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ACTIVITIES OF CATTLE AT PASTURE

by

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DISSERTATION FOR B.Sc. AGRIC. (SPECIAL)

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## ACTIVITIES OF CATTLE AT PASTURE

### S U M M A R Y

The need for the study of pasturing activities of indigenous animals is outlined as a possible basis for improving animal production.

The study is in three parts:-

- (i) Under local husbandry, free ranging, on natural grassland, to find out how much browse the animals take on free range. It is estimated that the local animal takes about 20% browse and 80% grass, in the dry season under conditions akin to Katamansu. This supplies about 0.81b digestible protein which satisfies the estimate required for rapid growth. This contrasts with about 0.371b estimated for Ashaley Botwey and explains the differences in condition of animals in the 2 places.
- (ii) On woody pastures to find out how much Grewia, in ample supply, would contribute to the diet of the local animal. The proportions recorded are about 40%: 60% of browse to grass.
- (iii) On Centrosema-Pangola pastures: to study the reaction of local animals to artificial pasture.

The factors affecting behaviour are discussed, referring to work elsewhere.

The relevance of the behaviour patterns observed is discussed with respect to husbandry implications.

It is shown that the grazing times recorded in the 3 situations are not necessarily proportional to respective intakes.

## I. INTRODUCTION

Grazing is generally recognised as the cheapest way of feeding ruminants. In most of Africa, it is the only way. To maximise the benefits from pasture, the livestock man must be in rapport with the grazing animal. Thus a study of the grazing habit is more than a mere academic exercise. This view has been held widely and various practical applications of such studies have been suggested (Wardrop 1953, Thorpe 1953, Tulloh 1961, Taylor 1964, Taylor 1953, Levy 1935).

Interest in behaviour studies dates back to 1787. (James Anderson cited by D.E. Johnstone-Wallace 1944 and John M. Wilson 1845, cited *ibid*). Systematic investigation into grazing behaviour were conducted from 1925-1928, by Stapledon and Jones (1925-1926), Cory (1927), Woodman et al (1927), H.H. Green (1925) Nevens (1927) and Fuller (1928).

Thereafter, knowledge of the activities of the grazing animal has accumulated steadily, but little information is available from tropical habitats.

In the low latitude, African tropics, where fodder conservation is alien to native peasant farming and its introduction is fraught with grave socio-economic problems, dependence on pasturing, (even into the dry season) is absolute. The importance of pasture utilisation work in Ghana is better visualised in the light of the urgent demand to multiply animal production. Thus a study of the native animal under various pasture conditions is called for as a possible basis of pasture and animal improvement work.

Grazing behaviour studies in the tropics began barely a decade ago, during which period about a dozen workers have reported such investigations. Of these only a few worked on indigenous animals. The only reports on the behaviour of free ranging cattle on natural pasture are by Smith (1959) and Payne et al (1951). West Tropical Africa's contributions are represented by two records, Rose Innes (1963) Rose Innes and Maby (1964).

The present work falls into three parts:-

1. Natural grassland under native methods of management.

2. "Woody-Pastures" with "Simulated-Shrubs" and natural grass.
3. Planted introduced pastures.

PART I: NATURAL GRASSLAND UNDER NATIVE METHODS  
OF MANAGEMENT

The importance of browse component in the dry season diet of the local animal in a peasant herd has been mentioned by Steward (1931), Rose Innes (1961) and others. This study is an attempt to look further into the species favoured and the contribution of browses to the diet under these conditions.

PART 2: WOODY-PASTURES WITH SIMULATED SHRUBS AND  
NATURAL GRASS

Lansbury (1960, 1959a, 1958a) Oyemga (1955a, 1958); Rose Innes (1959); Rose Innes and Mabey (1964), have pointed out the nutritional deficiencies of native grassland. However it has been observed that the condition of local cattle especially in the dry season is even better than their digestive efficiency and low maintenance requirements would allow (Oyemga 1958; Lansbury 1958a & b, 1956, 1960; R. Innes & Mabey 1964; R. Innes 1961, 1960). Lansbury (1960) and Rose Innes (1961) have traced the source of nutrient supply to browse species. Rose Innes and Mabey (1961 et seq.), have been investigating the contribution of various browse supply to the dietary intake of native cattle. This section of the present investigations formed part of this series of browse studies.

PART 3: PLANTED INTRODUCED PASTURES

The introduction of high yielding nutritious sown pastures may be regarded as the ultimate in ruminant feeding if costs of establishment and management are justified. This approach has great possibilities in Ghana with the prospect of irrigation from the Volta Dam, and openings to ley-farming. Digitaria decumbens and Centrosema pubescens are favoured in the literature as promising tropical pasture species.

(Oakes A.J. 1960; S. Little et al 1959; and Anon 1957; cited by Oakes; Wilson and Lansbury 1958; Richards 1965; Grieve and Osbourn 1965; Whyte R.O. 1962; Okorie et al 1965; Avram & Sigman 1962; Millroy R.T. 1964; and Forster and Mundy 1961). Centrosema was introduced into Ghana in 1926. (Wilson and Lansbury 1958). Dig. decumbens (Pangola grass) is a more recent introduction. Both have established well in Ghana, but no work has been done on their use as pasture species.

The work described aims at studying <sup>the</sup> animals behaviour on them as a step in investigating their utilisation.

## II. DEFINITIONS OF TERMS

### Grazing and browsing

The gathering and swallowing of herbage including short walks in-between bites.

Roving grazing: grazing while trekking.

Settled grazing: grazing up and down in a given area, contrasting with "roving" grazing.

### Rumination:

This is restricted to regurgitation, mastication of the bolus and reswallowing.

### Idling:

Refers to activities other than grazing and ruminating and thus it incorporates, fighting grooming, playing etc.

### Standing and lying:

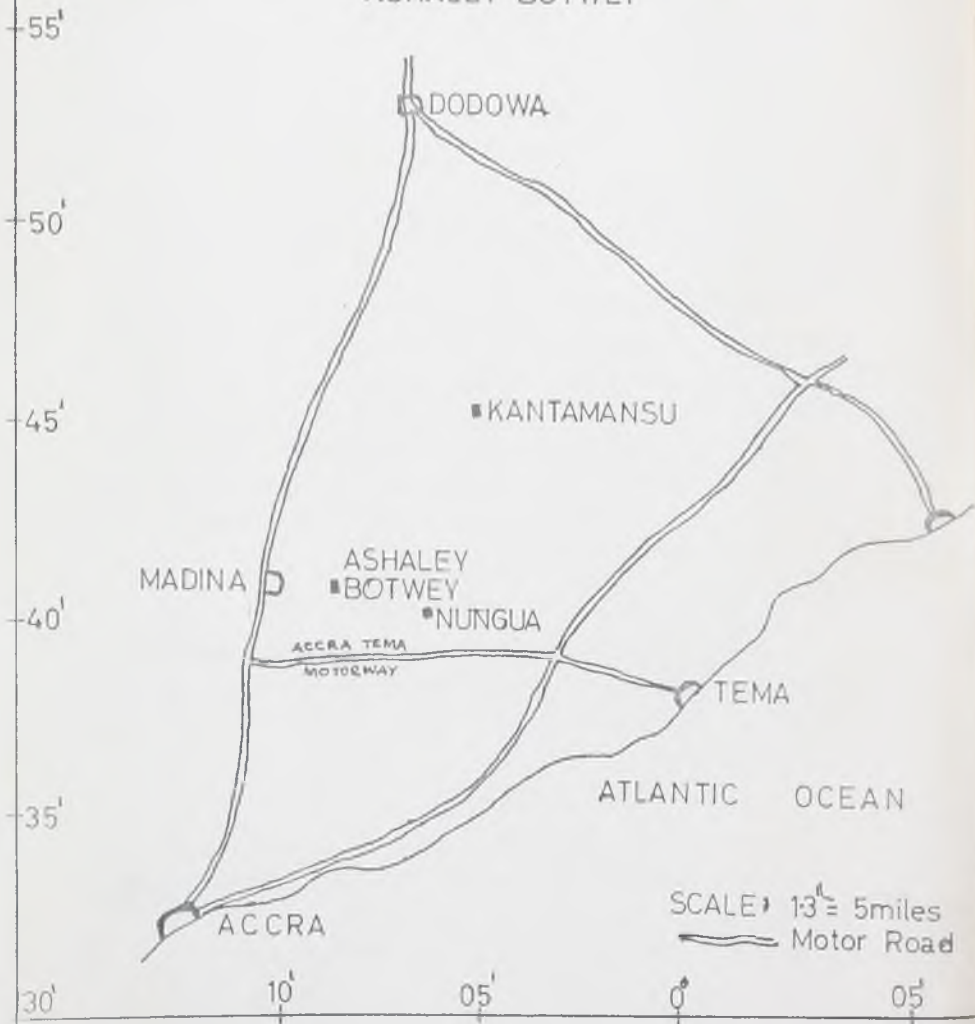
Standing may be combined with any of the three activities above and includes walking time. Lying may be confined with either of the last two activities.

