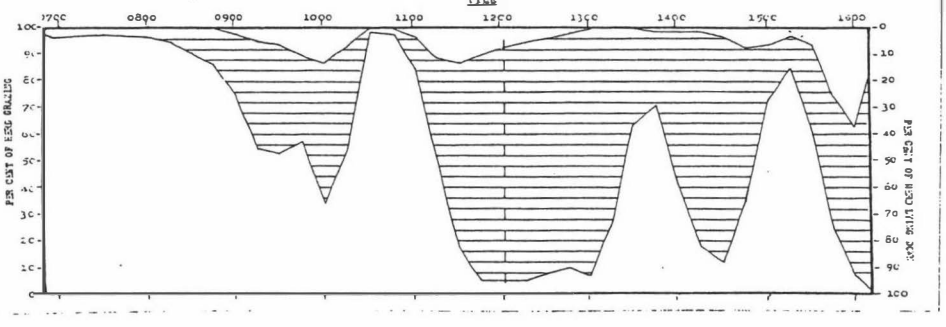
1 6 HERD BEHAVIOR NIGHT-PADDOCK (F)



1 7 HERD BEHAVIOR NIGHT-PADDOCK (J)



1 8 HERD BEHAVIOR DAY-PADDOCK (J)



6) Mar 10 - 11; Pad 3 (5.00 acres); 35 Friesians.

Feed: Pasture 2 - 6" high of ryegrass and clover, somewhat uneven. Classed as good. 890Lbs D.M./acre grazeable pasture. All cows had 40 minutes on chou moellier after milking

Weather: Cloudy and mild with light westerly breeze. Min. temp. 59.5F (Air) 54.2F (Grass) Sunset 1852 hrs. Sunrise 1812 hrs.

Behaviour: Gr. 4.00 hrs (33.3%); St. .69 hrs (5.8%) Lying 7.31 hrs (60.9%); Total time 12.00 hrs.

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7) Mar 18 - 19; Pad 12; 64 Jerseys.

Feed; Pasture 1- 2½" high of ryegrass and clover. Very dry, classed as average. Approx. 14 cwt. ensilage fed in the paddock.

Weather: Clear, calm, moderate temperature, heavy dew. Min. temp. 51.1F (Air) 40.8F (Grass) Sunset 1838 hrs.

Behaviour: Gr. 2,64 hrs (21.3%); St. 1.47 hrs (11.8%); Lying 8.31 hrs (66.9%); Total time 12.42 hrs.

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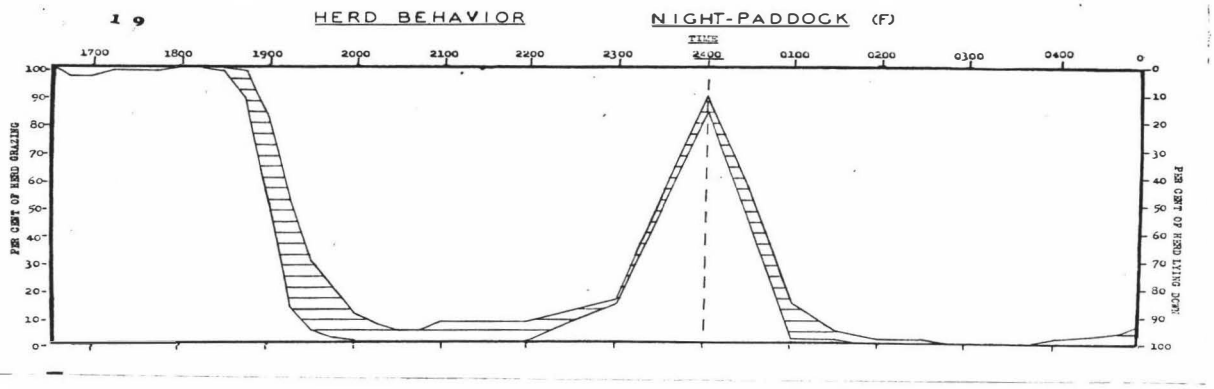
8) Mar 20; Pad 23; 63 Jerseys.

Feed: Pasture 1½ - 3½" high, of cocksfoot, ryegrass and clover Fairly dry, classed as average. 660lbs. D.M./acre grazeable pasture. Approx. 15cwt. ensilage fed at 1010 hrs.

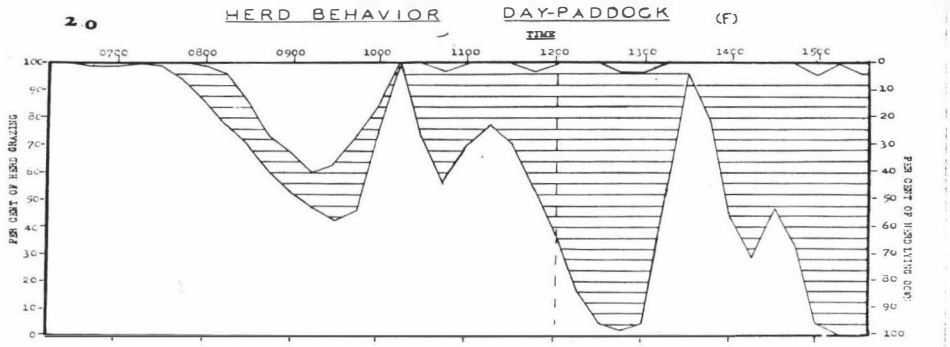
Weather: Sunny, becoming hot by 1130 hrs. Moderate N - W win Max. temp. 72.8F.

Behaviour: Gr. 4.96 hrs (53.3%); St. 3.84 hrs (41.2%); Lying .51 hrs (5.5%); Total time 9.31 hrs.

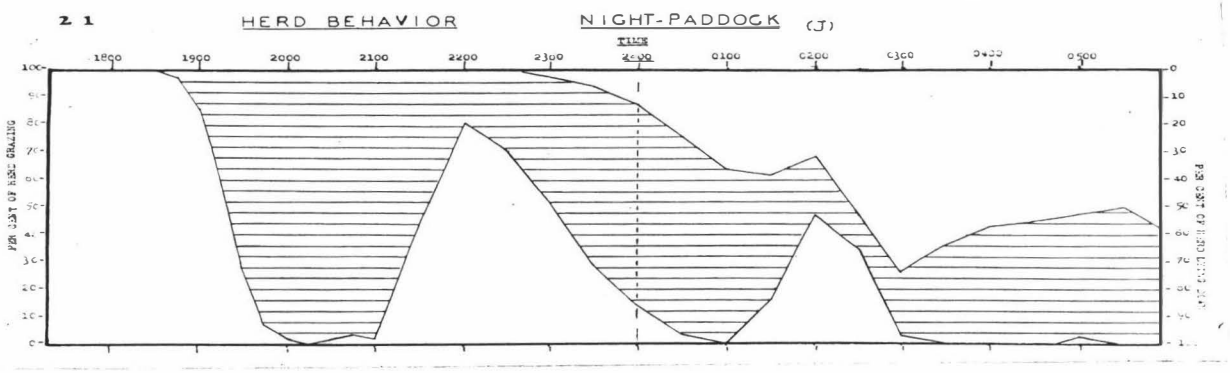
19 HERD BEHAVIOR NIGHT-PADDOCK (F)



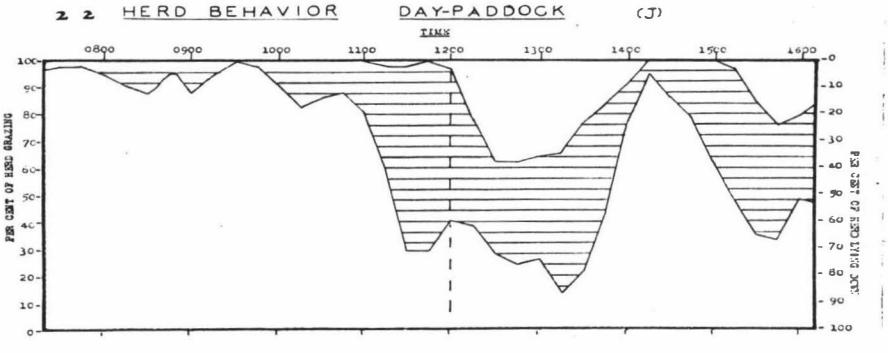
20 HERD BEHAVIOR DAY-PADDOCK (F)



21 HERD BEHAVIOR NIGHT-PADDOCK (J)



22 HERD BEHAVIOR DAY-PADDOCK (J)



Mar 29 - 30; Pad 3 (5.00 acres); 35 Friesians.

Feed: Pasture 1½ - 6" high of ryegrass and clover. Uneven, fairly dry, classed as everage. 560lbs.D.M./acre grazeable pasture. Approx. 15cwt. ensilage fed in paddock.

Weather: Cloudy and mild with light dew. Min. temp. 47.8F (Air) 37.6F (Grass). Sunset 1820 hrs.

Behaviour: Gr. 3.29 hrs (26.7%); St. .76hrs (6.2%); Lying 8.29 hrs (67.1%); Total time 12.34 hrs.

Mar 31; Pad 4 (6.24 acres); 35 Friesians.

Feed; Pasture 2½ - 3½" high, of ryegrass with considerable amount of clover. Patchy, classed as good. 500lbs. D.M./acre grazeable pasture. Approx. 9cwt. ensilage fed at 1000 hrs.

Weather: Sunny, becoming hot at 1200 hrs. Light N - W breeze Max. temp. 71.8F

Behaviour: Gr. 5.23 hrs (56.1%); St. 3.57 hrs (38.3%); Lying .53 hrs (5.6%); Total time 9.33 hrs.

Apr. 14 - 15; Pad 27 D.R.I. (1.88 acres); 29 Jerseys.

Feed: Pasture 2 - 3" high of ryegrass, cocksfoot and clover. Fairly dry, classed as average. 470lbs. D.M./acre of grazeable pasture.

Weather: Overcast, with rain at 1745 and very strong wind of gale force, which spent itself by 2330 hrs. Little shelter available for the animals which stood about in a group. Min. temp. 47.8F (Air) 45.4F (Grass) Sunset at 1754 hrs.

Behaviour: Gr. 3.88 hrs (30.8%); St. 5.70hrs (45.3%); Lying 3.00 hrs (23.8%); Total time 12.58 hrs.

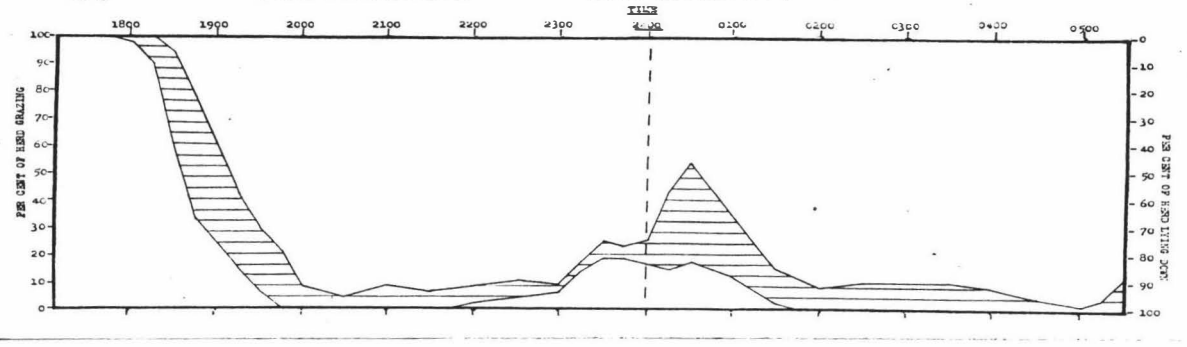
Apr 18; pad 30 D.R.I. (1.9 acres); 29 Jerseys.

Feed: Pasture 1½ - 2" high of ryegrass and clover. Uneven, classed as poor. 230lbs. D.M./acre of grazeable pasture. 175lbs. good hay fed at 0905 hrs.

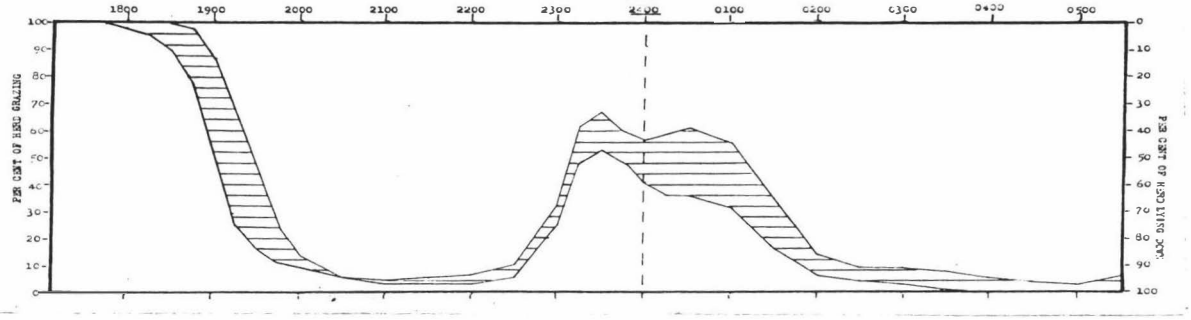
Weather: Sunny, moderate N - W breeze. Max. temp. 67.1F

Behaviour: Gr. 5.72 hrs (64.8%); St. 2.36 hrs (26.7%); Lying .75 hrs (8.5%); Total time 8.83hrs.

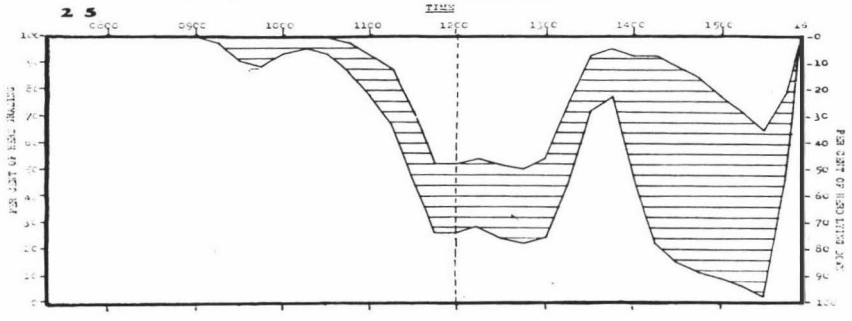
23 HERD BEHAVIOR NIGHT-PADDOCK (F)



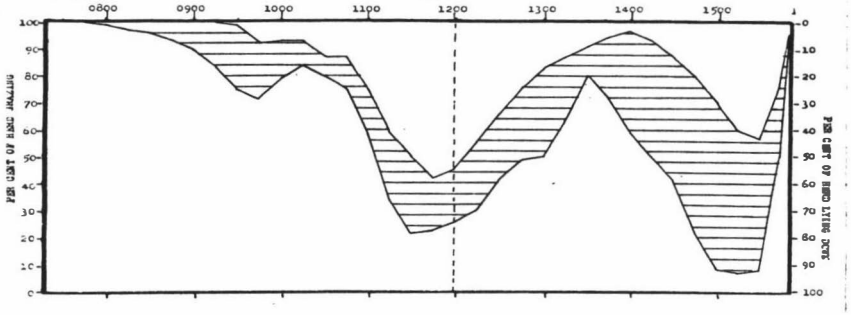
24 HERD BEHAVIOR NIGHT-PADDOCK (J)



25 HERD BEHAVIOR DAY-PADDOCK (F)



26 HERD BEHAVIOR DAY-PADDOCK (J)



COMBINED HERD:

) April 28 - 29; Pad 10 (5.00 acres); 24 Friesians.

Feed; Pasture 2 - 3" high, of ryegrass, cocksfoot, and white clover. Uneven, classed as fair cow pasture. 250lbs. of good hay in the paddock. 410lbs. D.M./acre grazeable pasture.

Weather: Clear sky, no wind, light dew, moon half full. Sunset at 1733 hrs. Min. temp. 49.7F (Air) 44.2F (Grass)

Behaviour: Gr. 1.77 hrs (14.3%); St. 1.41 hrs (11.4%); Lying 9.16 hrs (74.2%); Total time 12.34 hrs.

) April 28 - 29; Pad 10 (5.00 acres); 40 Jerseys.
Conditions similar to (23) above.
Behaviour: Gr. 2.94 hrs (23.8%); St. 1.21 hrs (9.8%); Lying 8.19 hrs (66.4%); Total time 12.34 hrs.

) May 2; Pad 17 (7.84 acres); 23 Friesians.

Feed; Pasture 3 - 4" high, of ryegrass and white clover. Very even; classed as good cow pasture. 440lbs. D.M./acre grazeable pasture. 150lbs. hay fed at 0950 hrs.

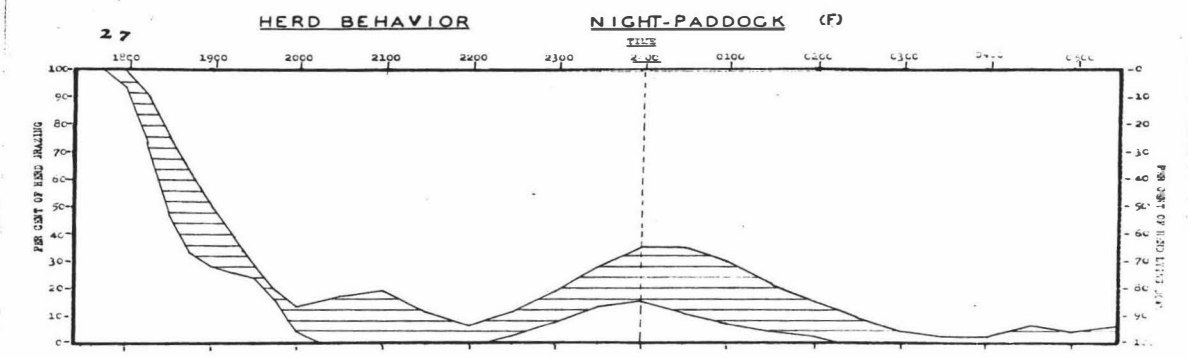
Weather: Fine, slightly overcast, mild, with light easterly wind. Max. temp. 62.8F.

Behaviour: Gr. 5.10 hrs (60.0%); St. 2.11 hrs (24.8%); Lying 1.29 hrs (15.2%); Total time 8.50 hrs.

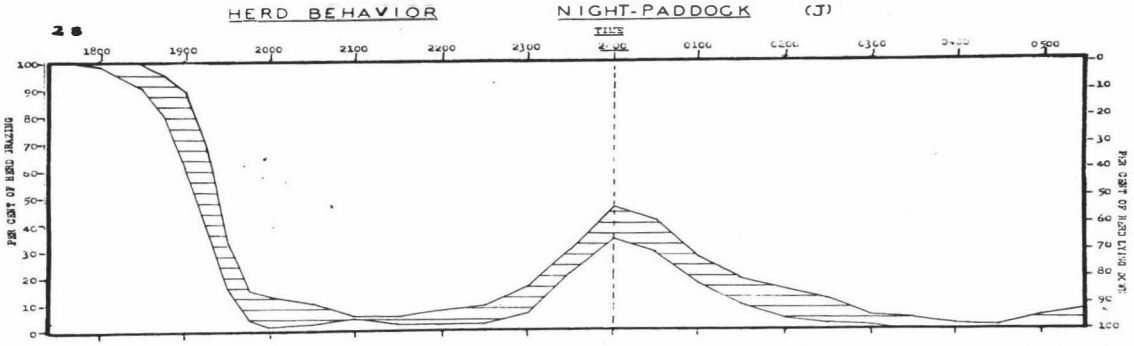
May 2; Pad 17 (7.84 acres); 38 Jerseys.
Conditions similar to (25) above.