### 'Woody-Pastures'

Ross-Innes used this term to describe pastures of natural grazing interspersed with woody legumes found in the local natural grasslands. (Ross-Innes 1965).

FIG. M

THE POSITIONS OF NUNGUA KATAMANSU AND  
ASHALEY BOTWEY



### III. MATERIALS AND METHODS

#### A. BEHAVIOUR ON NATURAL GRASSLAND UNDER NATIVE METHODS OF MANAGEMENT

This was carried out at two sites:

- (a) Katamansu
- (b) Ashaley Botwey

##### i. GEOGRAPHICAL LOCATION

###### a. Katamansu

This village is 10 miles NW of Tema and 30 miles NE of Accra as the crow flies. The map reference is roughly  $5^{\circ}45' N$ ,  $0^{\circ}05' W$ . (See Fig. M).

The grazing grounds lie to the West and North of the village up to the Dodowa-Accra Road. The daily rounks vary with season. In the wet season when pasture is lush, cattle graze within 1 mile of the kraals but in the dry season (as during these observations), they trek upwards of about  $3\frac{1}{2}$  miles out. In very severe droughts the animals were formerly taken to the fringe of the forest around Dodowa, over 10 miles away. This has been obviated by the building of a 150' x 2,640' dam (Ahn, 1965).

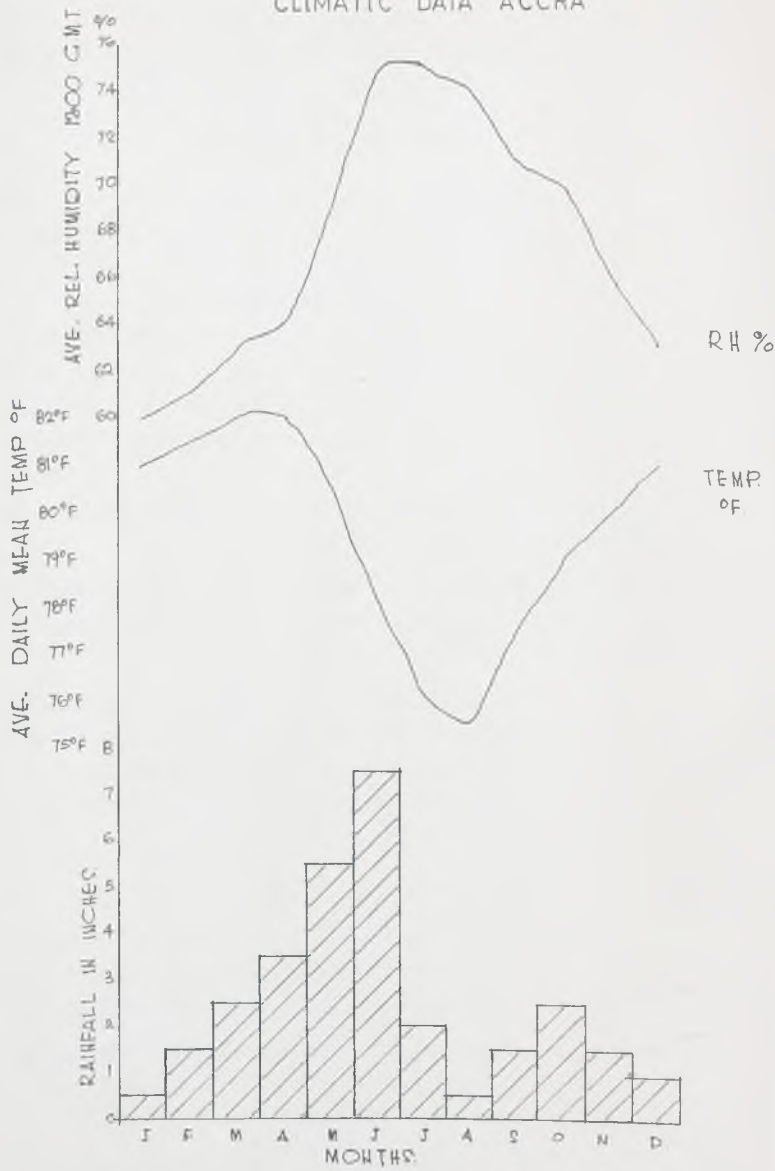
###### b. Ashaley Botwey

Ashaley Botwey is about 2 miles West of the University Farm, Nungua. The ranges extend from the Madina valley in the South to the Accra-Dodowa Road in the West, and North. Eastwards, the cattle graze as far as the Nungua Farm. (See Fig. M)

##### ii. CLIMATE

Climatic conditions in this section of the Accra plains are as shown by the climatic data recorded at the Accra International Airport (Fig. 23). Mean annual rainfall in Katamansu is higher than at Ashaley Botwey - about 35" and 28" respectively.

FIG 23  
CLIMATIC DATA ACCRA



The minimum temperature for the area is 63°F in December, the maximum is in February; 97°F. Relative humidity is about 96% at 05.00 hours GMT, reducing to 64% at 15.00 hours. X

### iii. SOILS AND DRAINAGE

Much of the area is clayey soil underlain by basic gneisses and schists and Archaean acid gneisses and schists (RF Lexton 1955). The fields of Ashaley Botwey are a gently rolling peneplain type whereas Katamansu has a strongly undulating physiography. The soils at Katamansu are therefore better drained and show more of upland red lateritic concretionary types with occasional out crops of indurated iron stone on the slopes. The slopes are less concretionary and more sandy. There is a graying of colour down slope with decrease in clay and increase in sand in the subsoils (RF Lexton 1955). Few patches of heavy clay soils were encountered in the Katamansu ranges, in contrast to those near Ashaley Botwey.

The valleys are generally dry except in the rainy season when ground water from the Akwapim ranges drains through them. They are then flooded, in some cases for months.

The main drainage systems are the Katamansu Kpaakpoh, Katamansu-Dsoowulu and Prafraha streams and their tributaries. All these fill seasonally breaking up into small permanent waterholes in the dry season. These and several ponds and three dams offered watering for the animals during the observations.

### iv. VEGETATION

Generally the vegetation is a sparsely distributed proclimax fire-controlled tree savanna (Pougey A.S. 1957) (Rose Innes 1962). Shrubs and trees are associated in thickets with mounds of *Macrotermes* sp.

Katamansu vegetation is more luxuriant and the shrubs are more frequent than Ashaley Botwey. This is due at least in part to the following:



Plate 1

Herbage in copious supply at  
Katamansu. Compare with  
Plates 3 and 6.



Plate 2  
Abandoned settlement at  
Ashaley Botway.

- (i) The heavier rainfall at Katamansu.
- (ii) The less intensive grazing; the stocking rate is low whereas Ashaley Botway has reached carrying capacity;
- (iii) The better drained soils;
- (iv) Shifting-cultivation has been in operation in Ashaley Botway for a considerable period of time but Katamansu lands are only now being opened up;
- (v) Tree cutting for firewood and charcoal has only now been started, at Katamansu, but <sup>has</sup> probably been going on for the past 10 years or more at Ashaley Botway. Lorries driving into the bush to bring the faggots doubtless contribute to the denudation of the vegetation;
- (vi) Less frequent severe burning at Katamansu, tied up with the less intensive land use and with the fact that fire is more destructive to woody species in open broken thicket than in denser thicket. (See Plates 1 and 3).

The vegetation of the ranges may be divided into:

- (i) Upland woody type
- (ii) Valley grassy type and
- (iii) The slopes; mixed tall-medium grass with shrubs.

Well drained upland soils and termitaria are inhabited by shrubs and trees. The species here include Griffonia simplicifolia, Baphia nitida, Capparis thoningii, C. erythrocarpos, Ritchiea reflexa, Grewia carpinifolia, Fagara zanthoxyloides, Lasiorhombia drupifera, Clausera anisata, Vernonia senegalensis, Dichapetalum guineense and Milletia thoningii whose frequency is higher at Katamansu than Ashaley Botway (where it is confined to termitaria).

At Katamansu impenetrable thickets were encountered on hills. In the Ashaley Botway ranges rectangular patches of closed dense thickets about 150 yards to 200 yards long and 75 to 150 yards were observed. (Plate 2) They were invariably fringed by indicators of abandoned settlements - Agave sisalana, Alce barteri, Thevetia peruviana

folia, Azadirachta indica, Capparis spp. Cassia species, and Fagara zanthoxyloides, occurred inwards. The ruins of a mud building, pieces of broken bottle and earthenware etc. confirmed they were secondary vegetation.

Medium to tall grasses like Andropogon gayanus, Panicum maximum, Hyparrhenia dissoluta, Cymbopogon giganteus, Oenone newtonii etc. were found frequently on the Katamansu hills and slopes and occasionally seen at Ashaley Botway.

Shrubs occurring in the tall-medium grasses are Gardenia species, Combretum chasalense and Diospyros mespiliformis. Dichrostachys glomerata occurs freely both upland and on slopes, outside thickets, even at Ashaley Botway. Rhynchosia minima, a creeping legume, occurs very widely on the transition between the slopes and valleys. It is suggested to contribute to the high fertility of the clay soils. Its abundance is a result of its unpalatability.

Rhyncholetrum repens and Imperata cylindrica, occur on abandoned farm sites. Heteropogon contortus occurs in pure stands on termitaria devoid of shrubs.

Vetiveria fulvibarbis, Brachiaria intermedia var acidula, increase in frequency as the slopes merge into the moister heavier soils of the valleys. Other grasses occurring here are Brachiaria falcifera, Monocymbium oeresiiforme, Imperata cylindrica.

Where the valleys are subjected to water logging, Andropogon gayanus, Paspalum, Sedges and Brachiaria spp, occur. Where valley bottoms are subjected to alternating seasonal flooding and dessication, few trees or shrubs are found, e.g. Mitrasyna.

Plantations of Azadirachta indica and Cassia extending to about three-quarters of a mile around the villages especially Katamansu serve as sources of firewood. The Azadirachta foci are sources from which birds and bats scatter seeds and spread the species at the expense of palatable species. Though this encroachment has not advanced far



Plate 3  
Cattle on range: Ashaley  
Botwey. Note lack of grazing.



Plate 4  
Spraying cattle: Katamansu

into the grazing lands, the distribution of these unpalatable plants around settlements foreshadows the potential danger they are to grazing lands as Dichrostachya glomerata is in Southern and Eastern Africa (Laxton 1955).

#### v. THE ANIMALS AND THEIR HUSBANDRY

Each of the two grazing areas is communally used by several herds belonging to different kraal owners. Each kraal owner has grazing rights over areas demarcated by water sheds recognised by all other users of the range.

As common throughout the Accra plains, a herd of cattle usually contains animals belonging to the kraal owner, his relatives, and friends. He hires a Fulani to tend the animals - appreciating the Fulani's traditional ability to look after cattle, and tacitly admitting his lack of understanding for cattle husbandry. For a large herd, the Fulani may in turn hire other Fulanis - whom he calls 'boys', to look after the animals.

In return the boy is usually given £4 to £5 a month, boarding and lodging, clothing and free medical care. The boy regards his employer as his father. The senior Fulani sells milk from the cows as his main wages. He also enjoys tips from buyers and from his kraal owner when there is a sale from his animals. The kraal owner is given a calf from every three for keeping animals for friends and relatives. Some Fulanis are kraal owners in their own right.

The Katamangu herd selected for the recordings consisted of about 100 West African Shorthorn and Sanga cows with 2 Gudali bulls. At Ashaley Botwey the observed herd numbered well over 200 head. The animals tend to be stunted and are inferior in condition to the Katamansu stock. This is the result of inferior husbandry and want of good grazing. (See Plates 3 and 6. Refer to section 1X: "Mixtures v/s their components").



Plate 5  
Cattle in their kraal.

The new flush of grass after burning is grazed too early. The influence of zebu bulls is less seen here than at Katamansu: a few West African Coastal Dwarf cows were in evidence.

The Katamansu cows are milked about 06.00 hours GMT daily, then any requiring special attention e.g. sick ones, are attended to. Between 08.30 and 0.9.30 they are released for grazing. They return at sundown between 17.00 and 18.30 to be kraaled. (Plate 5 Figs. 25 and 6).

At Ashaley Botwey the animals are grazed from about 03.30 - 04.30 hours till about 08.30 hours, when they return to the kraals for milking and are sent out again at about 10.00 - 11.00 till about 18.00 - 19.30 hours. Deticking at Katamansu is done fortnightly by spraying with Gammatox, by means of a stirrup pump immersed in a bucket of the mixture. See Plate 4. The animals are cast to gain access to the underaide. Elsewhere in the Accra plains little attention is given to ticks though Gammatox is sometimes applied by dabbing with cottonwool soaked with the mixture e.g. Ashaley Botwey. Hand removal of ticks is also practised, the tick being buried in fresh dung.

Castration is by crushing the spermalic cord, using a stone, after weaning it at about 1 year of age. Dehorning is not practised though at Katamansu the equipment is available. The stock boys agree this is desirable to prevent the sickening unsightly wounds due to goring.

Weaning is from 9 months but some 2 year olds were observed trying to suckle on range. Such persistent suckers are discouraged by clipping through their nostrils a metal loop pointed at the free end. This makes sucking impossible and indeed drinking uncomfortable, furthermore the dam kicks when pricked by the sharp end.

The main ailments are scours among wet-season calves. This is probably due to high milk production beyond the requirements of the calf resulting in overfeeding which precipitates the condition. Cows whose calves are constantly victims are milked very early e.g.

2 - 4 days postpartum instead of 2 weeks or more. This prevents the condition. Response to once weekly dosage of sulphamezathine is good. Worm infestation is a further complication which increases in the wet season. It is treated with phenothiazine. The Animal Health Department vaccinate annually against rinderpest.

The herdsmen treat local conditions by circum-cauterizing the affected part be it a goring wound or a swelling and allowing natural healing <sup>to</sup> take place. Strike maggots are removed after the sore has been bathed with gammatox undiluted.

The only local medicament known to these herdsmen is one for a retained after-birth; the author witnessed the effect of one drenching with the herbal preparation which brought out the placenta within a few hours.

There is no selection even in the Katamansu herds the aim still being numbers rather than quality of animals. Only a wasting chronic disease or other severe permanent incapacitation will qualify an animal for culling e.g. a cow with all 4 teats bad and unable therefore to nurse her young.

There is no organized marketing of cattle but butchers and others call at the kraals frequently. This system seems satisfactory for present levels of supply and demand. One Katamansu culled blind heifer was taken to Ashaiman butchers and found ready sale. Cattle theft is frequent at Katamansu but rare at Ashaley Botwey.

#### vi. GRASSLAND HUSBANDRY

The vegetation is burnt twice yearly in the dry season: January-February and September-October. Bush around villages is burnt by adventurous children to whom a bush fire is a gratifying sight. Out on range, rank dry herbage is set on fire by stockmen. The bush burns differentially and there is no plan to the burning, so patches of late, medium and early burnt occur side by side (Plate 8), thus encouraging a supply of fresh foliage through the dry season. The same



Plate 6  
Gully erosion hazard from  
cattle tracks. Ashaley  
Botwey.



Plate 7  
Browse species cut for  
firewood

piece of ground is not burnt each time. Occasionally a fire gets out of hand and claims many acres of thickets in its wake, these are however not easily destroyed.