Behaviour: Gr. 5.03 hrs (59.2%); St. 1.95 hrs (23.0%); Lying 1.51 hrs (17.8%); Total time 8.49 hrs.

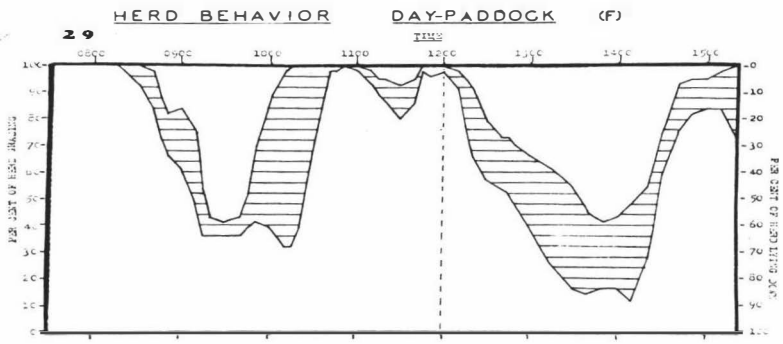
27


HERD BEHAVIOR
NIGHT-PADDOCK (F)
TIME
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

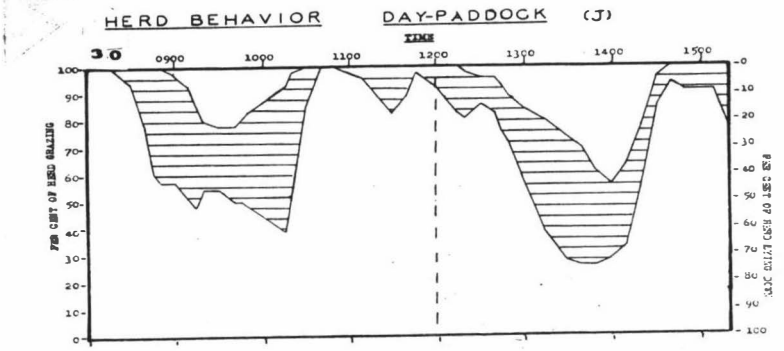
28


HERD BEHAVIOR
NIGHT-PADDOCK (J)
TIME
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

29


HERD BEHAVIOR
DAY-PADDOCK (F)
TIME
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

30


HERD BEHAVIOR
DAY-PADDOCK (J)
TIME
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

COMBINED HERD:

7) May 12 - 13; Pad 4 (6.24 acres); 23 Friesians.
Feed: Pasture 1½ - 3" high, of ryegrass and white clover; Patchy, classed as average. 375lbs. D.M./acre grazeable pasture. 250lbs. average quality hay in the paddock.
Weather: Clear sky, calm, moderate dew, moon in last quarter Sunset at 1716 hrs. Min. temp. 44.0F (Air) 34.1F (Grass).
Behaviour: Gr. 1.51 hrs (12.5%); St. 1.46 hrs (12.1%); Lying 9.13 hrs (75.5%); Total time 12.09 hrs.

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3) May 12 - 13; Pad 4 (6.24 acres); 41 Jerseys.
Conditions similar to (27) above.
Behaviour: Gr. 2.23 hrs (18.4%); St. .97 hrs (8.0%); Lying 8.88 hrs (73.4%); Total time 12.09 hrs.

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9) May 17; Pad 4 (6.24 acres); 22 Friesians.
Feed: Pasture 1½ - 2" high, of ryegrass and white clover. Patchy, classed as poor cow pasture. 220lbs. D.M./acre of grazeable pasture. Approx. 10 cwt. of chou moellier carted out and fed at 1030 hrs. 150lbs. average quality hay fed at 1140 hrs.
Weather: Overcast, cold easterly wind of moderate force. Max. temp. 56.3F.
Behaviour: Gr. 4.97 hrs (63.4%); St. 1.45 hrs (18.5%); Lying 1.42 hrs (18.1%); Total time 7.84 hrs.

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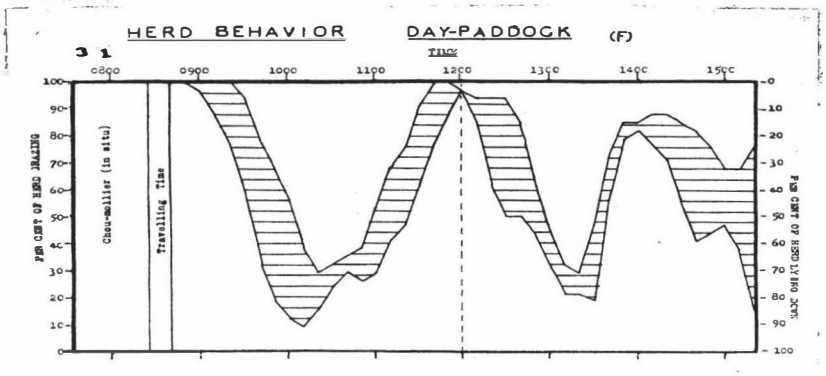
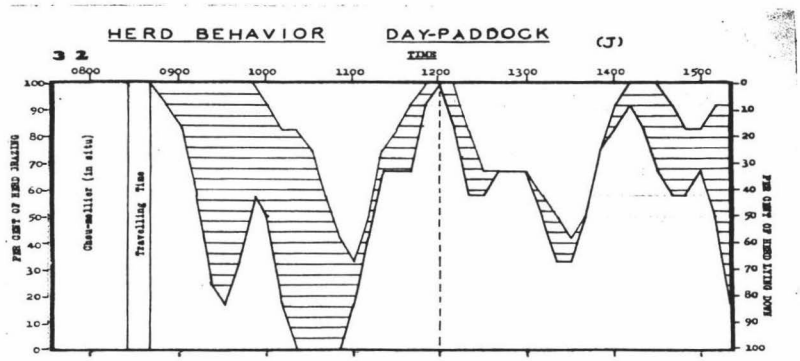
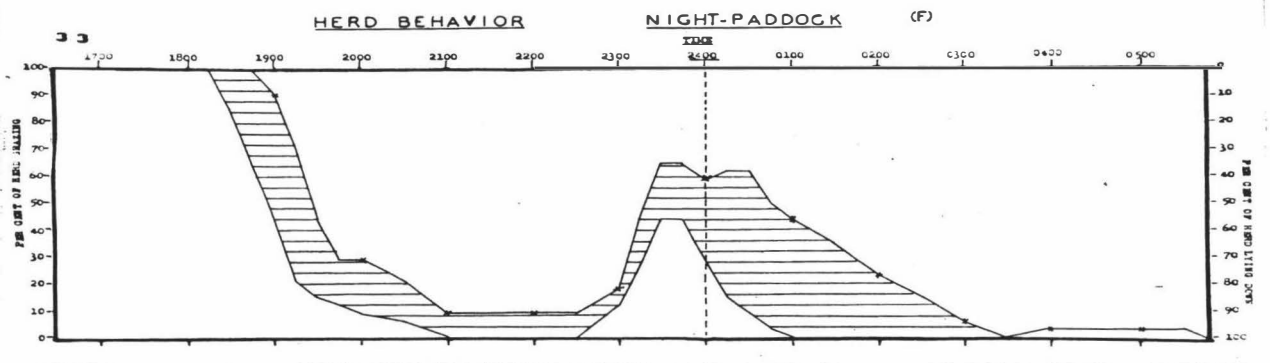
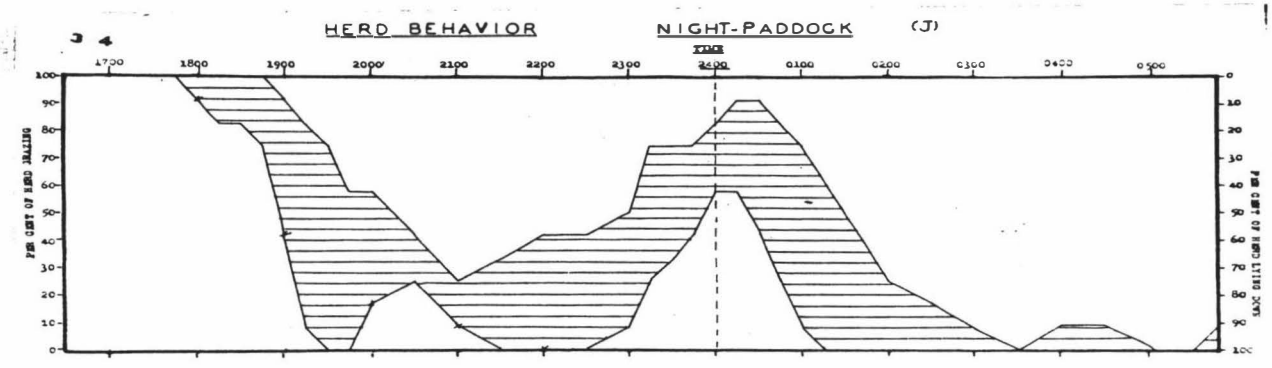
0) May 17; Pad 4 (6.24 acres); 23 Jerseys.
Conditions similar to (29) above.
Behaviour: Gr. 5.62 hrs (71.7%); St. 1.56 hrs (19.9%); Lying .66 hrs (8.4%); Total time 7.84 hrs.
Jerseys in particular preferred to stand or lie down near plantation, and sheltered from the wind.


HERD BEHAVIOR
DAY-PADDOCK
(F)
31
TIME
0800
0900
1000
1100
1200
1300
1400
1500
Chew-walker (in situ)
Travelling Time
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


HERD BEHAVIOR
DAY-PADDOCK
(J)
32
TIME
0800
0900
1000
1100
1200
1300
1400
1500
Chew-walker (in situ)
Travelling Time
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


HERD BEHAVIOR
NIGHT-PADDOCK
(F)
33
TIME
1700
1800
1900
2000
2100
2200
2300
2400
0100
0200
0300
0400
0500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


HERD BEHAVIOR
NIGHT-PADDOCK
(J)
34
TIME
1700
1800
1900
2000
2100
2200
2300
2400
0100
0200
0300
0400
0500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

COMBINED HERD:

May 31; Pad 19 (5.74 acres); 17 Friesians.

Feed: Pasture 1½ - 3" high, of ryegrass, cocksfoot and white clover. Classed as average cow pasture. 430lbs. D.M./acre of grazeable pasture. All cows had 60 minutes on chou moellier before entering the paddock. 100lbs. good hay fed in paddock at 0840 hrs.

Weather: Overcast and dull after a heavy dew and slight frost. A little rain at 0905 hrs, then weather improved until bright sunshine at 1410. Temperature mild. Max. temp. 52.5F.

Behaviour: Gr. 4.21 hrs (56.0%); St. 1.49 hrs (19.9%); Lying 1.80 hrs (24.0%); Total time 7.50 hrs.

May 31; Pad 19 (5.74 acres); 6 Jerseys.

Conditions same as (31) above.

Behaviour: Gr. 4.33 hrs (57.7%); St. 1.88 hrs (25.1%); Lying 1.29 hrs (17.2%); Total time 7.50 hrs.

May 31 - June 1; Pad 11 (7.10 acres); 17 Friesians.

Feed: Pasture 1½ - 2½" high, of perennial ryegrass and quite a lot of white clover. Patchy in places, classed as average. 400lbs. D.M./acre of grazeable pasture. Approx. 3 cwt. chou moellier and 150lbs. hay in the paddock.

Weather: Clear sky, calm, full moon, frost. Min. temp. 30.C (Air) 22.OF (Grass). Sunset 1701 hrs.

Behaviour: Gr. 2.86 hrs (21.6%); St. 2,00 hrs (15.1%); Lying 8.39 hrs (63.3%); Total time 13.25 hrs.

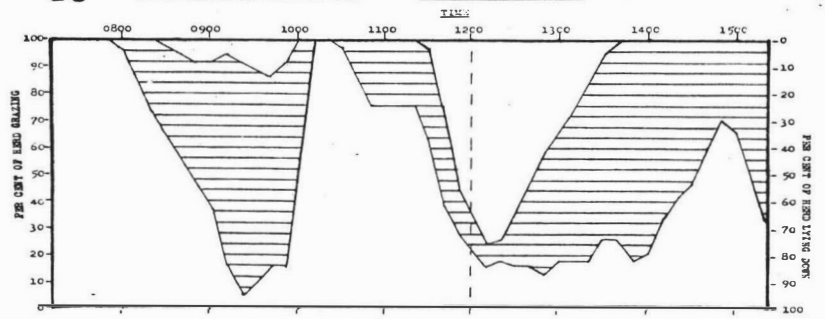
May 31 - June 1: Pad 11 (7.10 acres); 6 Jerseys.

Conditions same as (33) above.

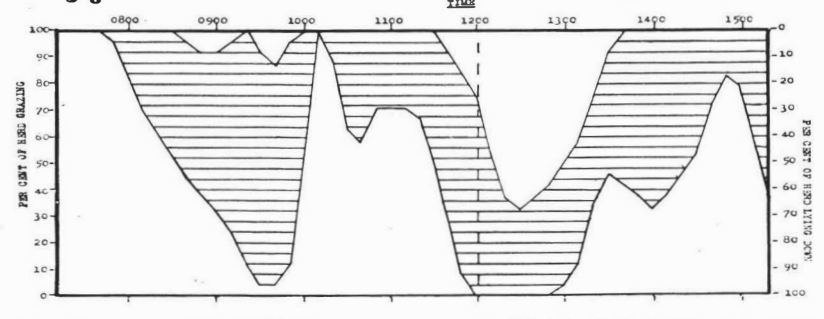
Behaviour: Gr. 3.19 hrs (24.1%); St. 3.38 hrs (25.5%); Lying 6.68 hrs (50.4%); Total time 13.25 hrs.

Both breeds, when not grazing, remained under some trees to keep out of a heavy frost.

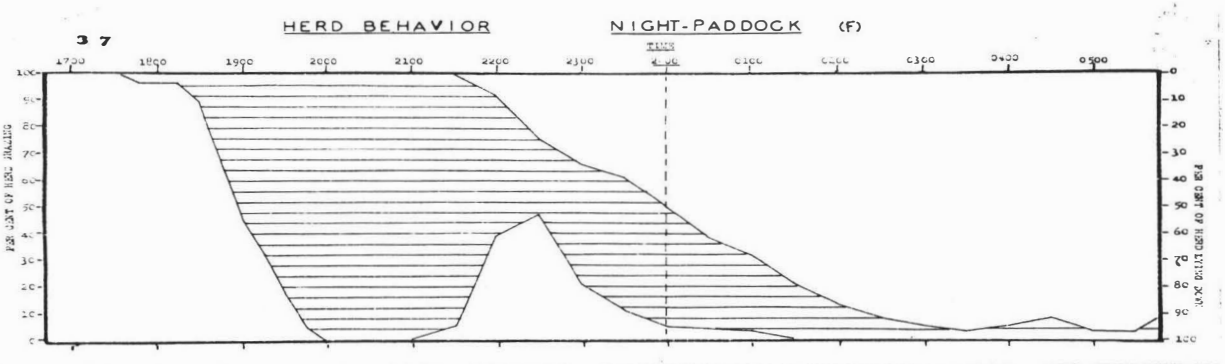
35 HERD BEHAVIOR DAY-PADDOCK (F)



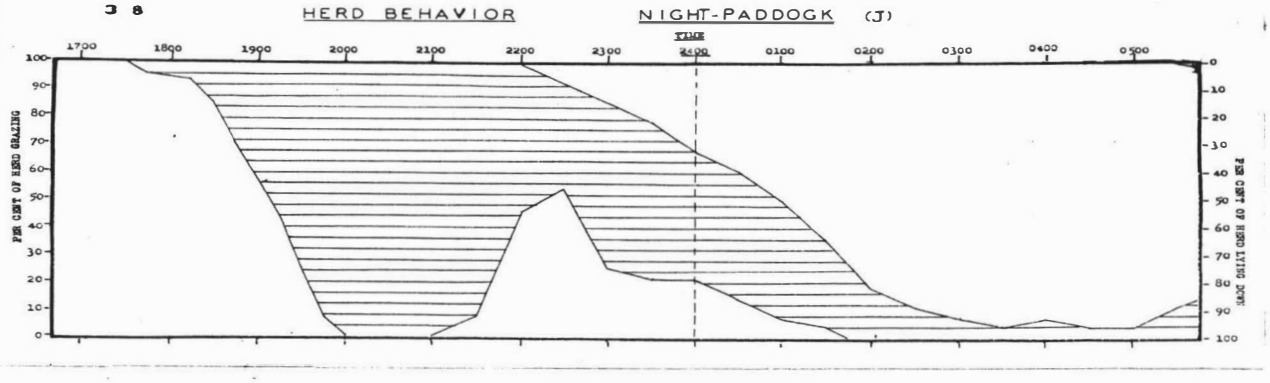
36 HERD BEHAVIOR DAY-PADDOCK (J)



37 HERD BEHAVIOR NIGHT-PADDOCK (F)



38 HERD BEHAVIOR NIGHT-PADDOCK (J)



COMBINED HERD:

June 27; Pad 3 (5.00 acres); 19 Friesians.

Feed: Autumn saved pasture. 8 - 10" high, of ryegrass and cocksfoot, with some clover. Classed as excellent pasture. 300lbs. of good hay fed at 1000 hrs.

Weather: Overcast, moderate to cool temperature, with light rain at 1210 hrs, becoming very heavy and continuous by 1230 hr Max. temp. 50.5F.

Behaviour: Gr. 4.10 hrs (50.0%); St. 3.08 hrs (37.7%); Lying 1.01 hrs (12.3%); Total time 8.18 hrs.

June 27; Pad 3 (5.00 acres); 12 Jerseys.

Conditions same as (35) above.

Behaviour: Gr. 3.75 hrs (45.8%); St. 3.54 (43.3%); Lying .88 hrs (10.8%); Total time 8.18 hrs.

All animals disturbed by student demonstration at 0815 hrs.

June 27 - 28; Pad 24; 19 Friesians.

Feed: Pasture 2 - 5" high, of ryegrass, cocksfoot and white clover. Patchy, classed as average. Approx. 12 cwt. chou moellier and 300 lbs. average quality hay fed in paddock.

Weather: Overcast, moderate to cool temperature. Very heavy rain at 1900 hrs, continuing until 2200 hrs. Min. temp. 40.0F (Air) 40.0F (Grass) Sunset at 1700 hrs.

Behaviour: Gr. 2.89 hrs (22.0%); St. 4.38 hrs (33.5%); Lying 5.82 hrs (44.5%); Total time 13.09 hrs.

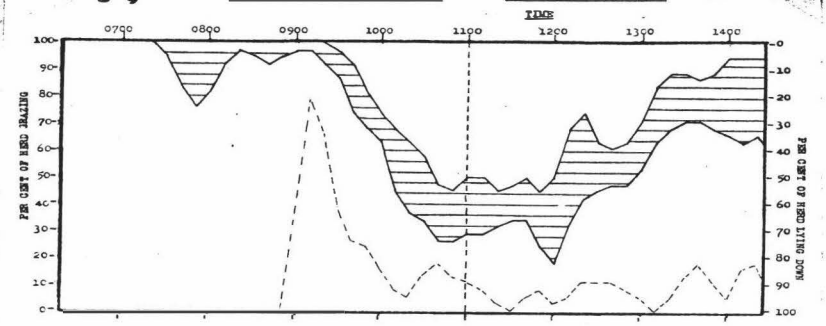
June 27-28; Pad 24; 14 Jerseys.

Conditions same as above.

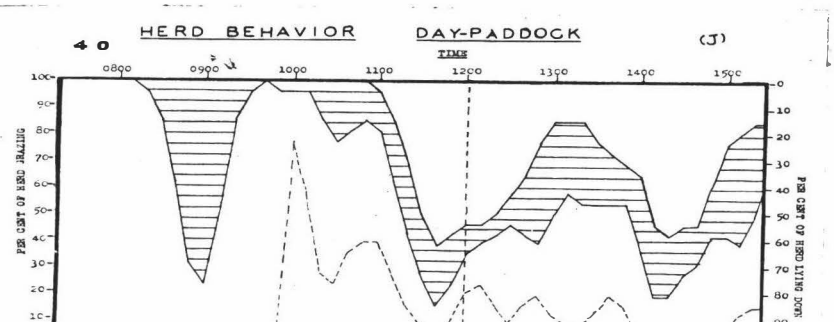
Behaviour: Gr. 3.28 hrs (25.1%); St. 4.77 hrs (36.4%); Lying 5.04 hrs (38.5%); Total time 13.09 hrs.

Notice (Graphs 37 and 38) the effect of heavy rain on herd behaviour.

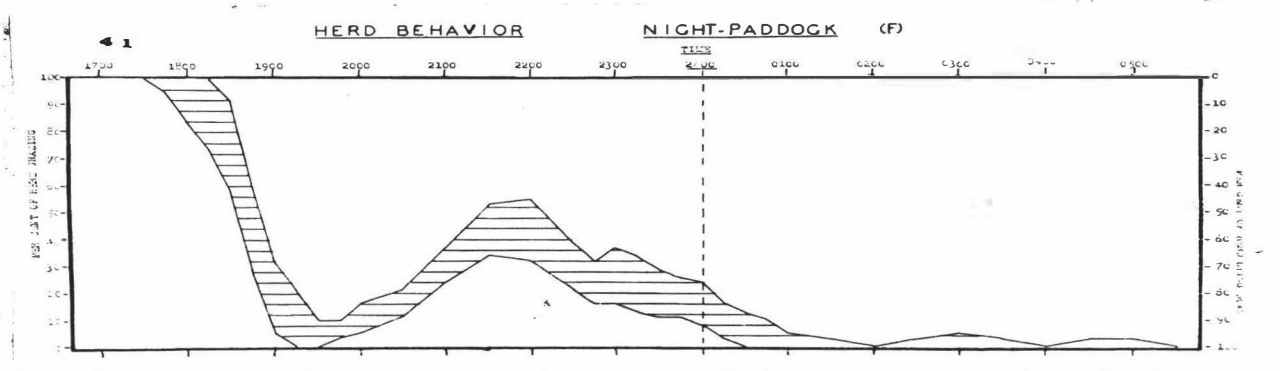
39 HERD BEHAVIOR DAY-PADDOCK (F)



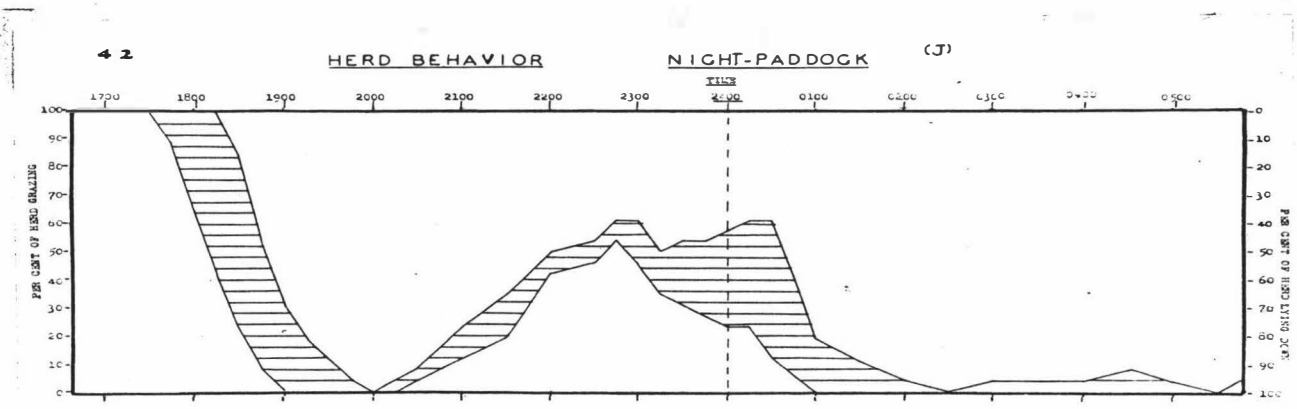
40 HERD BEHAVIOR DAY-PADDOCK (J)



41 HERD BEHAVIOR NIGHT-PADDOCK (F)



42 HERD BEHAVIOR NIGHT-PADDOCK (J)



COMBINED HERD:

) July 1; Pad 23; 19 Friesians.

Feed: Autumn saved pasture 8 - 9" high, of ryegrass, cocksfoo and clover. Classed as excellent. 1020lbs. D.M./acre of herbage on the fresh pasture. 300lbs. good hay fed at 0950 hr

Weather: Fine and sunny, with light N - W wind and cool temperature. Max. temp. 48.5F

Behaviour: Gr. 5.32 hrs (65.7%);: St. 1.26 hrs (15.6%); Lying 1.52 hrs (18.8%); Total time 8.10 hrs. Of 5.32 hrs grazing, .68 hrs (or 13% of grazing time) were spent eating hay (as shown by the dotted line in graphs 39 and 40)

) July 1; Pad 23; 13 Jerseys.

Conditions same as (39) above.

Behaviour: Gr. 4.83 hrs (59.6%); St. 1.67 hrs (20.6%) Lying 1.59 hrs (19.7%); Total time 8.10 hrs. Of 4.83 hrs grazing, .83 hrs (or 17% of grazing time) were spent eating hay.

July 1 - 2; Pad 24; 19 Friesians.

Feed: Pasture 2 - 4" high, of ryegrass, cocksfoot and white clover. Somewhat uneven, classed as average. Approx. 10cwt. chou moellier and 300lbs. hay fed in the paddock.

Weather: Clear sky, light easterly wind, full moon, and heavy frost. Min. temp. 31.0F (Air) 22.0F (Grass) Sunset at 1701

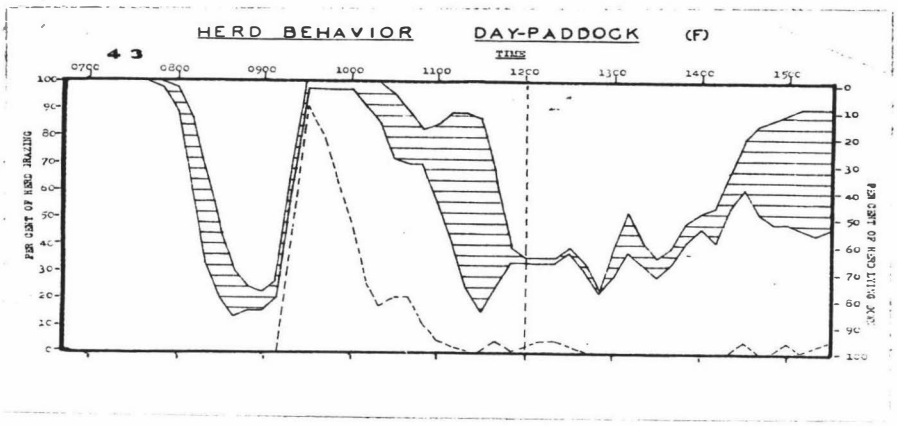
Behaviour: Gr. 2.51 hrs (19.2%); St. 1.36 hrs (10.4%); Lying 9.21 hrs (70.4%); Total time 13.09 hrs.

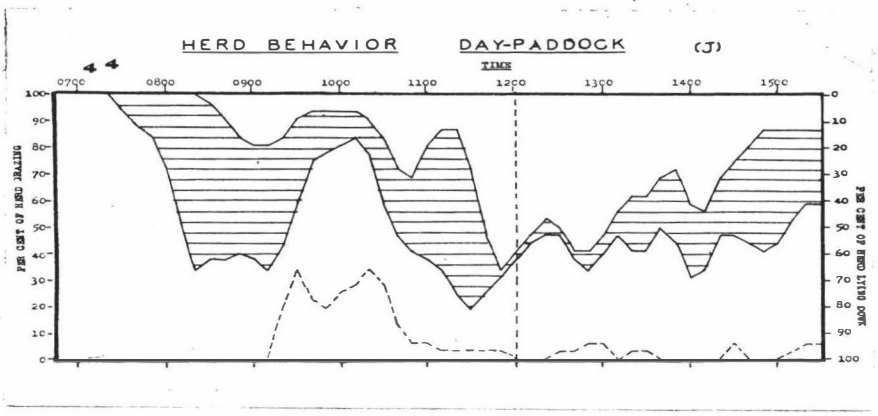
July 1 - 2: Pad 24; 13 Jerseys.

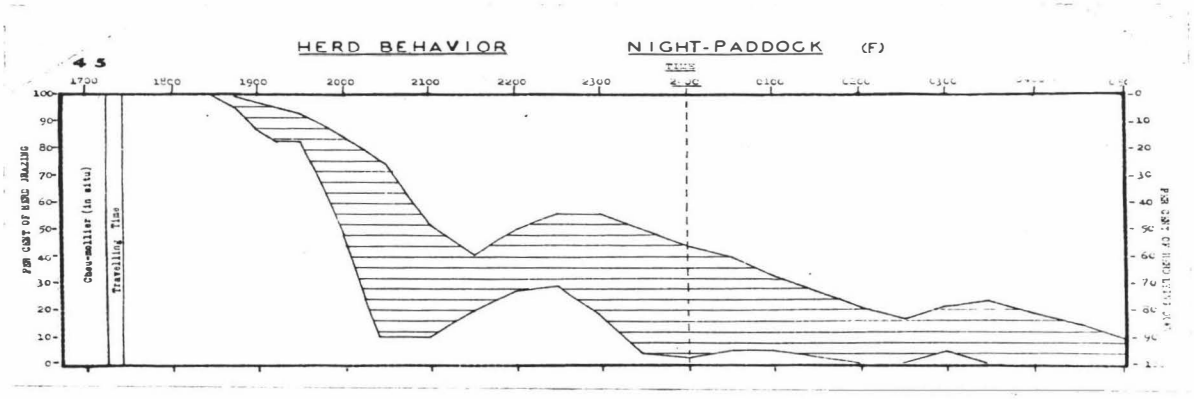
Conditions same as (41) above.

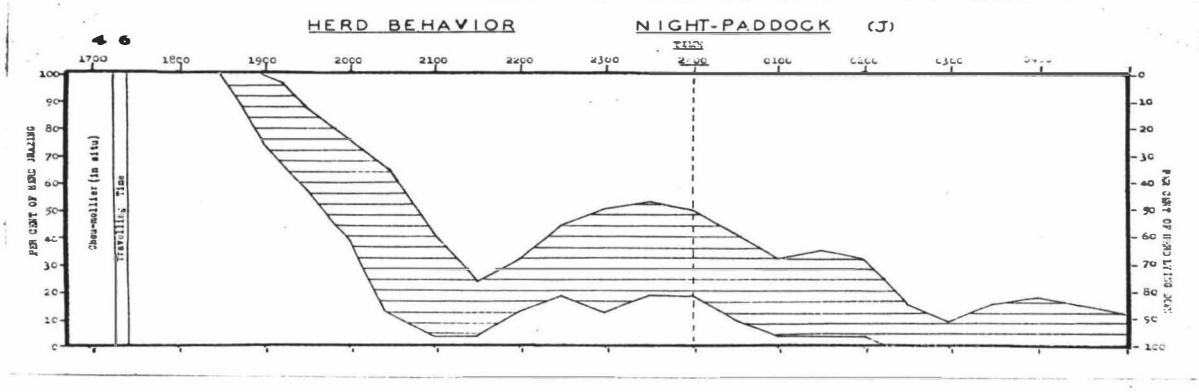
Behaviour: Gr. 2.61 hrs (20.0%); St. 1.81 hrs (13.8%); Lying 8.66 hrs (66.2%); Total time 13.09 hrs.

All cows endeavoured to shelter from the heavy frost when resting. (c.f. graphs 33 and 34).


HERD BEHAVIOR
DAY-PADDOCK
(F)
43
TIME
0700
0800
0900
1000
1100
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


HERD BEHAVIOR
DAY-PADDOCK
(J)
44
TIME
0700
0800
0900
1000
1100
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


HERD BEHAVIOR
NIGHT-PADDOCK
(F)
45
TIME
1700
1800
1900
2000
2100
2200
2300
0100
0300
Chew-cudder (in situ)
Travelling Time
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


HERD BEHAVIOR
NIGHT-PADDOCK
(J)
46
TIME
1700
1800
1900
2000
2100
2200
2300
0100
0300
Chew-cudder (in situ)
Travelling Time
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

COMBINED HERD:

July 25; Pad 21 (5.65 acres); 23 Friesians.

Feed: Autumn saved pasture 9 - 10" high, of ryegrass, cocksfoot and white clover. Classed as excellent cow pasture. 810lbs. D.M./acre of herbage on the fresh pasture. 200lbs. of good hay fed at 0910 hrs.

Weather: Fine and sunny, light N-W wind, Max. temp. 52.5F.

Behaviour: Gr. 4.70 hrs (53.7%); St. 1.42 hrs (16.2%); Lying 2.63 hrs (30.1%); Total time 8.75 hrs. Of 4.70 hrs grazing, .70 hrs (15% of the grazing time) were spent eating hay as shown by the dotted line on graphs 43 and 44.

July 25; Pad 21 (5.65 acres); 16 Jerseys.

Conditions same as (43) above.

Behaviour: Gr. 4.58 hrs (52.3%); St. 2.21 hrs (25.3%); Lying 1.96 hrs (22.4%); Total time 8.75 hrs. .46 hrs, (10% of the grazing time) were spent eating hay.

July 25 - 26; Pad 25 (3.57 acres); 24 Friesians.

Feed: Pasture 1 - 1½" high, of ryegrass and clover. Classed as poor cow pasture. Approx. 13 cwt. mangolds and 400lbs. of average quality hay fed in the paddock. All cows on chou moellier for 30 minutes after milking.

Weather: Clear sky, light breeze dying away, frost. Min. temp. 34.5F (Air) 25.0F (Grass). Sunset at 1718 hrs.

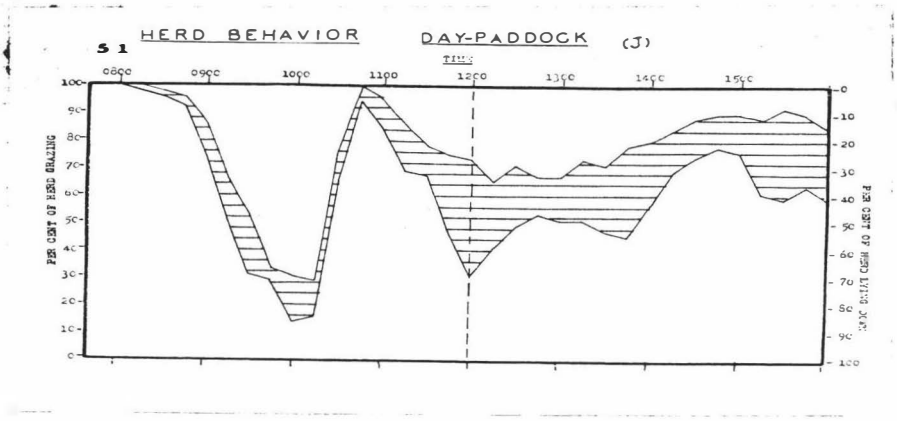
Behaviour: Gr. 3.38 hrs (28.0%); St. 2.84 hrs (23.5%); Lying 5.86 hrs (48.5%); Total time 12.08 hrs.

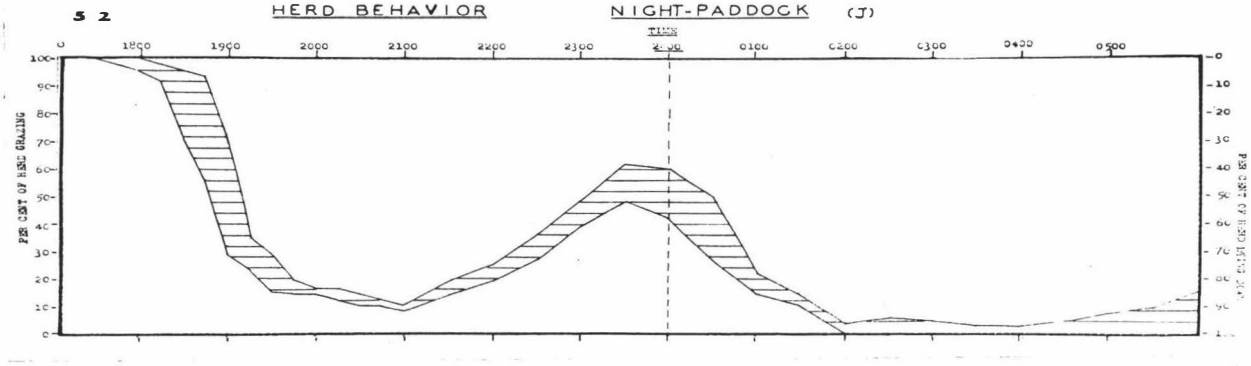
July 25 - 26; Pad 25 (3.57 acres); 17 Jerseys.

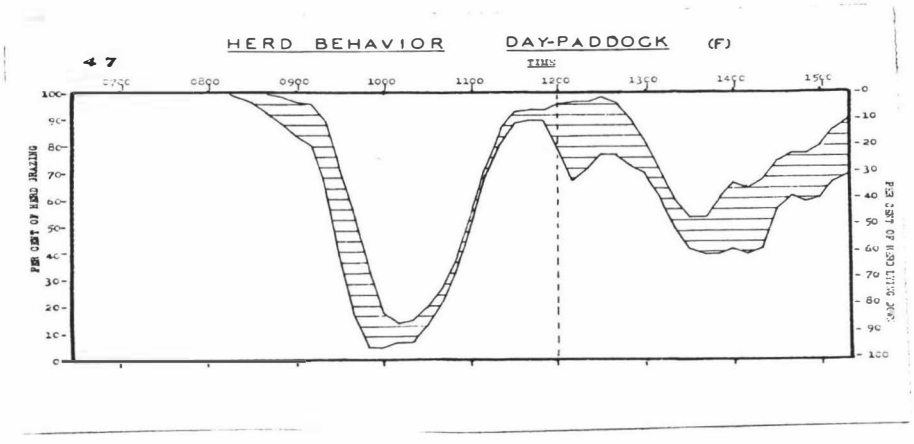
Conditions same as (45) above.