The fires are responsible for the ellipsoid shape of the thickets with their long axis parallel to the prevailing wind. They are doubtless the main check on succession to the climax vegetation. (Keay 1951, Keay 1959, Thomas 1960, Ramsay & R. Innes 1961). It is when overgrazing and excessive trampling combine with devastating fires that the danger arises: erosion can be serious under such conditions. (Plate 6).

Firewood cutting and mistimed land cultivation are other human activities threatening grassland conservation. Apart from depriving the plains of shade indiscriminate lopping of wood claims some palatable and nutritious species e.g. Millettia thonningii, browsed in the dry season (Plate 7). If planned, such loppings could provide browse sprout for dry season feeding. Carried out at the end of the dry season and cut at the base, as they are now, the lopping will tend to exterminate the thickets. There is a threat of soil exposure to direct insolation and aggravation of soil erosion.

Wet season grazing is mostly on higher ground, the valleys being waterlogged. With the advent of the dry season, the valleys offer lush green pasture and grazing tends to be concentrated there.

#### vii. PROCEDURE

The leader of each herd was observed and its activities recorded continuously. The Katamansu leader was a 6 year old Sanga cow its 3rd calf, 4 months old, at foot. At Ashaley Potwey, the leader was a 7 year old West African Shorthorn whose third calf was 2 months old.

At night, the leader was difficult to distinguish so the general behaviour of the whole herd was recorded judging from which activity the majority were engaged in. The use of a flash lamp to observe the animals greatly startled them and was discontinued. Perhaps they would

have to be trained to flash lamp. But conditions would then be unnatural.

The size of the herd precluded use of the detailed <sup>observations</sup> according to the system employed at Nungua and Kpong. The attempt to observe animals which moved together failed. The only method found suitable for these conditions was to select one animal and supplement recording of her behaviour with observations of other animals in the herd. Continuous observation was chosen instead of fixed time interval observation because

- (i) with one animal this was possible;
- (ii) activities on range were few: mostly either feeding and/or walking;
- (iii) each activity was exhibited continuously for considerable periods which could be timed.

viii. RESULTS

RANGE: A-HALEY BOTWEY

AFTERNOON ROUNDS

TABLE 1

21/1/66

From 10.47

To 18.08 hrs. GMT.

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Moving	206	47.73
Feeding Settled	164	37.70
Walking Only	69	14.48
Idling/Watering	1	0.23
	<u>440</u>	<u>100.00</u>

22/1/66

From 11.32

To 18.53

<u>ACTIVITY</u>	<u>TIME: MINS</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	272	61.82
Feeding Settled	75	17.05
Walking Only	90	20.45
Watering/Idling	3	0.68
	<u>441</u>	<u>100.00</u>

29/1/66

	From 10.30	To 18.40	
<u>ACTIVITY</u>		<u>TIME: MINS.</u>	<u>% OF TOTAL TIME:</u>
Feeding Roving		190	46.34
Feeding Settled		150	36.59
Walking Only		70	17.07
Watering/Idling		$\frac{1}{2}$	
		<u>410</u>	<u>100.00</u>

30/1/66

	From 11.00	To 18.20	
<u>ACTIVITY</u>		<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving		179	45.89
Feeding Settled		113	28.98
Walking Only		81	20.97
walking/Idling		$16\frac{1}{2}$	4.16
		<u>380</u>	<u>100.00</u>

4/2/66

	From 10.45	To 19.14	
<u>ACTIVITY</u>		<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving		173	33.92
Feeding Settled		217	42.55
Walking Only		110	22.37
Idling/Watering		9	1.00
		<u>509</u>	<u>100.00</u>

ASHLEY BOTWEY

DASH ROUNDS

TABLE 2

28/1/66

	From 03.25	To 08.15	
<u>ACTIVITY</u>		<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving		153	52.76
Walking Only		42	14.48
Cudding & Idling		95	32.76
		<u>290</u>	<u>100.00</u>

6/2/66

From 04.00

To 08.05

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	150	61.22
Walking Only	55	22.45
Cudding & Idling	<u>40</u>	<u>16.33</u>
Total	<u>245</u>	<u>100.00</u>

TABLE 3: ESTIMATED TOTALS  
(Fig. 30)

22/1/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	520	74.29
Walking Only	114	16.28
Others	<u>66</u>	<u>9.43</u>
Total	<u>700</u>	<u>100.00</u>

23/1/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	497	70.50
Walking Only	140	19.85
Others	<u>68</u>	<u>9.65</u>
Total	<u>705</u>	<u>100.00</u>

29/1/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	490	72.59
Walking Only	120	17.78
Others	<u>65</u>	<u>9.63</u>
Total	<u>675</u>	<u>100.00</u>

30/1/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	442	67.48
Walking Only	131	20.00
Others	<u>82</u>	<u>12.52</u>
Total	<u>655</u>	<u>100.00</u>

4/2/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	540	69.68
Walking Only	160	20.64
Others	<u>75</u>	<u>9.68</u>
Total	<u>775</u>	<u>100.00</u>

TABLE 4  
RANGE: KATAMANSU

12/1/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
From 09.00	To 17.55	
Feeding Roving	250	46.73
Feeding Settled	196	40.72
Walking Only	49	5.07
Idling	15	2.81
Watering/Suckling	<u>25</u>	<u>4.67</u>
Total	<u>535</u>	<u>100.00</u>

14/1/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
From 09.00	To 17.25	
Feeding Roving	203	40.12
Feeding Settled	242	47.54
Walking Only	28	5.54
Idling	-	-
Watering/Suckling	<u>33</u>	<u>6.52</u>
Total	<u>505</u>	<u>100.00</u>

15/1/66

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
From 09.30	To 17.44	
Feeding Roving	320	64.52
Feeding Settled	117	23.58
Walking Only	34	6.86
Idling	-	-
Watering/Suckling	<u>23</u>	<u>5.04</u>
Total	<u>494</u>	<u>100.00</u>

17/1/66

From 09.35

To 17.50 hrs. GMT.

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	299	60.61
Feeding Settled	36	7.07
Walking Only	120	24.24
Idling	20	4.04
Watering/Suckling	<u>20</u>	<u>4.04</u>
Total	<u>495</u>	<u>100.00</u>

18/1/66

From 09.53

To 18.00

<u>ACTIVITY</u>	<u>TIME: MINS.</u>	<u>% OF TOTAL TIME</u>
Feeding Roving	293	60.95
Feeding Settled	101	20.66
Walking Only	70	13.43
Idling	0	-
Watering/Suckling	<u>23</u>	<u>4.96</u>
Total	<u>487</u>	<u>100.00</u>

B. BEHAVIOUR ON "WOODY PASTURES" WITH SIMULATED  
SHRUBS AND NATURAL GRASS - NUNGUA

1. GEOGRAPHICAL LOCATION

These observations were carried out on the Annexe to the University of Ghana's Agricultural Research Station Nungua (lat. 5°40' N, long 0°06' W).

ii. CLIMATIC CONDITIONS:

The general conditions of the Western Accra Plains are shown in Fig. 23: Climatic data, Accra. The time of observation was the dry season, November, when temperatures are generally high.

iii. SOILS AND VEGETATION:

The experiment was sited on flat upland fairly well drained sandy grey soils of the Simpa series. The general elevation is about 250' above sea level. The vegetation has been described as a fire - controlled proclimax peppercorn tree savannah, (Rose Innes 1963) with a few thickets on Macrotermes mounds dotted all over the land. Species recorded include Schizachyrium schweinfurthii (dominant), Gtenium newtonii, Hyparrhenia dissoluta, Andropogon gavanus, Cymbopogon giganteus, Andropogon canaliculatus. The grass was about 2-2½' high, tough and stemmy and in full flower.

The thickets are similar in botanical composition to those described under range activities, section A iv.