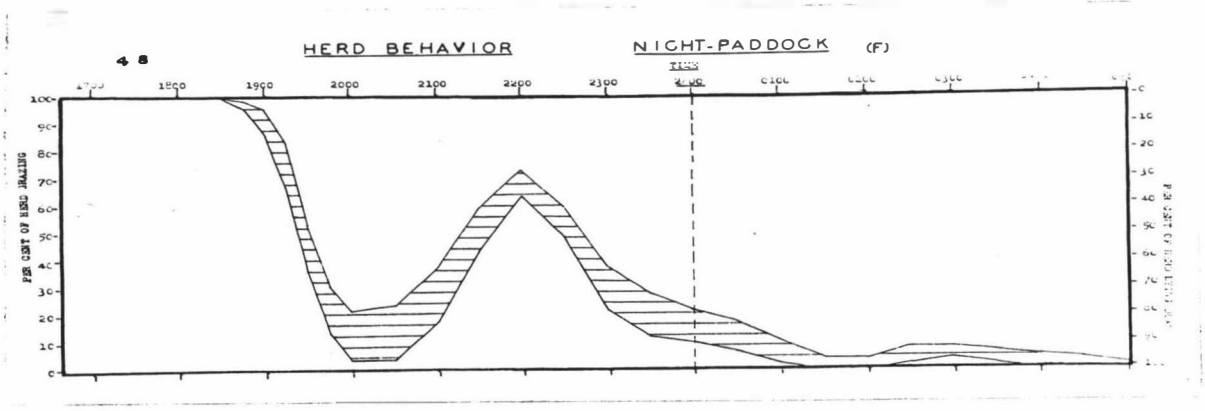
Behaviour: Gr. 3.04 hrs (25.2%); St. 2.81 hrs (23.3%); Lying 6.23 hrs (51.6%); Total time 12.08 hrs.

All animals sheltered under some trees from the frost when not grazing.


51
HERD BEHAVIOR
DAY-PADDOCK
(J)
TIME
0800
0900
1000
1100
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


52
HERD BEHAVIOR
NIGHT-PADDOCK
(J)
TIME
1800
1900
2000
2100
2200
2300
0100
0200
0300
0400
0500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


47
HERD BEHAVIOR
DAY-PADDOCK
(F)
TIME
0800
0900
1000
1100
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


48
HERD BEHAVIOR
NIGHT-PADDOCK
(F)
TIME
1800
1900
2000
2100
2200
2300
PER CENT OF HERD GRAZING

1) Aug. 14; Pad 11 (7.10 acres); 49 Jerseys.
Feed: Pasture 1½ - 3" high, of ryegrass, cocksfoot and clover. Uneven, classed as average. Approx. 15 cwt. ensilage and 150lbs. of hay fed at 1015 hrs.
Weather: Overcast, becoming fine by 1130 hrs. Max. temp. 57.8F.
Behaviour: Gr. 5:64 hrs (67.7%); St. 1.03 hrs (12.4%); Lying 1.66 hrs (19.9%); Total time 8.33 hrs.

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2) Aug 19 - 15; Pad 27 (3.36 acres); 52 Jerseys.
Feed: Pasture 1½ - 2½" high. of ryegrass and clover. Classed as poor. Approx. 18 cwt. ensilage and 300lbs. of hay fed in the paddock.
Weather: Cloudy, light Northerly wind, mild. Min. temp. 44.6 (Air) 38.0F (Grass) Sunset at 1737 hrs.
Behaviour: Gr. 2.90 hrs (22.6%); St. 1.14 hrs (8.9%); Lying 8.79 hrs (68.5%); Total time 12.83 hrs.

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7) Aug 24; Pad 11 (7.10 acres); 35 Friesians.
Feed: Pasture 2 - 3" high of ryegrass, cocksfoot and clover. Classed as average. 331lbs. D.M./acre of grazeable pasture. Approx 12 cwt. chou moellier and 200lbs. good hay fed out the previous day.
Weather: Fine and sunny, light easterly wind. Max. temp.61.3
Behaviour: Gr. 6.00 hrs (66.1%); St. 1.08 hrs (11.9%); Lying 2.00 hrs (22.0%); Total time 9.08 hrs.

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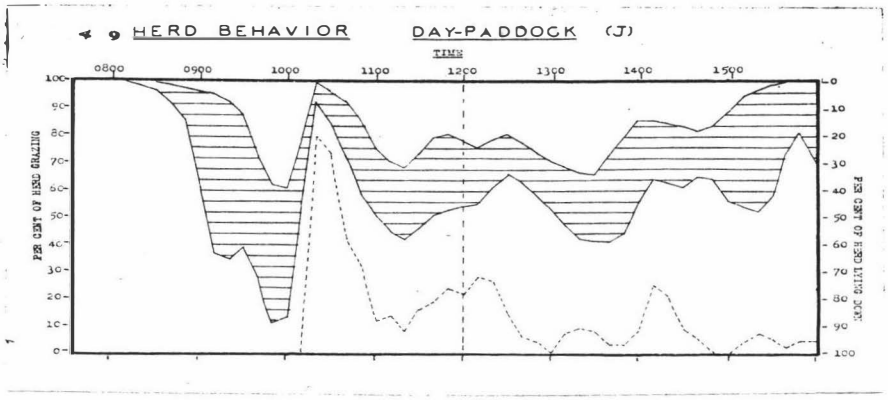
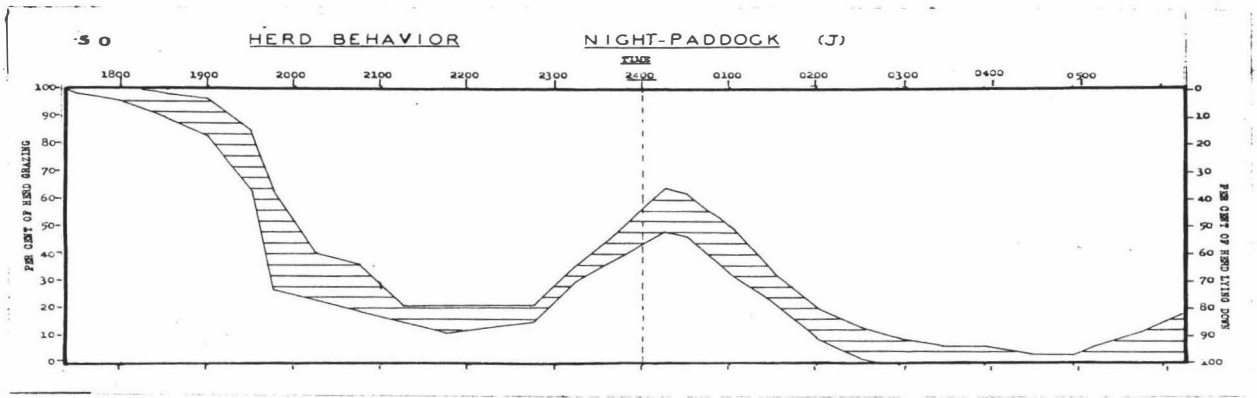
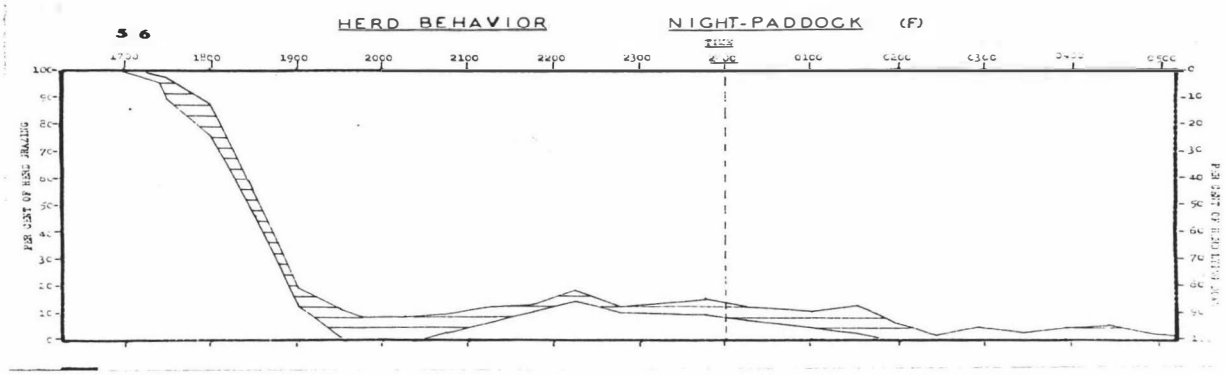
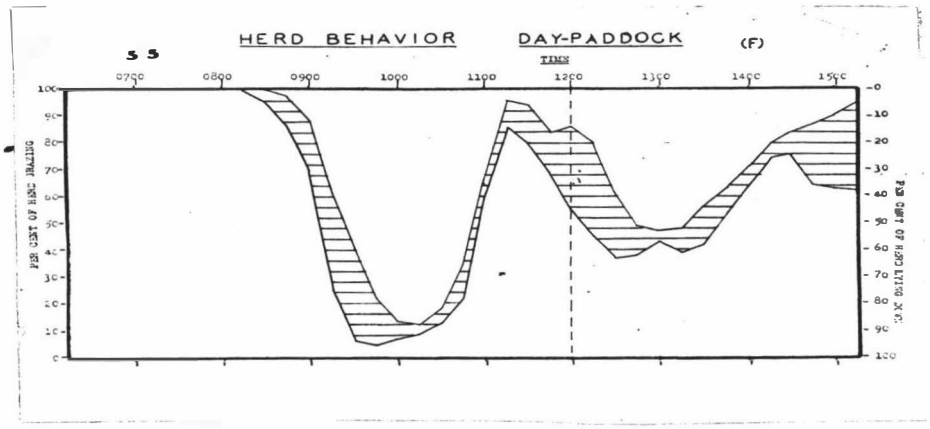
8) Aug 24 - 25; Pad 5 (5.00 acres); 35 Friesians.
Feed: Pasture 2 - 3" high, of ryegrass, cocksfoot and clover. Classed as average. Approx. 12 cwt. of ensilage, 8cwt. mangold and 150lbs. of good hay fed in the paddock.
Weather: Clear, later clouding over with a little rain at 2345 hrs. Min. temp. 44.6F (Air) 34.8F(Grass) Sunset at 1747 hrs
Behaviour: Gr. 3.73 hrs (30.3%); St. 1.04 hrs (8.4%); Lying 7.56 hrs (61.3%); Total time 12.33 hrs.


49 HERD BEHAVIOR DAY-PADDOCK (J)
TIME
0800 0900 1000 1100 1200 1300 1400 1500
PER CENT OF HERD GRAZING
PER CENT OF HERD RESTING OR DRINKING


50 HERD BEHAVIOR NIGHT-PADDOCK (J)
TIME
1800 1900 2000 2100 2200 2300 2400 0100 0200 0300 0400 0500
PER CENT OF HERD GRAZING
PER CENT OF HERD RESTING OR DRINKING


56 HERD BEHAVIOR NIGHT-PADDOCK (F)
TIME
PER CENT OF HERD GRAZING


55 HERD BEHAVIOR DAY-PADDOCK (F)
TIME
0700 0800 0900 1000 1100 1200 1300 1400 1500
PER CENT OF HERD GRAZING

Sept 20; Pad 28 (5.57 acres); 70 Jerseys.

Feed: Pasture 2 - 4" high, of ryegrass, cocksfoot and clover. Classed as good. Approx. 12 cwt. of ensilage fed at 1010 hrs.

Weather: Cool and overcast with moderate N - W wind. Max. temp. 58.8F.

Behaviour: Gr. 5.12 hrs (60.8%); St. 2.08 hrs (24.7%); Lying 1.22 hrs (14.5%); Total time 8.42 hrs. 1.38 hrs (27% of grazing time) spent eating ensilage as shown by dotted line in graph 49.

) Sept 20 - 21; Pad 23; 70 Jerseys.

Feed: Pasture 2 - 5" high, of ryegrass, cocksfoot and clover. Classed as good. Approx. 12 cwt. of ensilage fed in the paddock.

Weather: Overcast, mild, with light N - W breeze. Min. temp. 46.0F (Air) 38.2F (Grass) Sunset at 1814 hrs.

Behaviour: Gr. 3.20 hrs (24.9%); St. 1.50 hrs (11.7%); Lying 8.14 hrs (63.4%); Total time 12.84 hrs.

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5) Sept 20 - 21; Pad 24; 41 Friesians.

Feed: Pasture 3 - 6" high, of ryegrass, cocksfoot and clover. Classed as good. Approx. 8cwt. of ensilage fed in the paddock.

Weather: Same as (50) above.

Behaviour: Gr. 2.18 hrs (15.9%); St. .65 hrs (5.0%); Lying 10.07 hrs (78.1%); Total time 12.90 hrs.

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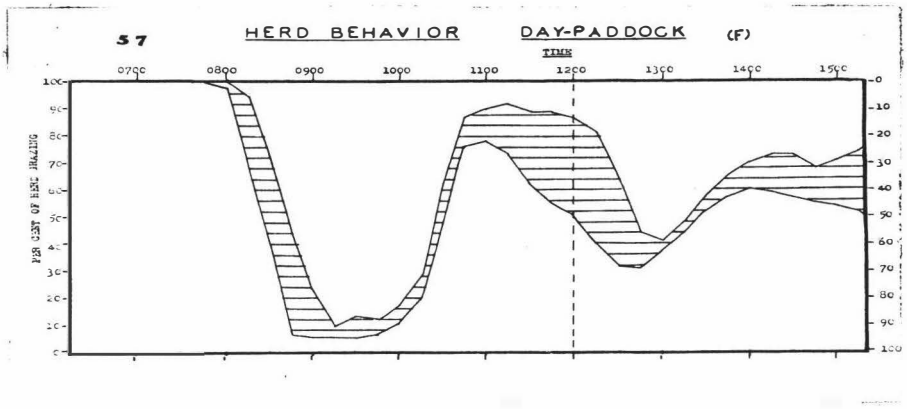
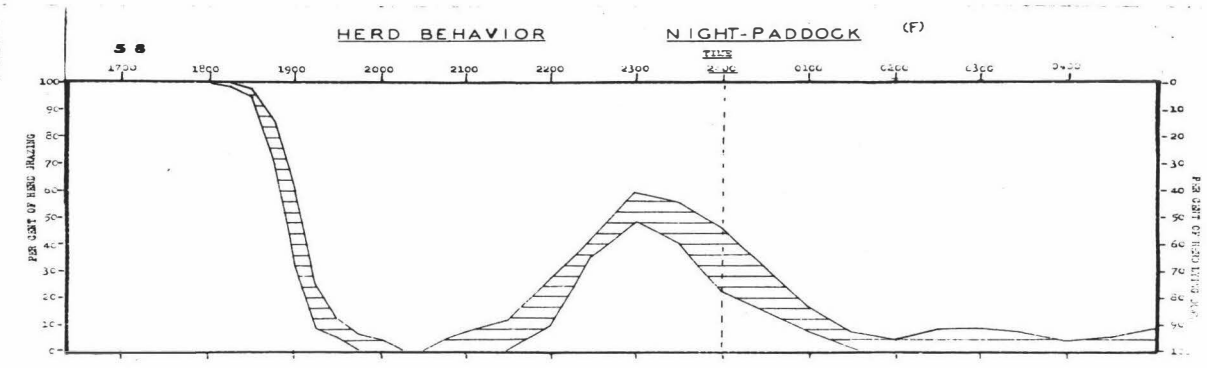
5) Sept 23; Pad 29 (5.98 acres); 42 Friesians.

Feed: Pasture 4 - 7" high of ryegrass and clover. Classed as good pasture.

Weather: Fine, slightly overcast, and light northerly breeze. Max. temp. 59.6F.

Behaviour: Gr. 5.48 hrs (60.9%); St. 1.08 hrs (12.0%); Lying 2.44 hrs (27.1%); Total time 9.00 hrs.


57
HERD BEHAVIOR
DAY-PADDOCK
(F)
TIME
0700
0800
0900
1000
1100
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


58
HERD BEHAVIOR
NIGHT-PADDOCK
(F)
TIME
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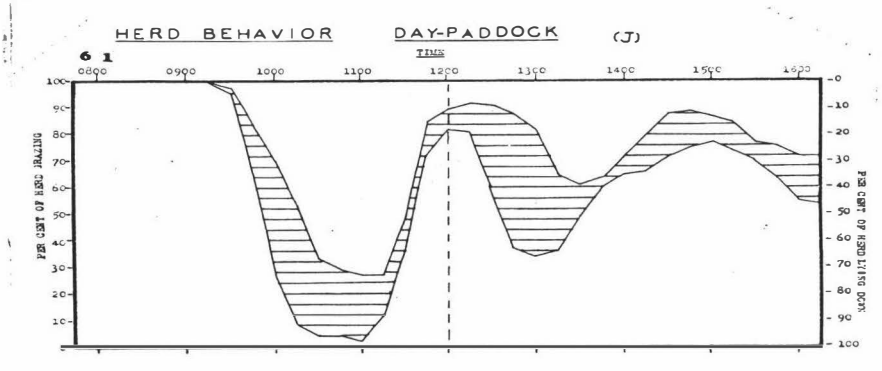
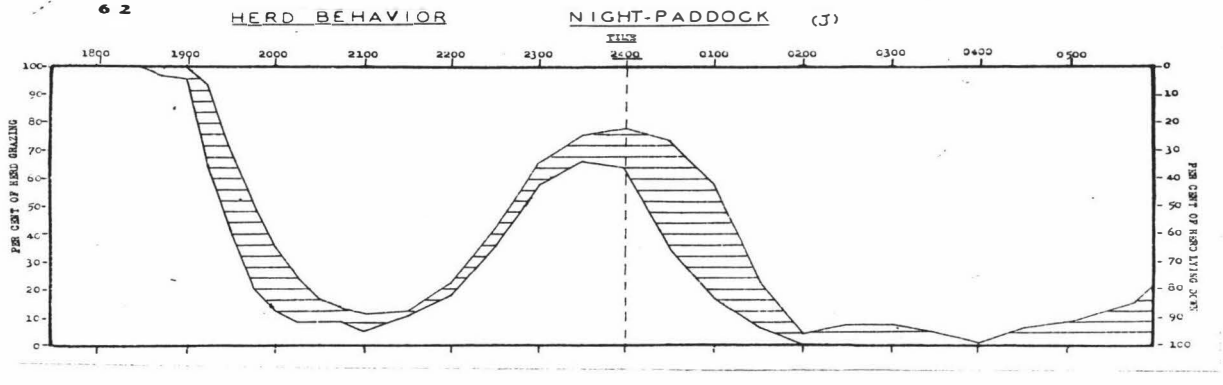
1900
2000
2100
2200
2300
0100
0200
0300
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


61
HERD BEHAVIOR
DAY-PADDOCK
(J)
TIME
0800
0900
1000
1100
1200
1300
1400
1500
1600
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


62
HERD BEHAVIOR
NIGHT-PADDOCK
(J)
TIME
1800
1900
2000
2100
2200
2300
0100
0200
0300
0400
0500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

Oct 11; Pad 29 (5.98 acres); 43 Friesians.

Feed: Pasture 4 - 6" high, of ryegrass and clover. Classed as excellent.

Weather: Overcast with a little rain in morning. Fine and windy after 1000 hrs. Max. temp. 61.1F.

Behaviour: Gr. 4.80 hrs (52.9%); St. 1.42 hrs (15.6%); Lying 2.86 hrs (31.5%); Total time 9.08 hrs.