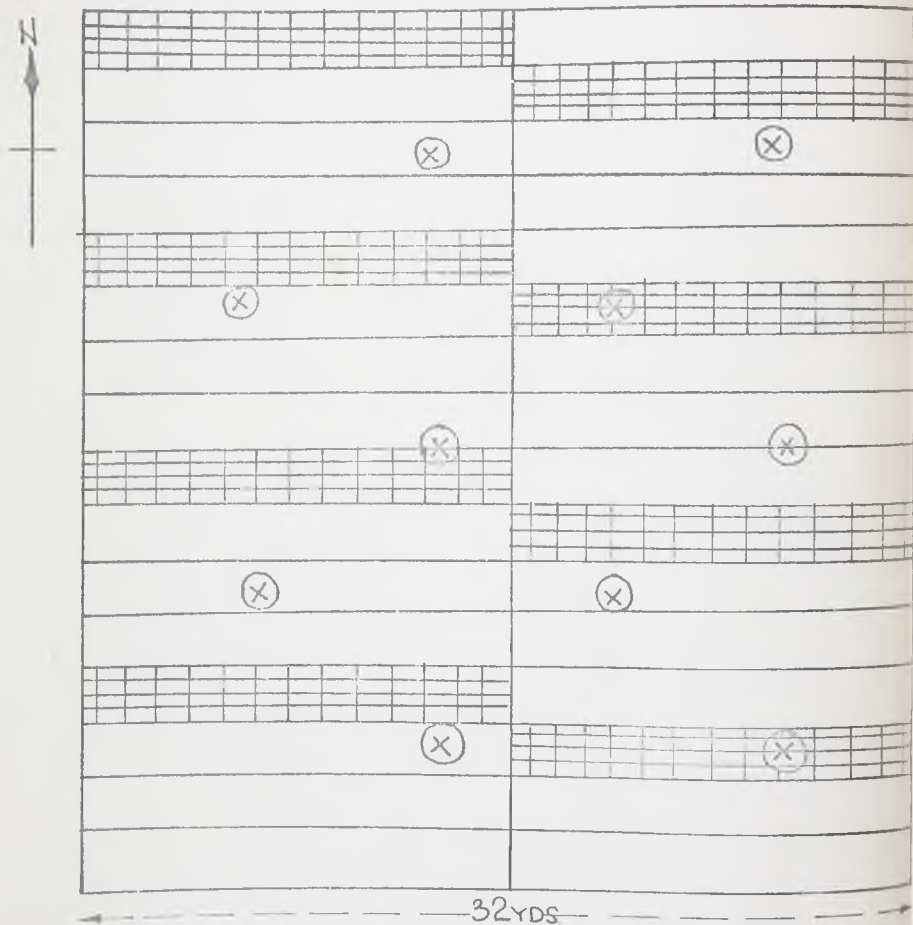
iv. THE ANIMALS

5 W.A. Shorthorn bullocks about 3 years of age were selected for their placid temperament and matched for weight. They weighed as follows:

No.	210	219	240	242	252
Wt.lbs.	670	645	648	596	595

All except No.252, had been used in a dry season fattening trial on concentrates. They had been trained to the electric fence and there was no problem in keeping them in the plot.

FIG 33  
THE WOODY PASTURES



CLIPPED BEFORE TRIAL



GREWIA BUNCHES,  
ON 'KUSIA STAKES'

v. THE PLOTS:

The browse/graze trials (Rose Innes and Mabey) of which this study forms a part set out to measure the intake of (a) browse and grass; (b) browse only, and (c) grass only, by native cattle. given free choice and ample supplies of the relevant feed. The shrub component was 'simulated' consisting of cut branches of the chosen species distributed on posts through the experimental grass plot. In a full scale investigation, each trial would be repeated several times. One species of shrub only was used for each investigation, in this case, Grewia carpinifolia. Measured intake was checked against observed feeding time whence these data are derived.

The browse-graze plot was divided into 32 strips, each 16 yards x 2 yards as shown (Fig.33). The original studies incorporate measurements of dry matter intake which entailed clipping before and after grazing. The shaded strips were clipped before grazing, their adjacent twins afterwards. The browse species, Grewia carpinifolia, was tied to 10 stakes evenly distributed in the plot, in bunches of 10lbs. The stakes were 'kusia' beams 3" square in cross section and about 5' long, driven 18" into the ground. The leaves hung down to about 1ft. off the ground. 2 six-inch nails at right angles through the top of the beams helped to anchor the bunches securely against tugging by the animals.

In the 'browse-only' trial, the plot was clipped clean with hand shears. The trial was delayed by technical hold-ups and sheep were sent in to graze down the sprouts a day before the observations. The stakes were planted as before.

The shrub was cut the evening before the trial and stored under a Fagara tree near the plots. Bunches were tied in units of 5 lbs. and tied to the posts just before 06.00 hrs. GMT. More bunches were cut in the course of the day and the supply on the stakes renewed at 3 hour intervals or as necessary.

The animals were night-kraled c.  $\frac{1}{2}$  mile away and were driven up to reach the plots before 06.00 hours. They were watered and entered the plots at 06.00 hours. They grazed and browsed at will with a single 4 minute break for watering at noon, until they were taken out of the plot at 18.00 for the last watering.

vi. RECORDINGS

One observer made 5-minute recordings of the number of animals engaged in various activities and handed over to another after 2 hours. Sheets showing columns for grazing, browsing, cudding-lying, cudding-standing, idling-standing and idling-lying were used. Wind, cloudiness and rain were recorded on a simple scale as follows:

	<u>Wind:</u>	<u>Cloud</u>	<u>Rain</u>
0	Nil	Nil	Nil
1	Light	Occasional	Light
2	Moderate	+50%	Moderate
3	Strong	Overcast	Heavy.

A 5-foot painter's ladder, used as a seat, for the recorders was placed a few feet away from the plot.

vii. RESULTS

The whole experiment was planned to include three treatments each replicated three times. Owing to an accident to the animals, however, only three of the nine projected trials were completed, two on browse (Grewia) only, and one on Grewia/grass.



TABLE 6

GREWIA-GRASS TRIAL: NUNGUA

TIME OF DAY	HRS.	NUMBER OF OBSERVATIONS																	
		6		7		8		9		10		11		12					
ACTIVITY	MINS.	20	40	20	40	20	40	20	40	20	40	20	40	20	40				
GRAZING		9	9	8	9	12	10	10	5	17	16	8	0	6	15	10	3	0	9
BROWSING		4	5	5	4	4	1	0	2	0	4	6	0	1	5	5	1	0	3
IDLING	LYING	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	STANDING	7	4	5	7	0	9	5	8	1	0	5	18	0	0	0	0	15	8
SUBMITTING	LYING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	STANDING	0	2	2	0	3	0	5	5	2	0	1	2	13	0	5	16	5	0

TABLE 6 CONTD.

		NUMBER OF OBSERVATIONS																	
TIME OF DAY	HRS.	12		13		14		15		16		17		18					
ACTIVITY	MINS.	20	40	20	40	20	40	20	40	20	40	20	40	20	40				
GRAZING		0	5	6	10	8	10	5	0	4	13	14	8	1	4	9	12	8	1
BROWSING		6	4	6	10	7	5	10	0	6	7	18	9	6	9	8	6	0	
IDLING	LYING	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	STANDING	14	11	2	0	3	3	0	0	2	0	0	1	9	10	2	0	6	7
RUMINATING	LYING	0	0	0	0	0	0	4	5	0	2	0	0	0	0	0	0	0	0
	STANDING	0	0	6	0	2	2	5	15	3	0	3	3	1	0	0	0	0	12

TABLE 7

## RESULTS ON "MOODY-PASTURES"

TIME	NUMBER OF OBSERVATIONS			
	GRazing	BROWING	CHUBBING	IDLING
06 - 08.00	-	22	11	87
8 - 10.00	-	42	29	49
10 - 12.00	25	49	6	35
12 - 14.00	16	42	13	49
14 - 16.00	1	40	23	56
16 - 18.00	57	55	3	25
Total	79	250	85	301

GREYIA ONLY  
10/11/65

% Total Time 11.0% 35.0% 11.9% 42.1%

06 - 08.00	-	15	58	47
8 - 10.00	-	32	64	24
10 - 12.00	5	72	17	26
12 - 14.00	4	65	22	24
14 - 16.00	1	77	41	1
16 - 18.00	45	41	19	15
Total	55	302	221	137

GREYIA ONLY  
12/11/65

% Total Time 7.7% 42.2% 30.9% 19.2%

06 - 08.00	57	23	7	33
8 - 10.00	56	12	15	27
10 - 12.00	43	15	39	23
12 - 14.00	39	38	10	28
14 - 16.00	44	32	40	4
16 - 18.00	35	38	13	34
Total	274	158	124	159