Oct 11 - 12; Pad 24; 43 Friesians.

Feed: Pasture 5 - 7" high, of ryegrass, cocksfoot and clover. Classed as excellent.

Weather: Overcast, with several light rain showers during the night. Min. temp. 49.4F (Air) 48.0F (Grass) Sunset 1836 hrs.

Behaviour: Gr. 3.21 hrs (25.5%); St. 1.03 hrs (8.2%); Lying 8.34 hrs (66.3%); Total time 12.58 hrs.

Oct 19; Pad 30 (8.32 acres); 74 Jerseys.

Feed: Pasture 4 - 7" high, of ryegrass and clover, with some cocksfoot. Classed as excellent.

Weather: Fine and cloudy, with moderate to strong N - W wind. Max. temp. 60.6F.

Behaviour: Gr. 5.03 hrs (59.2%); St. 1.47 hrs (17.3%); Lying 2.00 hrs (23.5%); Total time. 8.50 hrs.

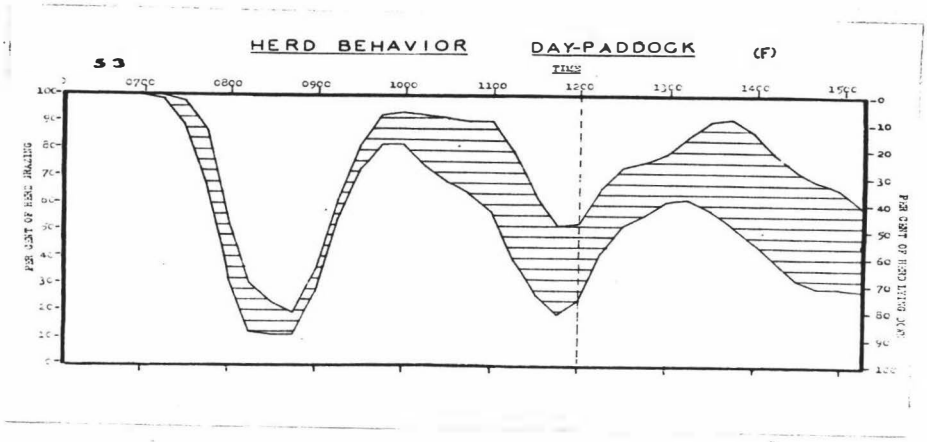
Animals endeavoured to shelter from the wind when not grazing.

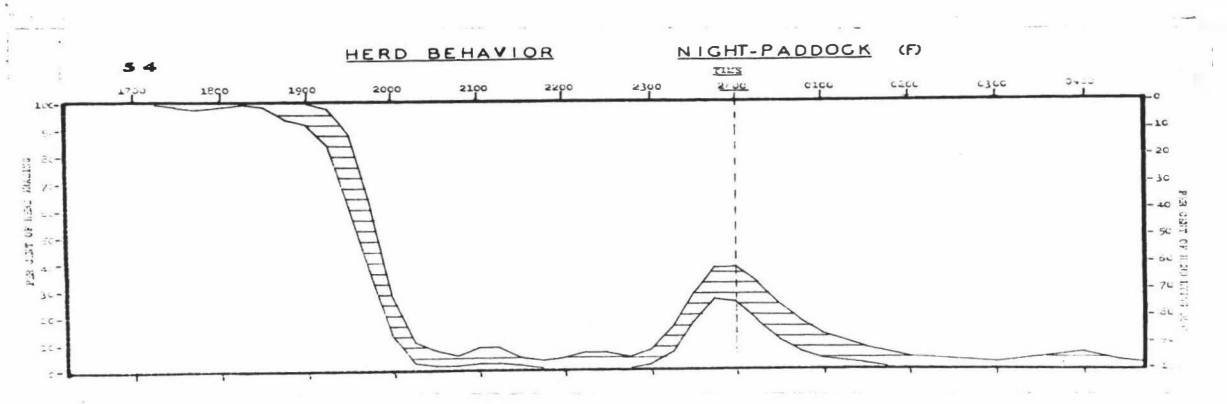
Oct 19 - 20; Pad 2 (5.00 acres); 74 Jerseys.

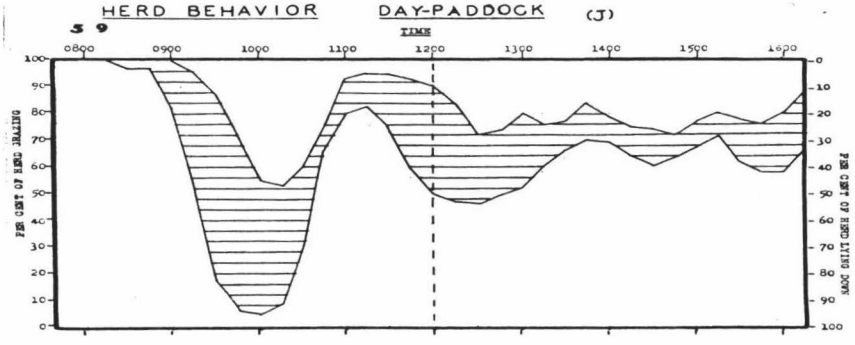
Feed: New Pasture, 4 - 5" high, mainly ryegrass with some clover. Classed as excellent.

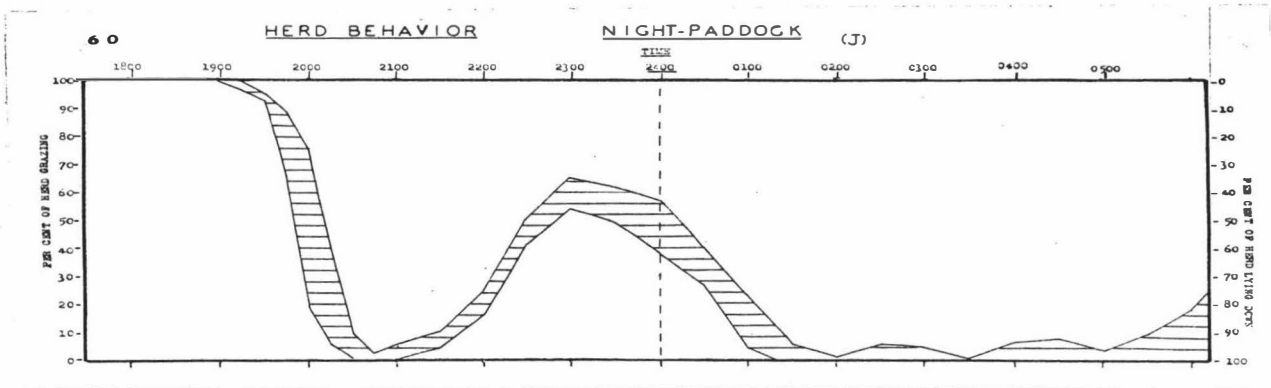
Weather: Overcast and mild, with light easterly wind. Min. temp. 52.0F (Air) 51.0F (Grass). Sunset at 1845.

Behaviour: Gr. 3.36 hrs (27.1%); St. 1.60 hrs (12.9%); Lying 7.46 hrs (60.0%); Total time 12.42 hrs.


53
HERD BEHAVIOR
DAY-PADDOCK
(F)
TIME
0700
0800
0900
1000
1100
1200
1300
1400
1500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


54
HERD BEHAVIOR
NIGHT-PADDOCK
(F)
TIME
1700
1800
1900
2000
2100
2200
2300
0100
0200
0300
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


59
HERD BEHAVIOR
DAY-PADDOCK
(J)
TIME
0800
0900
1000
1100
1200
1300
1400
1500
1600
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN


60
HERD BEHAVIOR
NIGHT-PADDOCK
(J)
TIME
1800
1900
2000
2100
2200
2300
0100
0200
0300
0400
0500
PER CENT OF HERD GRAZING
PER CENT OF HERD LYING DOWN

Nov. 22; Pad 4 (6.24 acres); 45 Friesians.

Feed: Pasture 4 - 7" high, of ryegrass and clover. Patchy, but classed as excellent.

Weather: Cloudy and mild, with bright sunshine at1300 hrs. Max. temp. 66.5F.

Behaviour: Gr. 4.83 hrs (53.1%); St. 1.98 hrs (21.8%); Lying 2.28 hrs (25.1%); Total time 9.09 hrs.

Nov. 22 - 23; Pad 24; 45 Friesians.

Feed: Pasture 3 - 6" high, of ryegrass, cocksfoot and clover. Classed as excellent.

Weather: Clear, but becoming cloudy, temperature mild, light N - W wind. Min. temp. 47.5F (Air) 42.0F (Grass) Sunset at 1926 hrs.

Behaviour: Gr. 3.49 hrs (27.8%); St. .80 hrs (6.4%); Lying 7.21 hrs (65.7%).

Nov. 30; Pad 40; 73 Jerseys.

Feed: Pasture 4 - 8" high, of ryegrass, cocksfoot and clover, with some other species. Classed as excellent.

Weather: Sunny, becoming hot, with moderate westerly wind all day. Max. temp. 76.2F.

Behaviour: Gr. 5.18 hrs (60.4%); St. 1.80 hrs (21.0%); Lying 1.60 hrs (18.6%); Total time 8.58 hrs.

Nov 30 - Dec 1; Pad 2 (5.00 acres); 73 Jerseys.

Feed: Pasture 3 - 4" high, mainly ryegrass with some clover. Classed as excellent.

Weather: Cloudy, light easterly wind, rain shower at 1900 hrs. Min. temp. 51.0F (Air) 44.0F (Grass) Sunset at 1936 hrs.

Behaviour: Gr. 3.37 hrs (26.6%); St. 2.15 hrs (17.0%); Lying 7.15 hrs (56.4%); Total time 12.67 hrs.

TABLE III: Summary of Herd Behaviour. Friesian Cows - Day Paddocks.

GRAPH NUMBER	DATE 1947	PAD. NO.	NO. OF COWS	NO. OF HOURS IN PADDOCK	AVERAGE TIME PER COW SPENT						MAX. AIR TEMP.
					GRAZING		STANDING		LYING		
					HRS.	%	HRS.	%	HRS.	%	°F
1	JAN 7	18	42	9.00	5.38	59.8	.87	9.7	2.75	30.5	62.9
2	" 8	21	42	8.83	6.33	71.7	.36	4.1	2.14	29.2	63.7
3	" 15	28	41	9.08	5.55	61.1	.68	7.5	2.85	31.4	58.5
5	" 30	4	41	9.33	3.98	42.7	3.16	33.9	2.19	23.4	76.0
20	MAR 31	4	35	9.33	5.23	56.1	3.57	38.3	.53	5.6	71.8
25	MAY 2	17	23	8.50	5.10	60.0	2.11	24.8	1.29	15.2	62.8
29	" 17	4	22	7.84	4.97	63.4	1.45	18.5	1.42	18.1	56.3
31	" 31	19	17	7.50	4.21	56.0	1.49	19.9	1.80	24.0	52.5
35	JUNE27	3	19	8.18	4.10	50.0	3.08	37.7	1.01	12.3	50.5
39	JULY 1	23	19	8.10	5.32	65.7	1.26	15.6	1.52	18.8	48.5
43	" 25	21	23	8.75	4.70	53.7	1.42	16.2	2.63	30.1	52.5
47	AUG 24	11	35	9.08	6.00	66.1	1.08	11.9	2.00	22.0	61.3
55	SEPT23	29	42	9.00	5.48	60.9	1.08	12.0	2.44	27.1	59.6
57	OCT 11	29	43	9.08	4.80	52.9	1.42	15.6	2.86	31.5	61.1
53	NOV 22	4	45	9.09	4.83	53.1	1.98	21.8	2.28	25.1	66.5
	MEANS			8.71	5.07	58.2	1.67	19.2	1.98	22.6	60.3
	STANDARD DEVIATION				.665		.907		.707		

TABLE IV: Summary of Herd Behaviour. Friesian Cows - Night Paddock

GRAPH NUMBER	DATE 1947	PAD. NO.	NO. OF COWS	NO. OF HOURS IN PADDOCK	AVERAGE TIME PER COW SPENT						MIN. TEMP. °F	
					GRAZING		STANDING		LYING		AIR	GRASS
					HRS.	%	HRS.	%	HRS	%		
4	JAN 16-17	4	41	11.91	2.76	23.2	.89	7.5	8.26	69.3	42.0	37.2
6	JAN 31-FEB1	11	41	11.92	3.64	30.5	1.20	10.1	7.08	59.4	49.2	42.2
7	FEB 6 - 7	5	41	11.92	4.49	37.7	.65	5.5	6.78	56.8	59.8	53.0
10	FEB 8 - 9	12	41	11.92	3.91	32.8	.59	5.0	7.42	62.2	61.0	57.0
16	MAR10 -11	3	35	12.00	4.00	33.3	.69	5.8	7.31	60.9	59.5	54.2
19	" 29 -30	3	35	12.34	3.29	26.7	.76	6.2	8.29	67.1	47.8	37.6
23	APR28 -29	10	24	12.34	1.77	14.3	1.41	11.4	9.16	74.2	49.7	44.2
27	MAY12 -13	4	23	12.09	1.51	12.5	1.46	12.1	9.13	75.5	44.0	34.1
33	MAY31-JUNE1	11	17	13.25	2.86	21.6	2.00	15.1	8.39	63.3	30.0	22.0
37	JUNE27-28	24	19	13.09	2.89	22.0	9.38	33.5	5.82	44.5	40.0	40.0
41	JULY 1- 2	24	19	13.09	2.51	19.2	1.36	10.4	9.21	70.4	31.0	22.0
45	" 25-26	25	24	12.08	3.38	28.0	2.84	23.5	5.86	48.5	34.5	25.0
48	AUG 24-25	5	35	12.33	3.73	30.3	1.04	8.4	7.56	61.3	44.6	34.8
56	SEPT 20-21	24	41	12.90	2.18	16.9	.65	5.0	10.07	78.1	46.0	38.2
58	OCT 11-12	24	43	12.58	3.21	25.5	1.03	8.2	8.34	66.3	49.4	48.0
54	NOV 22-23	24	45	12.50	3.49	27.8	.80	6.4	8.21	65.7	47.5.	42.0
	MEANS			12.39	3.10	25.1	1.16	9.4	8.07	65.3	46.0	39.5
	STANDARD DEVIATION				.799		1.018		1.204			

TABLE V: Summary of Herd Behaviour. Jersey Cows - Day Paddocks.

GRAPH NUMBER	DATE 1947	PAD. NO.	NO. OF COWS	NO. OF HOURS IN PADDOCK	AVERAGE TIME PER COW SPENT						MAX. AIR TEMP. °F
					GRAZING		STANDING		LYING		
					HRS.	%	HRS.	%	HRS.	%	
8	FEB 7	18 DRI.	64	9.25	4.73	51.1	2.76	29.8	1.76	19.0	73.2
11	" 21	30 DRI.	39	8.67	5.30	61.1	1.56	18.0	1.81	20.9	69.5
12	" 25	10 DRI	39	8.87	5.10	57.5	1.91	21.5	1.86	21.0	68.0
14	MAR 4	30	39	9.15	4.79	52.3	2.28	24.9	2.08	22.7	71.0
15	" 7	19	58	9.24	5.66	61.3	1.62	17.5	1.96	21.2	76.0
18	" 20	23 DRI.	63	9.31	4.96	53.3	3.84	41.2	.51	5.5	72.8
22	APR.18	30	29	8.83	5.72	64.8	2.36	26.7	.75	8.5	67.1
26	MAY 2	17	38	8.49	5.03	59.2	1.95	23.0	1.51	17.8	62.8
30	" 17	4	23	7.84	5.62	71.7	1.56	19.9	.66	8.4	56.3
32	" 31	19	6	7.50	4.33	57.7	1.88	25.1	1.29	17.2	52.5
36	JUNE27	3	12	8.18	3.75	45.8	3.54	43.3	.88	10.8	50.5
40	JULY 1	23	13	8.10	4.83	59.6	1.67	20.6	1.59	19.7	48.5
44	" 25	21	16	8.75	4.58	52.3	2.21	25.3	1.96	22.4	52.5
51	AUG 14	11	49	8.33	5.64	67.7	1.03	12.4	1.66	19.9	57.8
49	SEPT20	28	70	8.42	5.12	60.8	2.08	24.7	1.22	14.5	58.5
61	OCT 19	30	74	8.50	5.03	59.2	1.47	17.3	2.00	23.5	60.6
59	NOV 30	40	73	8.58	5.18	60.4	1.80	21.0	1.60	18.6	76.2
MEANS				8.59	5.02	58.6	2.09	24.2	1.48	17.2	63.2
STANDARD DEVIATION					.484		.723		.506		

TABLE VI: Summary of Herd Behaviour. Jersey Cows - Night Paddocks.

GRAPH NUMBER	DATE 1947	PAD. NO.	NO. OF COWS	NO. OF HOURS IN PADDOCK	AVERAGE TIME PER COW SPENT						MIN. TEMP.		
					GRAZING		STANDING		LYING				
					HRS.	%	HRS.	%	HRS.	%	AIR	GRASS	
9	FEB 8-9	11 DRI.	64	12.66	4.38	34.6	1.51	11.9	6.77	53.5	61.0	57.0	
13	" 26-27	14	39	12.10	3,92	32.4	1.38	11.4	6.80	56.2	38.5	30.0	
17	MAR 18-19	12 DRI.	64	12.42	2.64	21.3	1,47	11.8	8.31	66.9	51.1	40.8	
21	APR 14-15	27	29	12.58	3.88	30.8	5.70	45.3	3.00	23.8	47.8	45.4	
24	" 28-29	10	40	12.34	2.94	23.8	1.21	9.8	8.19	66.4	49.7	44.2	
28	MAY 12-13	4	41	12.09	2.23	18.4	.97	8.0	8.88	73.4	44.0	34.1	
34	MAY31-JUN1	11	6	13.25	3.19	24.1	3.38	25.5	6.68	50.4	30.0	22.0	
38	JUNE27-28	24	14	13.09	3.28	25.1	4.77	36.4	5.04	38.5	40.0	40.0	
42	JULY 1-2	24	13	13.08	2.61	20.0	1.81	13.8	8.66	66.2	31.0	22.0	
46	" 25-26	25	17	12.08	3.04	25.2	2.81	23.3	6.23	51.6	34.5	25.0	
52	AUG 14-15	27	52	12.83	2.90	22.6	1.14	8.9	8.79	68.5	44.6	38.0	
50	SEPT20-21	23	70	12.84	3.20	24.9	1.50	11.7	8.14	63.4	46.0	38.2	
62	OCT 19-20	2	74	12.42	3.36	27.1	1.60	12.9	7.46	60.0	52.0	51.0	
60	NOV30-DEC1	2	73	12.67	3.37	26.6	2.15	17.0	7.15	56.4	51.0	44.0	
	MEANS			12.60	3.21	25.5	2.24	17.7	7.15	56.8	44.4	38.0	
	STANDARD DEVIATION				.569		1.442		1.626				

DISCUSSION.

The most obvious feature on consideration of the graphs presented is the cyclic nature of animal behaviour, particularly in regard to grazing, such that there are three feeding periods on the day paddock and two on the night paddock. It is noted that although adverse climatic conditions of excessive heat (Graphs 5, 8, 15, 18, 20 and 59) or heavy rain (Graphs 21, 35, 36, 37 and 38) increases the standing time at the expense of lying down, such weather extremes do not affect either the duration or the cyclic pattern of grazing activities to the same extent. This supports the findings of Hancock and Wallace (17) that a much higher persistency of action exists for grazing than for standing or lying down.