GREYIA/GRASS  
4/11/65

% Total Time 38.3% 22.1% 17.3% 22.3%

63.4%: 36.6%

T A B L E 8

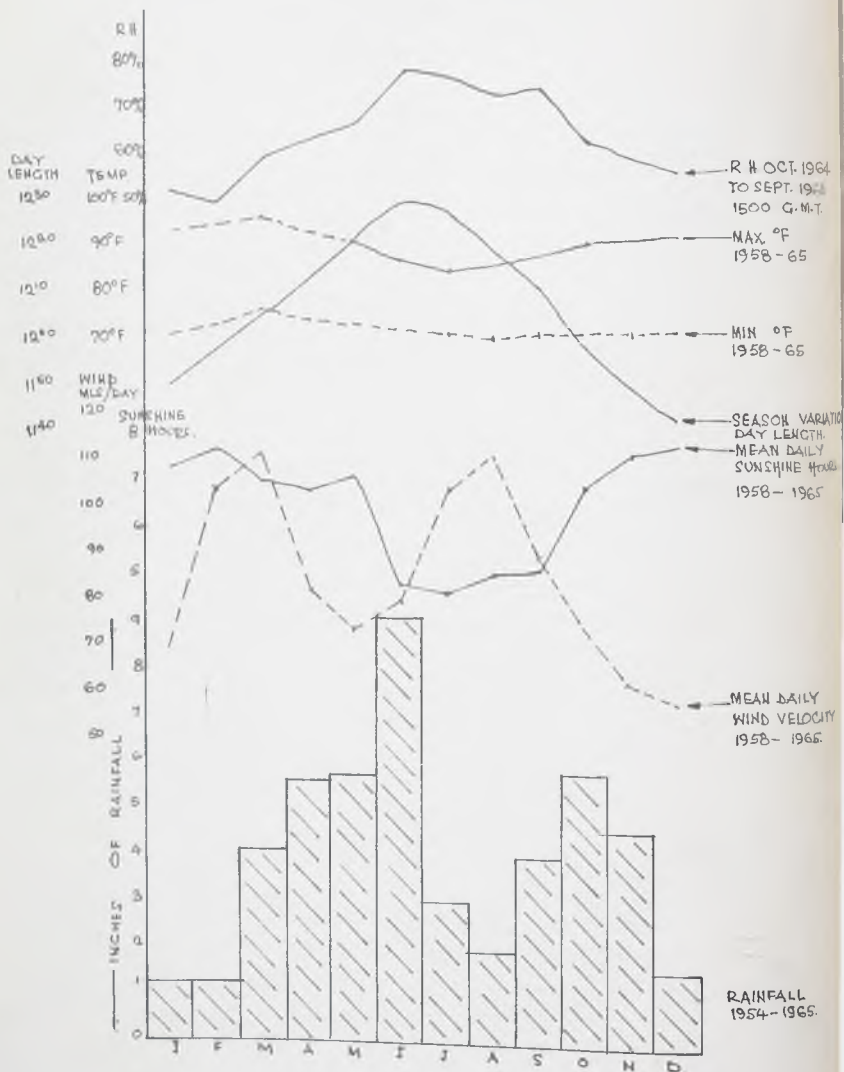
RATIOS OF GIBBIA TO GRASS: NUNGUA

<u>4/11/61</u>	<u>GRASS</u>	<u>GIBBIA</u>
TIME (% of Total Time)	38.3	22.1
(% of Feeding Time)	63.4	36.6
INTAKE: (% of Total Intake)	61.7	38.3
(% of Live wt.)		4.5

GIBBIA ALONE

10/11/65	% of liveweight intake in dry matter	1.77
12/11/65	% of Liveweight intake in dry matter	2.06

FIG 21  
 METEOROLOGICAL DATA : KPONG AIRS



## C. BEHAVIOUR ON ESTABLISHED PASTURES: KPONG

### i. GEOGRAPHICAL LOCATION OF KPONG

The University of Ghana Agricultural Irrigation Research Station (AIRS), Kpong is near the Volta River and about 70 miles by road North of Accra, at lat.  $6^{\circ}10'$  North, long.  $0^{\circ}4'$  East. Kpong is in the transition zone between the coastal savannah and the forest belt.

### ii. CLIMATE

The mean annual rainfall is 44" in a bimodal regime with major rains in March - June (50% of total) minor ones in September to November (36%) (Kowal & Hill, 1960, Fig.21). Temperatures range between  $70^{\circ}\text{F}$  minimum and  $95^{\circ}\text{F}$  maximum. March is the warmest month while July-August are the coolest.

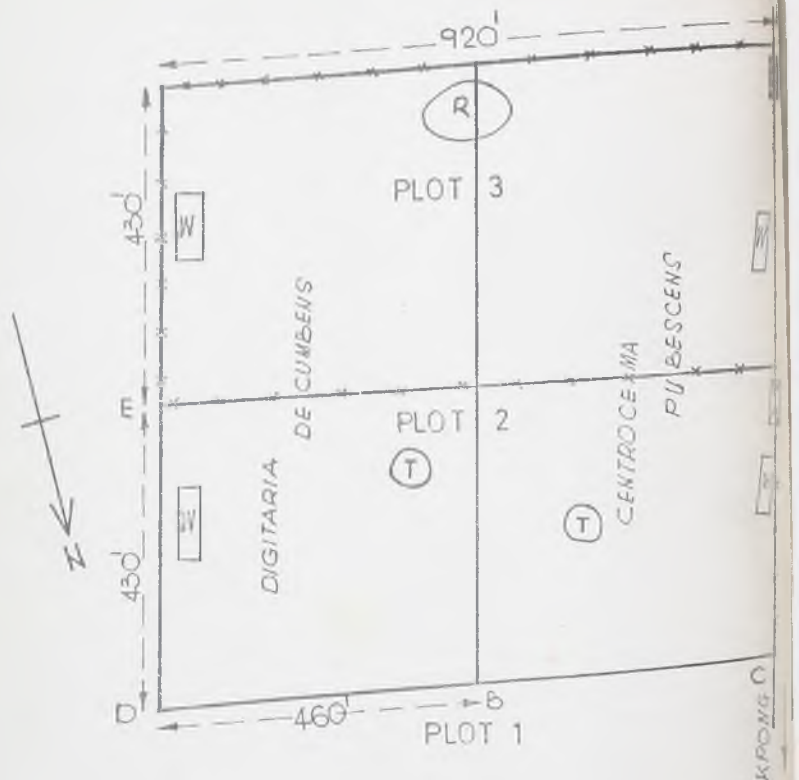
Photoperiod varies from maximum in June for 12 hours 28 minutes to December with a minimum of 11 hours 44 minutes (Kowal & Hill 1960). Relative humidities are generally high. Recordings at 15.00 hours fall to 50% in February, increasing to the peak of 77% in June.

Sunlight hours as recorded in the AIRS Annual Report (1964-65) varied from 4 hours - 30 minutes in July to 7 hours 40 minutes in February. The period of observation, July-September, was therefore cool but relative humidity was high, 70% minimum to 80% maximum at 15.00 hours. Wind velocities reach the maximum about this time. Mean period of sunshine per day is low, 5 hours, and rainfall was 3" in August. Daylight was progressively decreasing, but still long 12 hours 20 minutes (Fig.21).

### iii. SOILS

The paddocks (Fig.34, section (iv) below) in which the trials were held were sited on heavy black plastic clays of the Akuse-Prampam soil series. These soils contain upwards of 30-50% montmorillonitic clay with calcareous concretions. There is a gentle descent Northwards. The upper slopes are more gravelly and better

FIG 34  
THE PLANTED PASTURES



LEGEND

- BARBED WIRE
- A B ELECTRIC WIRE
- C D E ELECTRIC FENCE
- GATE
- WATER TROUGH
- REST AREA
- TERMITARIUM

AKUSE

KPOING

drained than the lower ones which are subjected to seasonal flooding from a nearby stream.

In the dry season the soil cakes hard and cracks deeply but in the wet season it swells by as much as 33, becoming cloddy and plastic. The reaction is slightly alkaline and base exchange capacity is high. The organic matter though scanty is spread through 18 to 24" topsoil overlying the lime concretionary zone. Weathered rock - basic gneiss - generally occurs at 3' - 4' depth (Kowal & Hill 1960) (Brammer 1955).