It will also be noticed that on occasions when supplements * were fed to cows while they were in the paddock, (Graphs 11, 12, 14, 18, 20, 22, 25, 26, 29, 30, 31, 32, 35, 36, 39, 40, 43, 44, 49 and 51) practically all animals not already grazing were induced to begin feeding activities once again, and if this induced feeding period did not happen to coincide with the usual grazing cycle, the effect was to upset herd behaviour for the remainder of the day on that paddock (Graphs 25, 26, 39, 40, 43, 44 and 49) Since the three normal daytime grazing cycles are spaced more or less evenly over the time available, we may conclude that supplements should be fed to coincide with the grazing cycles only at the following times :- (A) Within 1 hour of cows entering the paddock.

(B) Between 1000 - 1100 hours.

(C) Between 1330 - 1400 hours.

It must be conceded, however, that feeding supplements even at supposedly correct times (Graphs 14,15, 29, 30, 35, and 36) appears to alter the behaviour compared with that on pasture only (Graphs 1,2,53, 55, 57 and 61) although we must not exclude the possibility of other causes such as stage of lactation and season operating as well.

It is of interest to note, from the few occasions on which time devoted to eating supplements was recorded, (Graphs 39, 40,

*Used in the sense of all feed other than pasture.

43,44 and 49) that although nearly all animals begin to eat hay or ensilage, they persist in this activity only for a short time, preferring to resume grazing pasture. It may be that the little studied question of palatability and variety of diet are contributing factors. Since grazing cycles are reported to be so regular, (17) it does not seem probable that curiosity alone would account for the keen (if transitory) interest which cows show in supplements.

In most of the night paddocks, supplements had already been fed out on the pasture and it was not possible to obtain any further information on this point.

Turning now to herd behaviour on night paddocks, we see that here again the animals display a regularity in their habits, having two well-defined grazing periods.

Reference to the data presented shows that the first grazing period occurs until soon after sunset, when darkness sets in, and the second period occurs about or just before midnight.

The effect which moonlight may have on behaviour is in some doubt, and although Levy (13) reported more grazing done from 0100-0400 hours when there was some moonlight, our data do not support these conclusions (Graphs 7, 9, 10, 23, 24, 27, 28, 33, 34, 41 and 42). It is considered that the effect of moonlight is much less important than that of weather conditions.

No satisfactory explanation can be offered to explain the anomalous behaviour illustrated in Graphs 4, 23, 27 and 56 unless the animals are able, if they have enough time for a complete fill before dark, to do without any further grazing. Elsewhere (19) under carefully controlled conditions, workers have sometimes encountered similar variations in behaviour without any apparent reason.

The effect of weather conditions in influencing behaviour is evident in many of the graphs. It was noticed early in the investigation that sunshine was of indirect importance only in so far as it was associated with air temperature; similar conclusions are reached by Galaas (20) who reports, however, that keeping cows in the sun at high air temperatures caused an average rise of .7° F in body temperature as compared with body

temperature when the same cows were in the shade at the same air temperature.

Consideration of the graphs and the summaries presented in Tables III, IV, V and VI reveals that air temperatures above about 70° F. appear to interfere with normal behaviour, the animals preferring to stand in any shade available rather than lie down. Forbes Et. Al. (21) have studied the rate of metabolism of cattle in a respiration calorimeter, and find that the increase in heat production for standing as compared with lying is 15.1 Cals/K.G. L.W./hour. On the other hand, it has been found (20) that the respiration rate increases uniformly with air temperature, and one observation made by counting flank movements on three Jersey cows at 1400 hours on March 20, when the maximum temperature was 72.8° F, gave the following results:-

Cow	Respirations/Minute Lying	Respirations/Minute Standing
1	39	44
2	29	30
3	45	47

In view of the variation in the figures published by Galaas (20) one would hesitate to draw any conclusions from so few data. It does seem possible, however, that animals may be able to respire a greater volume of air when standing than when lying down, which would account for their standing in hot weather. Hancock and Wallace (17) found that excessive day temperatures affected grazing behaviour the same evening, but we have no data on this point.

Since the relative humidity at no time exceeded 76% in these studies, it has been disregarded because both Mitchell (22) and Kriss (23) have shown, with cattle, that a relative humidity up to 80% plays no modifying role in the evaporation of water (and hence heat elimination) from the body.

The cooling effect of wind (1) is thought to explain the almost normal behaviour shown on Graph 59, when the maximum temperature reached 76.2° F.

Although heavy frost does not appear to affect herd behaviour

(Graphs 33, 34, 41, 42, 45 and 46) nearly all animals seek the "shade" of any available trees when not grazing. Various workers (1), (24), (25), and (26) are agreed that dairy cows can tolerate freezing temperatures without discomfort provided the air remains still. However, the effect of strong cold winds, heavy rain (Graphs 35, 36, 37 and 38) or a combination of both, apparently causes some adjustment in behaviour, such that stormy conditions (Graph 21) bring about three grazing cycles instead of the normal two.

As Levy (13) has pointed out, the greater "feed flavour" in evening milk is probably the result of a cow's natural grazing behaviour.

TABLE VII: Distribution of grazing and lying between day and night paddocks.

FRIESIANS			JERSEYS		
Period covered (24 hrs) 1947.	Grazing % on Day Paddock.	Lying % on Day Paddock.	Period covered (24 hrs) 1947.	Grazing % on Day Paddock.	Lying % on Day Paddock.
			Feb 7-9	51.9	20.6
Jan 15-17	66.8	25.6	Feb 25-27	56.5	21.5
Jan 30-Feb 1	52.2	23.6	Mar 18-20	65.3	5.8
Mar 29-31	61.4	6.0	Apr.14-18	59-6	20.0
Apr 28-May 2	74.2	12.3	Apr 28-May 2	63.1	15.6
May 12-17	76.7	13.5	May 12-17	71.6	6.9
May 31-June 1	59.5	17.7	May 13-June 1	57.6	16.2
Jun 27-28	58.7	14.9	June 27-28	53.3	14.9
July 1-2	67.9	14.2	July 1-2	64.9	15.5
July 25-26	58.2	31.0	July 25-26	60.1	23.9
Aug 24-25	61.7	20.9	Aug.14-15	65.7	15.9
Sept.20-23	71.5	19.5	Sept.20-21	61.5	13.0
Oct.11-12	59.8	25.5	Oct. 19-20	60.0	21.1
Nov.22-23	58.1	21.7	Nov.30-Dec 1	60.6	18.3
Means	63.6	19.0		60.8	16.4
S.D.	7.2	6.9		5.1	5.3

The broken lines indicate days on which the two breeds were in the same herd.

In Table VII above is given the distribution of the various activities between day and night paddocks. For the period covered by each daytime and night-time observation, the time spent in one particular activity (e.g. grazing) on the day paddock is expressed as a per-centage of the total time grazing each 24 hours.

'Standing' has been omitted because animals necessarily stand in the yard during milking as well as in the paddock.

It will be noticed from this Table that, although some fluctuations occur, both Friesians and Jerseys, on the average, do approximately three-fifths of their grazing on the day paddocks and two-fifths on the night paddocks, and from this we may conclude that 40% of the available grazing area on a dairy farm should be used for night paddocks. While no figures are available, it is the writer's impression that many farmers use considerably less than 40% of their farm as night paddocks. The variation in the figures is largely accounted for by the discontinuity of daytime and night-time observations, (see "Discussion of Method" P13) and it will be noticed that on those occasions where a 24 hour period was covered with each observation, the variation is much smaller, and the means - 60.5% for both Friesians and Jerseys - are in agreement for the two breeds. It is of interest that the feeding of supplements in this study did not cause the day: night paddock grazing ratio to differ from that found by Hancock and Wallace (17) on pasture alone, even though the practice generally adopted on the College Farm during the winter was to feed adequate supplements on a comparatively bare night paddock. It is possible, therefore, that the rate of dry matter intake for supplements is of the same order as for pasture.

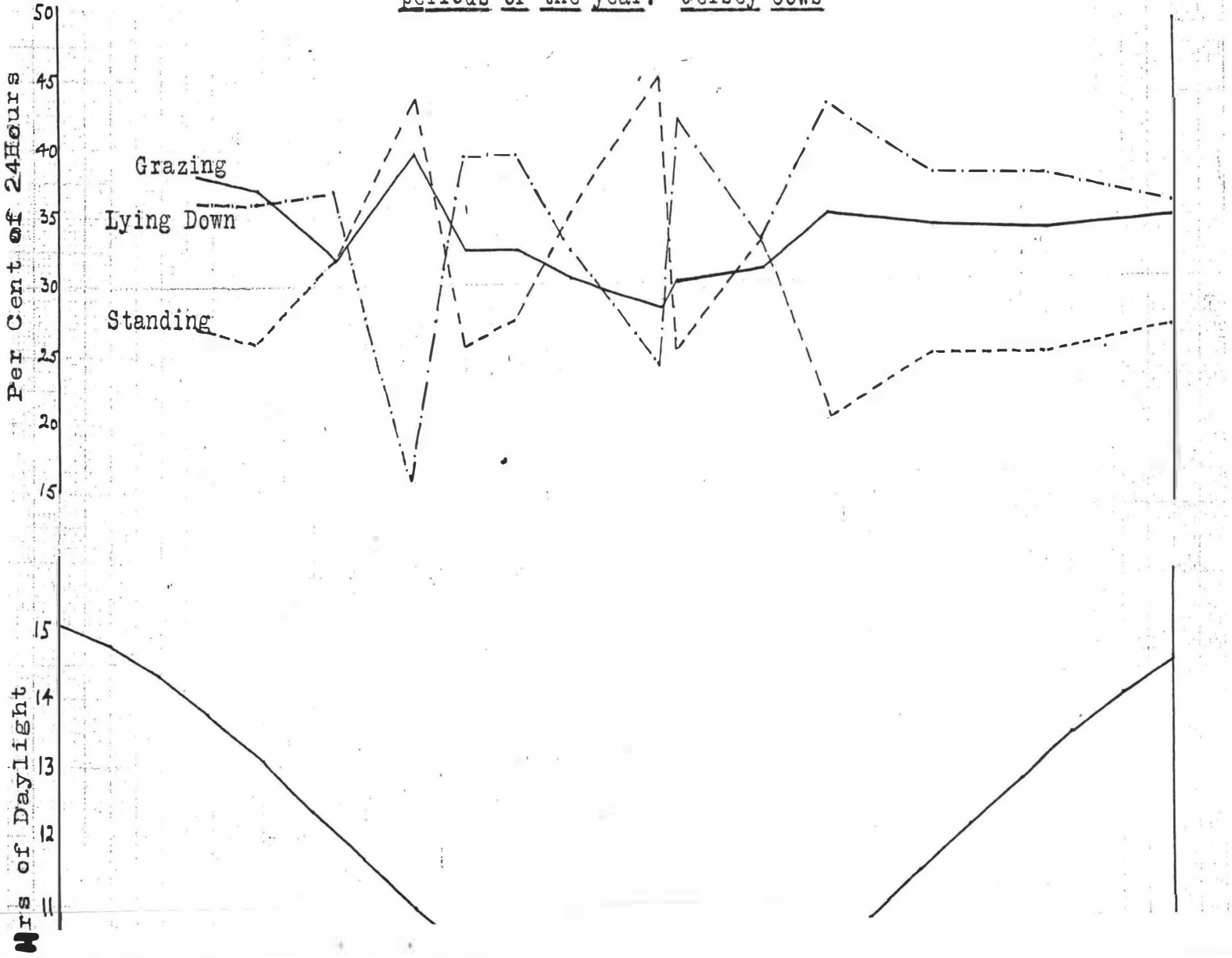
TABLE VII: FRIESIANS: Mean time spent grazing, standing and lying down each 24 hours.

Observation Period 1947.	No. of Cows	GRAZING Hrs/ Cow	GRAZING % of 24hrs	STANDING * Hrs/ Cow	STANDING * % of 24 hrs	LYING DOWN Hrs/ Cow	LYING DOWN % of 24 hrs	NOT GRAZING Hrs/ Cow	NOT GRAZING % of 24 hrs
Jan 15-17	41	8.31	34.6	4.57	19.0	11.12	46.3	15.69	65.3
Jan 30-Feb.1.	41	7.62	31.8	7.11	29.6	9.27	38.6	16.38	68.2
Mar.29-31	35	8.52	35.5	6.66	27.8	8.82	36.8	15.48	64.6
Apr.28-May 2.	23	6.87	28.6	6.68	27.8	10.48	43.5	17.16	71.3
May 12-17	22	6.48	27.0	6.98	29.1	10.54	43.9	17.52	73.0
May 31-Jun 1.	17	7.07	29.5	6.74	28.1	10.19	42.4	16.93	70.5
Jun.27-28	19	6.99	29.1	10.18	42.4	6.83	28.5	17.01	70.9
July 1-2	19	7.83	32.6	5.44	22.7	10.73	44.7	16.17	67.4
" 25-26	23	8.08	33.7	7.43	31.0	8.49	35.3	15.92	66.3
Aug.24-25	35	9.73	40.5	4.71	19.6	9.56	39.8	14.27	59.4
Sep.20-23	42	7.66	31.9	3.83	16.0	12.51	52.1	16.34	68.1
Oct.11-12	43	8.01	33.4	4.79	20.0	11.20	46.7	15.99	66.7
Nov.22-23	45	8.32	34.7	5.19	21.6	10.49	43.7	15.68	65.3
Means		7.81	32.5	6.18	25.8	10.01	41.7	16.19	67.5
Standard Deviation		.854		1.673		1.407		1.514	

* 'Standing' in Tables VIII and VIV is calculated by subtracting from 24 hours the total time spent grazing and lying down. It therefore includes time standing in the yard plus time standing in the paddock.

'Not Grazing' equals time standing plus lying down.

FIGURE II: Relative time spent in various activities at different periods of the year: Jersey Cows



UNIVERSITY OF NEW ZEALAND

Massey Agricultural College

PALMERSTON NORTH, N.Z.

P.O. Box 601,
PALMERSTON NORTH, N.Z.

29th December, 1947

The Registrar,
University of New Zealand,
P.O. Box 1524,
WELLINGTON.

Dear Sir,

I wish to certify that the thesis entitled "Some observations on the grazing behaviour and water consumption of lactating Friesian and Jersey cows" and presented by [redacted] for the degree of M. Agr. Sc., is, to the best of my knowledge, the candidate's own work.

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Yours faithfully,

W. Ridder

Professor of Dairying.

TABLE IX: JERSEYS: Mean time spent grazing, standing and lying down each 24 hours.

Observation Period 1947.	No. of Cows	GRAZING Hrs/ Cow	% of 24 hrs	STANDING Hrs/ Cow	% of 24 hrs	LYING DOWN Hrs/ Cow	% of 24 hrs	NOT GRAZING Hrs/ Cow	% of 24 hrs
Feb.7-9	64	9.11	38.0	6.36	26.5	8.53	35.5	14.89	62.0
Feb.25-27	39	9.02	37.6	6.32	26.3	8.66	36.1	14.98	62.4
Mar.18-20	63	7.60	31.7	7.58	31.6	8.82	36.7	16.40	68.3
Apr.14-18	29	9.60	46.0	10.65	44.4	3.75	15.6	14.40	60.0
Apr.28-May 2	39	7.97	33.2	6.33	26.4	9.70	40.4	16.03	66.8
May 12-17	32	7.85	32.8	6.60	27.5	9.54	39.8	16.14	67.3
May 31-Jun 1.	6	7.52	31.3	8.51	35.5	7.97	33.2	16.48	68.7
Jun.27-28	13	7.03	29.3	11.05	46.0	5.92	24.7	16.97	70.7
July 1-2	13	7.44	31.0	6.31	26.3	10.25	42.7	16.56	69.0
July 25-26	16	7.62	31.8	8.19	34.1	8.19	34.1	16.38	68.0
Aug.14-15	50	8.54	35.6	5.01	20.9	10.45	43.5	15.46	64.6
Sep.20-21	70	8.32	34.7	6.32	26.3	9.36	39.0	15.68	65.3
Oct.19-20	74	8.39	35.0	6.15	25.6	9.46	39.4	15.61	65.0
Nov.30-Dec 1.	73	8.55	35.6	6.70	27.9	8.75	36.5	15.45	64.4
Means		8.18	34.1	7.29	30.4	8.53	35.5	15.82	65.9
Standard Deviation		.735		1.749		1.771		1.763	

Tables VIII and IX set out the mean time spent in various activities each 24 hours, calculated from the period covered by a daytime and night time observation. The data show that both breeds spend, on the average, about one-third of their time grazing, 26-28% standing, and 27-42% lying down.

In the 'grazing' column of both tables there appeared to be a slight but definite trend towards shorter grazing times during the winter months, and the following graphs (Figures I and II) were constructed from the 'per-centage' columns of Tables VIII and IX respectively. It would appear from the graphs that a relationship exists between hours of daylight (i.e. from sunrise to sunset) and the time devoted to grazing; to test this assumption, correlation coefficients were calculated after the method of Snedecor (27)

FRIESIANS: JERSEYS:

$r = .1086$ (N.S.) $r = .1271$ (N.S.)

The non-significance of the correlations was brought about larely by variations in the data available, but in view of the effect of daylight, through the anterior pituatary gland, on breeding activities in sheep, (28) it would not be surprising to find a somewhat similar effect on grazing habits of cattle.

It will also be noticed from Figures I and II that, while grazing behaviour is reasonably steady, lying down and standing

vary widely in opposite directions, appearing to be inter-dependent. This feature of behaviour was noted throughout the investigation; it did not seem to be of much importance to resting animals whether they were standing or lying down.

Another point worth recording is in connection with the effect of rain on the palatability of pasture. As stated earlier, animals generally refused to eat any rank patches of growth, but it was noticed on one occasion that after heavy rain the previous night, they lightly grazed most of the rank patches of herbage, presumably because the rain had allayed the unpleasant smell of previous stock excretions. The implication is that "cleaning up" a paddock of uneven growth is best accomplished after heavy rain.

Animals in oestrus were observed to interfere with the behaviour of other animals in the herd only when they were either standing or lying down; they did not distract animals which were already grazing, due to the relative persistency of this activity.

SECTION II BREED COMPARISONS.

Jersey cows are generally thought to be more economical than Friesians under New Zealand conditions, since the higher carrying capacity and their supposedly better foraging ability make for greater efficiency of production. There is the further advantage that, being small, they punish the sward less under wet conditions.

As mentioned in the introduction, one of the objects of this study was to compare the behaviour of the two breeds, and some of the observations on herd behaviour have been used for this purpose. Since the only strict comparisons that can be made are when both Jerseys and Friesians are subject to identical feed and climatic conditions, this limits us to data collected on the combined winter herd. The results set out in Tables X and XI have been extracted from the data already presented on herd behaviour, and represented by the graphs nos. 23 - 46 which have been arranged in pairs to facilitate a visual comparison.

From both Table X and the graphs we see a surprising degree of similarity in the grazing behaviour of the two breeds, and a similar but less marked correspondence between standing and lying down. However, there is a tendency for Jerseys to graze, on the average, 24 minutes (or 3%) longer on the night paddocks than the Friesians, and this extra feeding is done mostly during the midnight grazing period, as will be seen by a comparison of the night-paddock graphs for the two breeds. Tables X and XI also show that Jerseys tend to stand more in both the day and night paddocks at the expense of lying down and this feature was noticed throughout the investigation. Although the differences between means proved non-significant in every case by Snedecor's "t" test, (27) this is probably because too few data were available, while the standard deviations were at the same time comparatively large.

TABLE X: Comparison of the behaviour of Jersey and Friesian Cows depastured on the same paddocks.

DAY PADDOCKS.

E 47	PAD-DOCK NO.	LENGTH OF TIME IN PADDOCK.	GRAZING		STANDING		LYING DOWN	
			JERSEYS HRS.	FRIESIANS HRS.	JERSEYS HRS.	FRIESIANS HRS.	JERSEYS HRS.	FRIESIAN HRS
	17	8.50 100%	5.03 59.2%	5.10 60.0%	1.95 23.0%	2.11 24.8%	1.51 17.8%	1.2 15.2%
	4	7.84 100%	5.62 71.7%	4.97 63.4%	1.56 19.9%	1.45 18.5%	.66 8.4%	1.42 18.1
	19	7.50 100%	4.33 57.7%	4.21 56.0%	1.88 25.1%	1.49 19.9%	1.29 17.2%	1.80 24.0%
	3	8.18 100%	3.75 45.8%	4.10 50.0%	3.54 43.3%	3.08 37.7%	.88 10.8%	1.01 12.3%
	23	8.10 100%	4.83 59.6%	5.32 65.7%	1.67 20.6%	1.26 15.6%	1.59 19.7%	1.52 18.8%
	21	8.75 100%	4.58 52.3%	4.70 53.7%	2.21 25.3%	1.42 16.2%	1.96 22.4%	2.63 30.1%
EANS .D.		8.15 100%	4.69 57.5%	4.73 58.0%	2.14 26.3%	1.80 22.0%	1.32 16.2%	1.62 20.0%
			.636	.492	.725	.691	.479	.55

NIGHT PADDOCKS.

E 47	PAD-DOCK NO.	LENGTH OF TIME IN PADDOCK.	GRAZING		STANDING		LYING DOWN	
			JERSEYS HRS.	FRIESIANS HRS.	JERSEYS HRS.	FRIESIANS HRS.	JERSEYS HRS.	FRIESIAN HRS
/4	10 4	12.34 100%	2.94 23.8%	1.77 14.3%	1.21 9.8%	1.41 11.4%	8.19 66.4%	9.1 74.2
/5	4	12.09 100%	2.23 18.4%	1.51 12.5%	.97 8.0%	1.46 12.1%	8.88 73.4%	9.1 75.5
/6	11	13.25 100%	3.19 24.1%	2.86 21.6%	3.38 25.5%	2.00 15.1%	6.68 50.4%	8.3 63.3
/6	24	13.09 100%	3.28 25.1%	2.89 22.0%	4.77 36.4%	4.38 33.5%	5.04 38.5%	5.8 44.5
7	24	13.08 100%	2.61 20.0%	2.51 19.2%	1.81 13.8%	1.36 10.4%	8.66 66.2%	9.2 70.4
/7	25	12.08 100%	3.04 25.2%	3.38 28.0%	2.81 23.3%	2.84 23.5%	6.23 51.6%	5.8 48.5
EANS .D.		12.65 100%	2.88 .395 22.8%	2.49 .717 19.7%	2.49 1.331 19.7%	2.23 1.189 17.6%	7.28 1.535 57.5%	7.9 1.6 62.7

TABLE XI: Summary of the data on breed comparisons from Table X

	AVGE. LENGTH OF TIME IN PADDOCK. HRS.	GRAZING		STANDING		LYING DOWN	
		JERSEYS HRS.	FRIESIANS HRS.	JERSEYS HRS.	FRIESIANS HRS.	JERSEYS HRS.	FRIE-SIANS HRS.
DDOCKS	8.15 100%	4.69 57.5%	4.73 58.0%	2.14 26.3%	1.80 22.0%	1.32 16.2%	1.62 20.0%
PADDOCKS	12.65 100%	2.88 22.8%	2.49 19.7%	2.49 19.7%	2.23 17.6%	7.28 57.5%	7.93 62.7%
D NIGHT	20.80 100%	7.57 36.4%	7.22 34.7%	4.63 22.3%	4.03 19.4%	8.60 41.3%	9.55 45.9%
% OF DAY AND	39.2%	62.0%	65.5%	46.2%	44.7%	15.3%	17.0%

TABLE XII: Comparison of distance walked by Jerseys and Friesian under identical conditions on the same day-paddock.

COW	DATE	PADDOCK NUMBER	GRAZING TIME (minutes)	DISTANCE WALKED (minutes)
"TOY" (Jersey)	May 17	4	320	2172
"LOTTIE" (Friesian)	" "	"	340	2036
"UNA" (Jersey)	July25	21	281	1370
"VERNA" (Friesian)	" "	"	279	1251

In Table XII is given a breed comparison of distance walked, carried out on two day paddocks; it is fortunate that the grazing times were approximately the same in each case.

DISCUSSION:

In view of their smaller size and lower milk production, it is of some interest that Jerseys tend to graze for slightly longer than Friesians, specially on the night paddocks (compare Tables III, IV, V, and VI covering all observations) and, moreover, they travel further - on the day paddocks at least - during approximately the same grazing time.

Because the theoretical feed requirements and the dry matter intake are less for smaller animals (29), and our own data (see Section IV) do not indicate any significant difference between rate of eating, we may conclude that Jerseys are more selective feeders than Friesians, since they take at least as many mouthfuls of herbage for a smaller dry matter intake.

While New Zealand Group Herd Test figures do not disclose any advantage in average butter-fat production for either breed, Friesians appear to be superior in average individual production under semi-official testing, where feeding is likely to be better. (30) Under the conditions of dairy husbandry in New Zealand, where a cow must gather her own feed, our data provide some factual evidence to justify the confidence placed in Jersey cows as superior foragers, which is to be expected from their smaller size. It is also probable that Friesians, being less selective feeders, necessarily consume and presumably make use of the coarser elements of pasture although whether there is a breed difference in efficiency of the digestive processes remains an open question.

The data on temperature are not extensive enough to permit any breed comparisons, and in any case several workers (31), (32), (33) are agreed that it is not until air temperature reaches 80 - 85°F that European cattle have difficulty in heat disposal through the lungs. Seath and Miller (32) have showed that Friesians are less tolerant of air temperatures above 80°F than Jerseys, while Rhoad (34) finds a genetic difference in efficienc of heat disposal above 70°F between four types of cattle.

The similar effect of hours of daylight upon the two breeds

will be noted in Figures I and II in Section I.

In conclusion, it was noticed during this study that Friesian cows seemed more stable in their grazing habits than Jerseys, taking less notice of distractions and generally settling down more quickly on entering the paddock. Another feature with the Jerseys was their tendency, specially during the third daytime grazing period, for almost the whole herd suddenly to begin grazing for a short time. Hancock and Wallace (17) have calculated that any two random animals in a herd pursue the same activity for an average of 69% of the time.

SECTION III: WATER CONSUMPTION.

Water is of importance in dairy cow nutrition because it represents 87% of the composition of milk and over 50% of the cow's body tissues. (35)

Atkeson and Warren 1934 (36) have reviewed the considerable body of literature on the use of water by dairy cows, and they point out that few of the published results can be used to predict the water requirements of cows under conditions differing from those of the particular experiment reported.

More recently, Ritzman and Benedict 1938 (1) have studied, among other things, the role of drinking water in the digestion and absorption of food nutrients by cattle. Their results support the findings of other workers that water requirements are determined primarily by the amount of dry matter consumed, by the type of body tissue formed (as in growth or fattening) by the amount of milk yielded, and by temperature as affecting loss by vaporisation.

The following Tables give the results of some measurements * of the free-water consumption of lactating Jersey and Friesian cows carried out by the method enumerated on page 10.

* The water consumption in the yard was invariably negligible, and subsequent measurements were all confined to the paddock.

TABLE XIIIA: Free-water intake of lactating Friesian Cows.

DAY-PADDOCKS

DATE 1947	NO. OF COWS	D.M. % OF PASTURE	INTAKE GALLONS/ COW	REMARKS.
MAR 11	35	22.0%	5.66	Hot, sunny, slight wind
MAR 18	35	23.0%	5.69	Hot, sunny, calm
MAR 31	35	16.8%	6.60	Very hot, sunny, calm
APR 9	35	19.1%	4.06	Mild, overcast, light wind
AUG 24	35	13.1%	3.65	Mild, rain showers all day,ca
SEPT26	42	16.7%	4.67	Cool, fine, moderate wind
NOV 22	45	16.9%	5.82	Warm, overcast, light breeze
	MEANS	18.2%	5.16	

NIGHT-PADDOCKS

MAR 10-11	35	25.0%	5.24	Mild, overcast, light wind
MAR 16-17	35	24.7%	5.06	Moderate, clear sky, light de
MAR 22-23	35	26.9%	4.89	Mild, clear sky, light dew
APR 2- 3	35	26.4%	3.83	Cool, clear sky, moderate dew
AUG 24-25	35	15.5%	4.13	Cool, overcast, slight rain a 2300 hrs.
SEPT18-19	39	16.0%	1.95	Mild, rain showers all night
	MEANS	22.4%	4.18	

TABLE XIIIB: 24 HOUR TOTAL INTAKE.

PERIOD	INTAKE TOTAL GALLONS PER COW	ESTIMATED PRODUCTION MILK/DAY/COW lbs.	RATIO Lbs. WATER PER lb. MILK
MAR 10-11+11	10.96	37.2	2.93
MAR 16-17+18	10.75	34.5	3.12
MAR 22-23+31	11.49	30.8	3.73
APR 2- 3+ 9	7.89	28.1	2.81
AUG24 +24-25	7.78	37.3	2.09
SEPT18-19+26	6.62	44.2	1.50
MEANS	9.24	35.4	2.79

TABLE XIVA: Free-water intake of lactating Jersey Cows.

DAY-PADDOCKS

DATE 1947	NO. OF COWS	D.M. % OF PASTURE	INTAKE GALLONS/ COW	REMARKS.
MAR 7	58	30.0%	6.83	Hot, sunny, calm
MAR19	63	41.0%	6.93	Hot, sunny, calm
APR 1	60	19.4%	3.17	Mild, slight rain, moderate wind
AUG15	52	20.2%	2.74	Mild, rain showers, calm
SEPT20	65	17.2%	3.83	Cool, no rain, light wind
NOV14	72	16.7%	4.12	Warm, fine, medium wind
	MEANS	24.0%	4.60	

NIGHT-PADDOCKS

MAR15-16	63	31.1%	2.57	Mild, clear sky, modeate dew
MAR18-19	64	30.8%	1.91	Mild, clear sky, heavy dew
MAR31-Apr1	58	35.6%	1.90	Mild, clear sky, heavy dew
SEPT 5-6	65	15.4%	1.85	Cool, avercast, rain at 2200 hrs.
SEPT26-27	65	18.3%	1.46	Cool, light wind, rain showers during night.
SEPT20-21	65	16.1%	2.38	Mild, overcast, no rain, light wind.
NOV14-15	72	15.3%	2.63	Moderate, clear sky, medium wind, no dew.
	MEANS	23.2%	2.10	

TABLE XIVB: 24 HOUR TOTAL INTAKE

PERIOD	INTAKE TOTAL GALLS/COW	ESTIMATED PRODUCTION MILK/DAY/COW lbs.	RATIO lbs. WATER PER lbs. MILK.
MAR7+15-16	9.40	19.3	4.87
MAR18-19Z19	8.84	17.9	4.94
MAR31+APR1	5.07	15.2	3.34
AUG15+SEPT5-6	4.59	28.6	1.60
SEPT30+20-21	6.21	29.8	2.08
NOV14+14-15	6.75	30.0	2.25
MEANS	6.81	23.5	3.18

TABLE XV A: Free-water intake of lactating Friesian and Jersey Cows (Combined Winter Herd.)

DAY - PADDOCKS.

Date 1947.	No.Cows of each Breed.	Total No. Cows.	D.M.% of Pasture	Intake Gals per Cow.	REMARKS.
May 17	22F & 23J	45	18.1%	4.02	Cool,Cloudy,Easterly
May 31	17F & 6J	23	23.3%	5.48	Moderate,overcast,hvy
Jun 26	19F & 14J	23	-	1.18	Continuous heavy rain a
Jun 27	19F & 12J	31	-	3.29	Cool,Hvy rain at 1200
Jul. 1	19F & 13J	32	22.3%	5.09	Moderate,sunny after
Jul. 5	19F & 7J	26	23.5%	7.54	Moderate,sunny light
Jul. 8	20F & 7J	27	22.1%	5.97	Moderate,sunny after
Jul. 9	20F & 7J	27	25.4%	5.85	Cool,o'cast,no rain,li
Jul.10	20F & 8J	28	-	2.54	Rain showers all day.
Jul.25	23F & 16J	39	21.6%	5.28	Mod.,sunny,frost in m
			MEAN	4.62	

NIGHT - PADDOCKS.

May 12-13	23F & 41J	64	18.7%	.83	Mild,Hvy dew, calm.
Jun 27-28	19F & 14J	33	-	4.94	Cool,Hvy rain after 1
Jul 1-2	19F & 13J	32	24.1%	2.88	Cool,clear sky,easter
Jul 8-9	20F & 7J	27	22.6%	3.93	Cold,clear sky,frost
Jul 9-10	20F & 8J	28	20.5%	1.54	Cool,ov'cast,rain at
Jul 10-11	20F & 8J	28	-	1.32	Much rain during nig
Jul 11-12	20F & 8J	28	-	1.35	Much rain during eve
Jul 25-26	24F & 17J	41	23.4%	3.37	Cold,clear sky,frost
			MEAN	2.52	

TABLE XV B; 24 Hour Total Intake.

PERIOD	Intake Total Galls Per Cow.	Estimated Production Milk/Day/Cow (Factory Returns)	Ratio Lbs Water per lb Milk.
June 27-28	8.23	27.4	3.00
July 1-2	7.97	25.3	3.15
July 8-9	9.90	26.5	3.74
July 9-10	7.39	27.3	2.92
July 10-11	3.96	25.7	1.54
July 25-26	8.65	28.0	3.09
MEANS	7.68	26.7	2.91

DISCUSSION:

Comparisons within and between Tables XIII, XIV and XV reveal that:-

(1) The average 24 hour water consumption for Friesian and Jersey cows over the whole experimental period was 9.24 and 6.81 gallons respectively. The average estimated milk productior per cow per 24 hours * over the same period was 35.4lbs (Friesiar and 23.5lbs (Jerseys).

(2) The dry matter content of the pasture exerts a marked effect on water consumption such that, under comparable climatic conditions in March, for example, Jersey cows consumed more water than the Friesians, even though producing, at that time, only 52% as much milk.

(3) Water consumption varies greatly under different weather conditions, presumably through the effect of rain, dew or frost on the D.M. content of the feed. It should be noted that the results for the column "D.M.Content of Pasture" were determined, for the most part, on dry pasture samples and therefore do not necessarily indicate the effect of rain, dew, or frost. Their significance is further obscured by the fact that no D.M. determinations were made on any supplements, which themselves were subject to varying weather conditions.

(4) The higher average ratio of water intake: estimated milk production in the case of Jerseys (Tables XIII B and XIV B) is probably because they generally received less succulent pasture than Friesians during the March-April period.This explanation is strengthened by the fact that the ratio for the Combined Herd (Table XV B.) is intermediate between that for the Jerseys and Friesians separately. In any case, no breed difference in the proportion of water intake: milk production has been reported in the literature.

* Calculated by interpolation from Group Herd Test Monthly Sheets over the same period.

(5) The per-centage of the total 24 hour intake consumed on the day paddocks is given below.

Friesians	55.8%
Jerseys	67.5%
Combined Herd	60.1%
MEAN	61.1%

In view of overseas results demonstrating that water intake shows a close relationship to dry matter ingested (37), (1), (38), (39), (40), and (41) it is considered that the above results enable us to extend the conclusions already drawn from a study of herd behaviour (Section I.). Thus, the fact that dairy cows spend some 60% of their 24 hour grazing time on the day paddocks (Section I.)(17), and also consume 60% of their free water on the same paddocks, leads to the conclusion that, under our conditions, the dry matter intake is in the same proportion between day and night paddocks as grazing time and water intake, viz 60: 40.

(6) The effect of hot, sunny weather (when the maximum temperature was above 70° F.) of increasing water intake is not surprising in view of the role of water in heat elimination. (1) Similar conclusions have been reached elsewhere (42), (43),.

It is also to be expected that a relationship exists between the water intake and average body weight of the two breeds, although, according to Gowan milk production is to some extent a function of body weight.

It has been pointed out (1) that although there is a relative constancy between water intake, feed level, and milk production under similar conditions, this stability is often masked by daily fluctuations of a temporary nature due to various causes. While not enough data are available in this study to demonstrate statistical significance, the variation in the figures presented agree with overseas results. This temporary variation is advanced as a reason for the abnormally high water consumption on the night of June 27-28 (Table XV A, Combined Herd). It should also be remembered that at high levels of production, the water in the milk represents a greater proportion of total water requirements, so that the ratio of free water: milk will vary accordingly.

The data presented on the water intake of cows are of interest in emphasizing the importance of an ample supply, the variation in average daily consumption due to weather, and the difference between Friesians and Jerseys. While Atkeson and Warren (36) conclude that the most dependable method of measuring the water requirements of cows consists of the water in milk plus a definite amount of water per pound of dry matter, we must agree with them when they point out that attempting to arrive at average figures applicable even in a general way to all cows is a matter of great difficulty except under strictly controlled conditions.

Comparison of our own and overseas results indicates that New Zealand dairy cows consume considerably less free water than dairy cows in the United Kingdom and the United States, where it is generally agreed that some 15-30 gallons per day of free water are necessary (44). Since many dairy herds in the United Kingdom apparently become accustomed to receiving water only twice a day (45) it seems possible that New Zealand cows, requiring less water, need be watered only in the yard during milking, with a considerable saving of reticulation costs on most farms. Before recommending such a practice, more information on a field scale is required, while the effect of high temperatures in increasing the number of drinks (17) may be an additional factor under New Zealand conditions, where several dairying districts sometimes suffer from periods of hot dry weather.

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SECTION 1V INDIVIDUAL BEHAVIOUR

As mentioned on page 9, some observations were made ,where practicable, on individual cows, and some of the results are given in Tables XV1 and XV11. A few night observations were discarded as being unreliable.

The figures in red are the per-centages of total time devoted to each activity, while for comparison herd behaviour on the same day is given.(for grazing only) in the last column. As might be expected, the times which individual animals spend grazing tend to vary in the same manner as herd behaviour on that particular day and it is believed that the quantity and quality of the feed available is largely responsible for this variation.

The Dairy Research Institute have been conducting an experiment in which one group of cows are kept before calving on a very low plane of nutrition, and the opportunity was taken, on Aug. 4, to make an observation on six dry Jersey cows, and a detailed study of two of them. The following results were obtained:-

Time in Paddock	Average hours per cow spent: Grazing	Standing	Lying	Cudding
8.50 hrs (0700-1530)	5.86hrs (70.2%)	2.94hrs (29.8%)	nil ___	.33hrs (3.9%)

One animal spent 85% of the time grazing, and another 72%. The feed available for these cows was extremely poor, such that no pasture could be clipped with the grass shears, but some 5½ lbs. of hay/cow was fed out. It is worth recording the remarkable way in which the animals were able to consume every straw, so that there was no trace of hay left within an hour. These results are quoted because they show:-

(a) The foraging ability of cows on pasture classed as poor, even for sheep.