#### iv. THE PASTURES

2, 4-acre paddocks planted to Centrosema pubescens and Digitaria decumbens. (Fig.34).

#### PLANTING

After clearing, subsoiling, discing and harrowing, Centrosema was manually dibbled in with 3-4 seeds per hole at 2' x 2' spacing. Digitaria runners chopped into 4"-5" lengths were planted 3-4 per hole using a hoe. Planting was commenced in July 1964 and protracted for 2-3 months because of late rains. 2 hoeings were necessary to keep down weed growth. Notwithstanding this, by the end of July 1965 when the observations were begun, weed infestation was 35% on the upper slopes and 28% on the middle portion. Weed population was estimated by pacing. The findings are therefore inaccurate but fair for the present purpose.

#### FERTILIZATION:

Triple superphosphate was applied to Centrosema plots, at 60 lbs/acre.

#### ARRANGEMENT OF THE PADDOCKS

The gates were at the South West corners of the paddocks and admitted the animals on to the Centrosema first.

The fence around plot 2 was incomplete so an electric fence was put around it. Another electrified line divided Centrosema from Pangola when the herd was split for grazing one on either feed. This proved ineffective and a second wire was placed above the other at  $3\frac{1}{2}$  4' from the ground.

v. EXPERIMENTAL ANIMALS

9 West African Shorthorn bullocks, 2 Ndama bullocks and 1 'unrelated' bullock believed to have some Jersey blood; perhaps Ndama cross - Jersey-Ndama or Jersey-Shorthorn.

<u>No.</u>	<u>Description</u>	<u>Wt.(lbs)</u>
0012	Ndama	722
0016	"	660
39	WAS (leader.)	532
56	"	502
57	"	488
59	"	458
63	"	540
55	"	462
60	"	584
62	"	452
64	"	446
111	N/JNdama	536

These were all selected from the AIRS bullock herd and trained to an electric fence. The animals were starved c.24 hours, and driven into the  $\frac{1}{2}$  acre electrically fenced plot with tufts of grass and Centrosema on the wire. They soon learnt to keep away from the electrified wire.

PREVIOUS GRAZING:

Before this study, the cattle had been grazing on natural rough grassland, rank in most parts, around the Station. The diet therefore

consisted of mixed natural grasses and shrubs. The more important grass species are Schizachyrum sanguineum, Vetiveria fulvibarbis, Andropogon canaliculatus, Brachiara falcifera. These are eaten readily. The 2 station herds: (a) Bulls and bullocks

(b) Cows and Calves

are normally grazed from 09.39 GMT till about 1400 to 15.00 hours GMT. and kraaled in night paddocks with little grazing.

In the behaviour studies, the experimental animals were kraaled at night and driven down to the paddocks about  $\frac{3}{4}$  mile away to enter the fields at 06.00 hours GMT. They were taken out at 18.00 hours GMT. The kraal was the electrically fenced area where they had been trained. Water was provided in the paddocks and in the kraal.

#### vi. PROCEDURE

The same forms were used as for the Nungwa "Woody-Pasture" trials. Miscellaneous activities like grooming, fighting, leadership were also recorded.

There was an introductory period of about 8 days. During this time animals became accustomed to their new regime and environment, and recording techniques were tested. There were 3 treatments. The animals were:-

- (i) allowed free access to both Centrosema and Pangola;
- (ii) grazed on Centrosema only;
- (iii) grazed on Pangola only.

In (i) the dividing electric fence was removed and 12 animals were allowed access to both Centrosema and Digitaria. In (ii) and (iii), the animals were divided into 2 groups: "Red" and "Green" herds. These were alternated so that if the Red herd was on Pangola in one trial, it would be on Centrosema in the next, and vice versa for the Green herd.

<u>Red Herd</u>	<u>Green Herd</u>
No.	No.
55	0012
60	0016
62	39*
63	56
64	57
111	59

\* Leader of the two herds.

- 31 -  
T A B L E 9

ACTIVITIES OF PANGOLA-CENTROSEMA: DAILY SCORES AS % OF TOTAL TIME

DATE	GRAZING		CUDGING		IDLING	
	PANGOLA	CENTROSEMA	L	S	L	S
29:7:65	40.55	34.44	0.99	6.60	2.32	15.10
31:7:65	29.79	47.00	3.65	9.55	2.19	7.82
2:8:65	28.07	48.67	2.08	11.87	1.22	8.09
4:8:65	29.55	46.86	1.38	13.77	1.06	7.38
6:8:65	33.71	31.64	1.20	11.86	0.75	20.84
19:8:65	46.47	22.92	3.70	6.66	10.01	10.24
20:8:65	39.42	31.78	6.83	8.33	4.80	8.85
21:8:65	41.50	28.26	4.74	10.01	8.12	7.36
22:8:65	32.67	37.31	3.93	11.32	3.82	10.04
1:9:65	37.92	40.97	2.67	8.62	0.11	9.72
2:9:65	41.74	39.90	3.47	5.73	1.35	7.80
MEANS	36.49	37.25	3.15	9.48	3.25	10.38

T A B L E 10

ACTIVITIES OF PANGOLA: DAILY SCORES AS % OF TOTAL TIME

DATE	GRAZING	CUDGING		IDLING		HERD
	PANGOLA	L	S	L	S	
30:7:65	70.20	2.27	5.93	5.78	15.82	GREEN
1:8:65	57.76	2.78	10.95	10.93	17.58	RED
3:8:65	62.94	6.04	15.90	2.83	12.29	GREEN
5:8:65	45.97	9.03	12.36	9.03	23.61	RED
7:8:65	61.47	6.83	13.80	5.47	12.44	GREEN
23:8:65	55.77	5.32	14.81	7.54	16.56	RED
25:8:65	57.64	8.69	12.16	8.92	12.60	RED
26:8:65	57.41	9.72	9.72	9.73	13.42	GREEN
27:8:65	56.49	9.72	9.61	9.93	14.23	RED
28:8:65	62.85	7.52	10.65	5.56	13.42	GREEN
30:8:65	64.91	8.78	9.60	6.14	10.57	GREEN
3:9:65	62.50	8.33	13.53	3.83	11.81	GREEN
MEANS	59.66	7.09	11.59	7.14	14.53	

TABLE 11

ACTIVITIES OF CANTROSEMA: DAULT SECONDS AS % OF TOTAL TIME

DATE	GRAZING	CUDGING		IDLING		HERD
	CANTROSEMA	L	R	L	R	
30:7:65	79.00	0.86	8.50	2.89	8.77	RED
1:8:65	68.53	2.89	8.34	6.95	13.09	GREEN
3:8:65	60.49	11.10	16.05	3.79	8.58	RED
5:8:65	70.66	2.34	9.39	2.82	14.78	GREEN
7:8:65	62.82	10.00	11.96	5.10	10.31	RED
23:8:65	58.20	4.93	11.57	5.80	19.45	GREEN
25:8:65	52.31	7.52	8.91	10.30	20.96	GREEN
26:8:65	37.02	8.10	6.94	20.26	27.67	RED
27:8:65	48.39	8.67	10.53	8.60	22.80	GREEN
28:8:65	50.67	6.71	10.77	8.68	23.17	RED
30:8:65	49.88	7.98	9.97	9.58	22.58	RED
3:9:65	47.33	8.10	12.97	9.49	22.11	RED
MEAN	57.09	6.60	10.51	7.86	17.86	