(b) Under such conditions they grazed 70% of 8.5hrs as compared with 59% of 8.6hrs (Table V page 36)or only 11% more than lactating cows on normal pasture, which is within their

TABLE XVI: Behaviour of Individual Cows
Friesians-Day Paddocks

Cow	Pad. No.	Date 1947	Time Spent Grazing min.	Standing min.	Lying min.	Cudding min.	No. Drinks	Time on Paddock min.	Herd Grazing Behaviour min.
"Redbreast"	18	7/1	330	15	195	—	2	540	323
		%	61	3	36			100	60
"Whitey"	18	7/1	305	60	175	—	3	540	323
		%	57	11	32			100	60
"Redbreast"	21	8/1	375	10	150	—	2	535	380
		%	70	2	28			100	72
"Whitey"	21	8/1	390	35	110	—	1	535	380
		%	73	7	20			100	72
"Redbreast"	28	15/1	440	20	85	—	2	545	333
		%	81	4	16			100	61
"Whitey"	28	15/1	370	40	135	—	1	545	333
		%	68	7	25			100	61
"Redbreast"	4	31/3	320	190	50	105	3	560	314
		%	57	34	9	19		100	56
"Lottie"	4	17/5	340	85	50	65	1	475	298
		%	72	18	11	14		100	63
"Lottie"	19	31/5	345	35	95	30	2	475	253
		%	73	7	20	6		100	56
"Utility"	19	31/5	315	65	95	75	1	475	253
		%	66	14	20	16		100	56
"Verna"	21	25/7	279	133	113	140	1	525	282
		%	53	25	22	27		100	54
"Superb"	11	24/8	360	45	158	110	2	560	360
		%	64	8	28	20		100	66
"Yelda"	11	24/8	355	53	152	65	1	560	360
		%	63	10	27	12		100	66
"Winter"	11	24/8	485	nil	75	27	2	560	360
		%	87		13	5		100	66
"Lottie"	4	22/11	335	55	155	65	2	545	290
		%	62	10	28	12		100	53

TABLE XVII : Jerseys-Day Paddocks

"Vesper"	(21)	18/2	356	102	42	65	2	500	—
		%	71	20	8	13		100	
"Vesper"	(30)	21/2	315	123	97	58	2	535	318
		%	59	23	18	11		100	61
"Unit"	(10)	25/2	293	44	253	106	1	590	306
		%	50	8	43	18		100	58
"Unit"	(30)	4/3	223	109	228	64	2	560	287
		%	40	20	41	11		100	52
"Vesper"	(30)	4/3	342	70	138	38	2	550	287
		%	62	13	25	7		100	52
"Iris"	19	7/3	405	85	65	60	3	555	340
		%	73	15	12	11		100	61
"Vim"	(30)	18/4	310	220	nil	120	1	530	343
		%	58	42		23		100	65
"Toy"	23	20/3	250	290	20	205	4	560	298
		%	45	52	4	37		100	53
"Toy"	4	17/5	320	145	10	65	3	475	337
		%	67	31	2	14		100	72
"Toy"	19	31/5	295	180	nil	60	1	475	260
		%	62	38		13		100	58
"Una"	19	31/5	260	55	155	125	2	475	260
		%	55	12	33	26		100	58
"Toy"	3	27/6	250	185	55	85	1	490	223
		%	51	38	11	17		100	46
"Una"	3	27/6	175	265	50	88	—	490	223
		%	36	54	10	18		100	46
"Toy"	23	1/7	268	132	85	55	1	485	290
		%	55	27	18	11		100	60
"Una"	23	1/7	305	125	55	105	—	485	290
		%	63	26	11	22		100	60
"Brunnette"	28	20/9	315	140	50	20	2	505	307
		%	62	28	10	4		100	61

D.R.I. Paddocks shown in brackets

range of variation. These experimental cows were all dry, although almost at full term, and no data is available on their grazing behaviour subsequent to parturition.

The level of production of most of the cows used for these individual studies was considerably above the herd average, and an effort was made to test the assumption that high producers spend more time grazing than low producers. However, when the grazing times of the highest and lowest producers in the herd were arranged either together or separately by breeds, the standard error in each case was of the same order as the difference in grazing times; this being far outside the limits of significance, (46) the data proved inconclusive. Hancock and Wallace (17), under more strictly controlled conditions, found that grazing times are no guide to the feed requirements of cows, although whether all animals conform to theoretical standards (on which correlations of this nature must be based) is a matter which awaits further research.

Some studies of the distance walked were made, and the results are set out in Table XVIII. Although little data is available, it would appear that the distance travelled, which shows considerable variation , is governed by:-

(a) The amount and type of feed available
(b) The time devoted to grazing
(c) The size of the paddock

The comparatively short distance walked by the low plane cows "Yugo" and "Yodel" is probably because they were observed to graze more "intensively" on the meagre pasture available.

Although the mean distances travelled by the two breeds (Jerseys 2117 yards, Friesians 1549 yards) on the day paddocks is not great, it gives the animals a fairly complete coverage of the grazing area;(see Appendix 1) this feature was in evidence on both the day and night paddocks. Our results on the distance walked support those found by Hancock and Wallace(17) and by Johnstone-Wallace and Kennedy with beef cattle(15)

TABLE XVIII: Distances walked in paddock.
Jerseys.

Observation Period (1947)	No. and size of Paddock	Cow	Grazeable D.M./acre (lbs)	Time spent Grazing (min)	Distance Walked (yards)
Day Feb.18	(21). 2.62ac.	"Vesper"	——	356 71%	2455
Day Feb.21	(30) 1.90ac.	"Vesper"	655	315 59%	2140
Day Feb.25	(10) 1.24ac.	"Unit"	605	293 50%	1463
Day Mar. 4	(30) 1.90ac.	"Unit"	840	223 40%	1806
Day Mar. 7	19 5.74ac.	"Iris"	670	405 73%	3335
Day Apr.18	(30) 1.90ac.	"Vim"	230	310 58%	2194
Day May 17	4 6.24ac.	"Toy"	220	320 67%	2172
Day July 25	21	"Una"	810	281 54%	1370
Night Feb.26-27	(14)	"Unit"	——	272 37%	1520
Day Aug. 4	(9) 1.25ac.	"Yugo"	Low Plane	432 85%	2252
"	"	"Yodel"	"	367 72%	2245
		Friesians			
Day May 17	4 6.24ac.	"Lottie"	220	340 72%	2036
Day July 25	21 5.65ac	"Verna"	810	279 53%	1251
Day Aug.24	11 7.10ac	"Superb"	330	360 64%	1472
Day Aug.24	11 7.10ac	"Yelda"	330	355 63%	1440
Night Mar. 10-11	3 5.00ac	"Redbreast"	——	230 32%	1810

In Table XIX are given some data collected on the number of bites per minute while grazing, for each of the two breeds. The counts were made at half-hourly intervals while the animals under observation were grazing, and they have

been used to estimate the total number of bites per day.

TABLE XlX: Rate of eating on Day Paddocks.

FRIESIANS				JERSEYS			
Cow and Date	Grazing		Esti-mated total bites/ day	Cow and Date	Grazing		Esti-mated total bites/ day
	Avge. bites/ minute	Time (min)			Avge. bites/ minute	Time (min)	
"Red-breast" 31/3/47	58	320	18560	"Vesper" 18/2/47	48	356	17088
"Util-ity" 31/5/47	51	315	16065	"Iris" 7/3/47	45	405	18225
"Verna" 25/7/47	53	279	14787	"Toy" 17/5/47	49	320	15680
"Lottie" 22/11/47	49	335	16415	"Una" 25/7/47	47	281	13207
Means	53	312	16456	Means	47	341	15746

No significance can be demonstrated in the rate of eating between the two breeds on these data. It is interesting, however, to make a theoretical calculation of the number of bites per 24 hours. Although no regular observations were carried out on the rate of eating in the night paddocks, a few isolated counts on both breeds (not presented here) showed that the number of bites per minute was of the same order as on the day paddocks; this agrees with findings elswhere.(17)

Allowing, then, that the ratio of day: night paddock grazing is 60:40, and that the rate of eating is the same in both cases, the total number of bites in 24 hours is approximately 24,000. With an assumed daily dry matter intake of 25lbs (Jerseys), and 18% of dry matter in the pasture, it can be calculated that with each bite, a cow takes less than one-twelfth ounce of green herbage. This provides evidence from another direction that dairy cows, despite their size, can be very selective grazers.

DISCUSSION

The variation in behaviour between different cows is considerable, both in respect of grazing time and the number of grazing periods, since some animals on day paddocks may have four or five periods, while others have only two or three of longer duration. It was noticed, however, that the same cows tended to behave in the same fashion on different days, and in view of the very high correspondence reported in grazing within identical twin pairs,(17) it would seem that the grazing habits are genetically determined. Johnstone-Wallace and Kennedy (15) have stated that beef cattle do not graze longer than 7-8 hours in each 24 whatever the condition of the pasture, and although we made no continuous observations after 1530 hours on the low plane cows, it does seem likely that there is an upper limit to the time an animal will devote to gathering food. The fact that on several occasions the low plane cows were observed to be resting during the hours of darkness tends to strengthen this conclusion.

The times devoted to chewing the cud (page 58) show much variation, and in any case do not take account of cudding either in the yard or in the night paddocks. It was noticed nevertheless, that once a cow began ruminating, she could be relied on to persist without a pause for some 15-20 minutes, before abruptly stopping; this feature has been remarked on elswhere. (17)

The number of drinks varied from none to four, according to the weather and the type of food, although it often happened that animals went to the trough to drink only a small quantity if water. Most cows in the herd watered themselves before 1130 hours and this was especially noticeable after they had received hay. On the night paddocks, most of the herd drank water before settling down for the night, while the consumption in the yards was invariably negligible.

The figures for distance walked are mainly of academic interest, but also serve to illustrate how animals are able

to range over the whole of the grazing area, and they provide some further evidence of the superior foraging ability of Jerseys.

In connection with the rate of eating, the figures given in Table XlX are averages only, but a tendency was noticed for the number of bites per minute to decrease slightly towards the end of, and subsequent to the first grazing period.

These studies of individual animals have given us some factual evidence on the way a cow divides her day into well-defined periods of different activities, so that once grazing begins, animals generally persist in this action for at least twenty consecutive minutes, and usually much longer. A similar persistency of action is apparent when ruminating, but not when standing or lying down.

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SUMMARY AND CONCLUSIONS

(1) The circumstances of this investigation were such that it was impossible to control the many variable factors governing the behaviour of dairy cows(page 1) and it was decided, therefore, to carry out a survey with the object of establishing a standard of behaviour for lactating Friesian and Jersey cows over a period of eleven months.

(2) The literature pertaining to animal behaviour has been briefly reviewed (page 3)

(3) The criticisms of the method adopted were caused, in the main, by physical rather than technical limitations, while the feeding of supplements tended to confuse the interpretation of the results.(pp 7-15)

(4) A considerable body of data from observations carried out on the Massey College Herds have been presented and discussed under the headings Herd Behaviour, Breed Comparisons, Water Consumption, and Individual Behaviour. (pp 16-63)

(5) The following conclusions were arrived at:-

(A) Dairy cattle are regular in their habits, having four feeding cycles during daylight and one during the night.

(B) While weather conditions have been shown to have some effect on animal behaviour, specially air temperature and rain, they do not inter fere greatly with feeding activities.

(C) Dairy cows spend approximately one-third of each 24 hours in feeding activities, which are divided between day and night paddocks in the ratio of 60:40.

(D) The time devoted to grazing varies with the season so that less is done during the winter months.

(E) No statistically significant differences were found between Jerseys and Friesians, but there was a tendency for Jerseys to graze slightly longer on the night paddocks.

(F) Dairy cows can be very selective feeders, and in this respect, Jerseys are superior to Friesians.

(G) The free-water consumption of 9.24 and 6.81 gallons for

Friesians and Jerseys respectively is largely influenced by the dry matter content of the feed, and by milk production.

(H) The average day:night water consumption ratio agrees with the day:night grazing ratio; hence the conclusion that the dry matter intake is in the same ratio.

(I) No significant relationship could be established between the time spent grazing of the highest and lowest producing cows in the herd.

(J) No significant difference between the two breeds in the number of bites per minute could be established.

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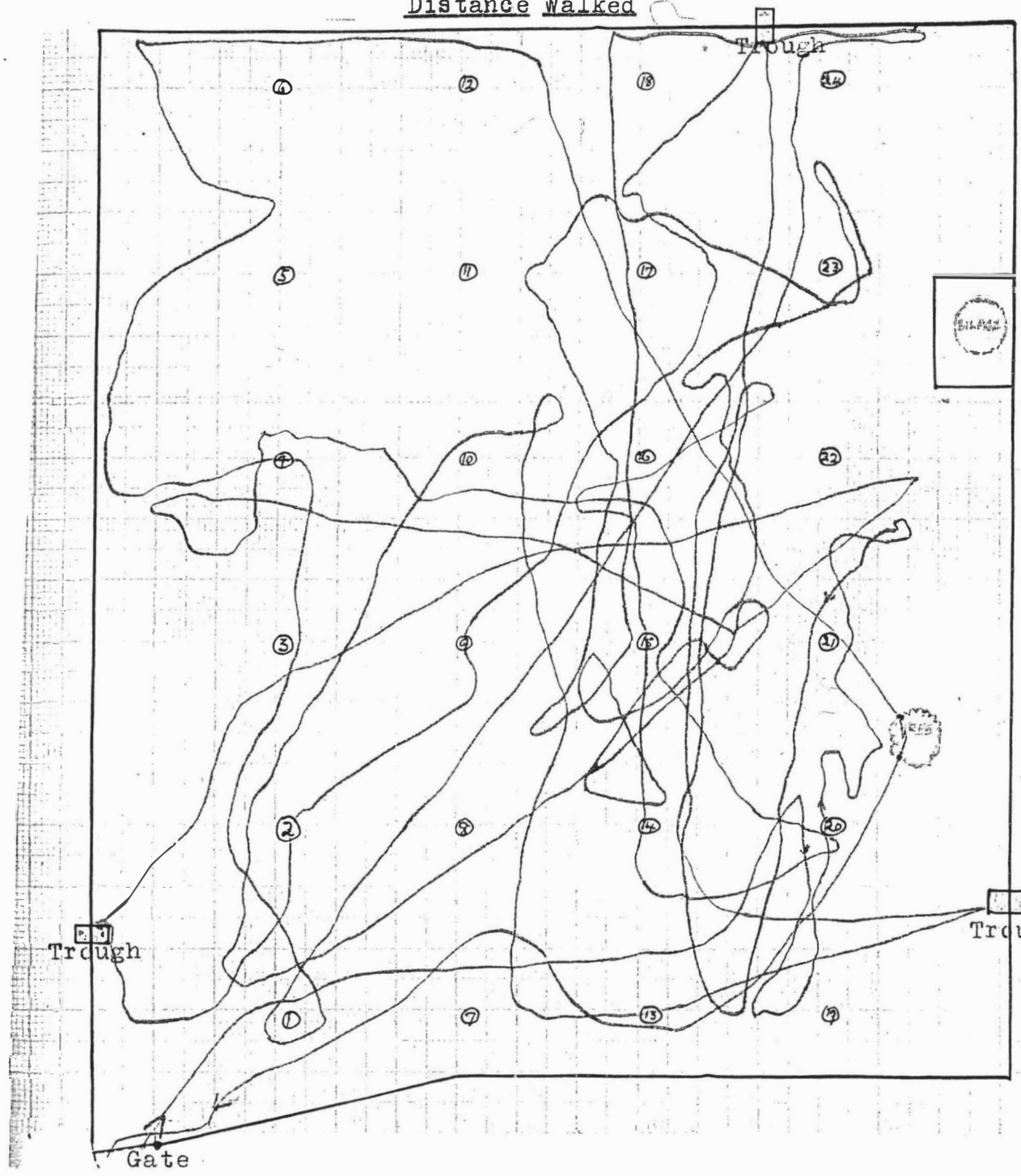
APPENDIX I Diagram of paddock 21 D.R.I. Farm Feb. 18
Distance Walked



Cow under observation: "Vesper" No.77

Numbered pegs placed in the ground at 22 yard intervals

The path travelled by "Vesper" is plotted in relation to the numbered pegs.

Scale: 3cm. = 22 yards

APPENDIX II: The weights of 30 bales of hay selected at random on Feb. 3, 1947.

Number	Weight (lbs)	Number	Weight (lbs)
1	52.6	17	48.9
2	50.9	18	49.7
3	51.0	19	50.7
4	47.4	20	49.8
5	52.3	21	49.5
6	49.5	22	49.3
7	48.8	23	51.2
8	49.8	24	50.4
9	50.1	25	50.0
10	50.6	26	50.5
11	49.3	27	49.7
12	50.0	28	50.7
13	49.1	29	51.2
14	51.0	30	48.7
15	50.2	Mean	50.1
16	50.3		

APPENDIX III : Illustrating the type of data collected in the Field Notebook.

Herd Behaviour. Paddock 21 (Winter Grass)

July 25 Combined Herd

Time	Friesians			Jerseys		
	No. Grazing	No. Standing	No. Lying	No. Grazing	No. Standing	No. Lying
0640	23	—	—	16	—	—
0650	23	—	—	16	—	—
0700	23	—	—	16	—	—
0710	23	—	—	16	—	—
0720	23	—	—	16	—	—
0730	23	—	—	14	2	—
0740	23	—	—	14	2	—
0750	22	1	—	13	3	—
0800	19	3	1	10	6	—
0810	9	9	5	6	10	—
0820	6	7	10	5	11	—
0830	3	5	15	7	8	1
0840	3	3	17	5	9	2
0850	4	1	18	8	5	3
0900	3	2	18	4	9	3
0910	6	1	16	7	6	3
0920	22	1	—	7	7	2
0930	23	—	—	12	3	1
0940	22	1	—	12	3	1
0950	23	—	—	13	2	1
1000	22	1	—	13	2	1
1010	20	3	—	14	1	1
1020	19	4	—	11	3	2
1030	14	7	2	8	5	3
1040	18	2	3	7	3	6
1050	14	4	5	6	6	4
1100	12	9	2	6	8	2
1110	7	13	3	5	9	2
1120	4	17	2	3	11	2
1130	3	16	4	3	6	7
1140	8	2	13	5	1	10
1150	7	1	15	5	—	11
1200	8	—	15	7	—	9
1210	8	—	15	7	1	8
1220	8	—	15	8	1	7
1230	9	1	13	7	—	9
1240	5	—	18	5	1	10
1250	5	—	18	6	1	9
1300	8	5	10	7	1	8
1310	9	2	12	8	2	6
1320	6	2	15	5	5	6
. . . . .	et cetera.					
1520	11	10	2	10	4	2
1530	10	11	2	9	5	2

Remarks: All cows entered paddock at 0640 hrs
4 Bales good hay fed at 0920 hrs
Cows removed at 1530 hrs
Weather:
Condition of pasture.