TABLE 12

GROSS AVERAGE C'S FOR ALL 12 DAYS AS % OF TOTAL TIME

- 3 -

TIME OF DAY	HRS.	6	7	8	9	10	11	12	13	14	15	16	17	18	MEANS
<u>MIXED</u>															
PANGOLA		37.61	36.43	49.03	32.13	17.93	43.09	38.61	38.58	33.40	35.94	41.49	33.79	36.50	
CENTROSEMA		60.24	54.17	42.90	34.27	45.24	37.81	31.94	19.78	20.53	36.05	29.33	34.90	37.26	
CUDDING	L	0.00	0.19	0.06	3.84	8.79	4.39	5.52	6.91	7.39	0.33	0.13	0.19	3.15	
CUDDING	S	0.44	2.53	1.79	9.99	11.36	6.20	10.95	18.24	15.80	16.94	12.30	7.26	9.48	
IDLING	L	0.06	1.71	1.77	8.32	4.97	2.40	4.90	6.98	5.55	1.82	0.32	0.19	3.25	
IDLING	S	1.64	4.98	4.45	11.45	11.71	6.11	8.07	9.51	17.33	8.87	16.44	23.67	10.35	
<u>PANGOLA</u>															
PANGOLA		88.50	90.26	58.88	32.39	45.08	68.17	48.89	30.81	70.79	62.23	63.63	64.83	60.37	
CUDDING	L	0.00	0.53	6.29	16.22	13.62	8.46	10.52	16.63	4.99	4.57	3.79	0.70	7.19	
CUDDING	S	1.86	1.42	10.26	16.83	16.49	8.41	11.04	20.96	8.25	11.82	10.81	7.36	10.46	
IDLING	L	0.83	1.04	3.20	22.22	9.76	6.25	10.74	15.26	6.18	4.24	1.25	1.00	7.25	
IDLING	S	8.80	6.75	16.38	12.35	15.06	8.72	18.81	16.33	9.80	17.14	20.52	26.11	14.73	
<u>CENTROSEMA</u>															
CENTROSEMA		79.64	72.76	59.15	40.93	38.03	62.34	50.50	33.25	61.61	51.68	66.72	72.98	57.47	
CUDDING	L	0.00	0.58	5.49	23.24	13.75	8.45	8.82	15.17	6.56	3.36	1.53	0.00	6.41	
CUDDING	S	2.30	5.72	8.14	12.61	16.28	10.69	10.94	16.10	9.89	16.63	10.47	4.17	10.33	
IDLING	L	0.00	0.91	10.65	21.79	14.04	6.01	10.21	15.51	5.37	6.15	2.82	0.13	7.80	
IDLING	S	18.06	20.03	16.57	11.43	17.90	12.51	19.33	19.96	16.57	22.19	18.47	22.72	18.00	

#### IV. SOURCES OF ERROR

##### 1. ON PLANTED AND "WOODY-PASTURES"

1. The interpretation of the observation may occasionally have varied from one observer to another. A walk between bites of herbage, while the animal was masticating, may have been recorded by one person as "desultory" grazing or browsing, whereas another might have recorded it as ruminating.
2. Idling may have been inflated by including drinking, grooming, fighting and playing but not by very much.
3. Boredom may cause careless recording. To counteract the tendency to drowse, some recorders stood most of the time, moving round as necessary to watch a habit more closely.
4. Animals may have been disturbed and interrupted the activity (e.g. ruminating) when a recorder observed too closely.
5. Personal errors in counting and writing.
6. The animals may have been too far from the observer for accurate recording.

##### 11. ON RANGE

1. Restricting observations to a "leader" cow as representing the whole herd is open to statistical objections because it ignores individual variation. However many authors have used this procedure. D.E. Tribe (1949) observed 1 sheep in a group of five, and, Hughes and Reid (1951) recorded both herd and individuals and found no difference. No better system could be devised under the circumstances.
2. Night observations could have been better recorded in moonlight. Reliance on the ear to estimate number of animals grazing must be subject to large errors.
3. The behaviour of the animals was partly forced on them by the direction in which they were herded. Whether they crossed shrubby or grassy or burnt land influenced the pattern of grazing

to some extent. Altogether such errors must have been very small.

## V. DISCUSSION

### 1. GRAZING BEHAVIOUR

#### i. The grazing technique:

The grazing animal is constantly on the move while ingesting herbage. The tongue is rolled round a tuft to pull it and the lower incisors out as the head is raised and turned slightly by a jerk of the neck. On low herbage, e.g. 1"-2", the animal's head tends to move more vertically than laterally; tongue movement continues as on tall herbage but the horny pad on the upper jaw seems to be more employed. On fresh succulent herbage, the animal sometimes stops and grazes within an arc described by the head swung left and right. An animal may crouch under fences to reach herbage.

#### ii. General patterns

Generally the animals start feeding as soon as they enter pastures. This was expected as they were kraaled at night and must have been hungry in the morning.

On range, grazing is at first desultory. This is because (i) under local conditions grazing in the vicinity of the kraals is scanty in the dry season, especially Ashaley Botwey, and (ii) herdsmen drive the animals when they settle to graze. At Ashaley Botwey grazing commenced sooner in the walk to the fields than at Katamansu. (Figs. 31, 24, 25, 26). This may be related to the fact that the Ashaley Botwey animals were grazed outwards and walked back, whereas at Katamansu the animals were walked into the field and grazed homewards. The walk back was therefore consistently longer at Ashaley Botwey. At Katamansu the animals finished the day by intensive grazing within about a mile radius of the kraals.

Range cattle graze continuously with very erratic occasional brief rests lasting a few seconds to a few minutes. Grazing at Ashaley Botwey was more continuous than Katamansu probably because of (i) the shorter time at their disposal and (ii) the lower height

of grass which meant that the animals were not getting much and had to graze harder and longer. This tendency to graze longer on scanty herbage has been observed by Waite (1963), Morgan (1951) McKeenan (1956) and others. In flush valleys the animals were allowed to graze to and fro and sometimes spent as much as 90 minutes in one area; settled grazing.

On the 'artificial' and 'woody' pastures grazing fluctuated. At Kpong there were three constant periods of peak activity with 2 troughs, one at 09.00 hours GMT, to 10.00 hours and another at 13.00 to 14.00 hours (Fig.1). At Nungua consistent peaks would require more trials to establish. The two trials show three minima interspersed among four peaks of two to three hours grazing (Figs.10-14, 31). Herbage qualities may account for the longer cycle of grazing at Kpong than Nungua. During the troughs, the animals mostly lay down (Figs. 3, 5) cudging or idling, witnessed by the strong semblance between the reversed graph from the grazing regime (Figs.1, 5, 13, 14, 19). (Compare with Figs 4 and 6, standing and idling behaviour respectively.)

### iii. Selection of herbage:

The grazing animal apparently takes what herbage it finds, rejecting only objectionable species e.g. those possessing obnoxious odours or tastes. However, the existence of gradations of palatability is widely documented. Different species are eaten with different degrees of relish. Certain plant associations are preferred (Hunter 1960), Atwood & Hunger (1957). The animal may reject a feed under certain conditions but eat it avidly under other conditions. Thus Bothriochloa intermedia var acidula an inhabitant of the black clays, is normally untouched but when growing on termitaria (a very common habitat) is eaten readily. Vetiveria fulvibarbis has low palatability at Nungua, but at Kpong, it ranks very high in palatability. Dasmann (1949), and Leach (1946) have also reported this place to place variation in preferred foods. Seasonal differences have been recorded by Heady and Torrall (1959), Leach (1956), Ivins (1952) Tribe (1949) Hunter (1960) etc. This is exemplified by the strong taste developed for Milletia at this time of the year.

In the absence of other substitutes, cattle will accept otherwise unwanted feed. Thus Stylosanthes humilis and Trarostis curvula (H. Imes 1966a), and Tripsacum laxum (Anon 1959) a harsh appearing species, were eaten avidly. However even when supplied with very palatable feed, animals want to take some not-so-palatable species in addition. At Kpong, the animals frequently reached for plants like Pennisetum, Uraria picta, Vetiveria fulvibarbis and even Lantana camara, outside the fence, sometimes having to crouch to take a bite. Lantana camara is reputedly poisonous: Williamson & Payne (1959) Chapman et al (1963). However the local animal may be taking sublethal doses.. The cattle spent considerable time selecting Paspalum and Brachiaria falcifera which had invaded large patches of the Gentrosema section. Imperata cylindrica was grazed avidly both in and outside the paddocks but this species was untouched by Ashaley Botwey animals which ceased grazing when they came to pure stands of this species.

The herbage selecting habit was strongly exhibited on the planted pastures. The habit was not observed till towards the end of the first grazing cycle. It may be inferred that the animal accepts any edible feed when it is very hungry; after a partial fill it starts 'creaming' i.e. selecting more palatable species. (See section vi A d: "Fatigue of Mouthparts").

#### iv. Depraved appetites:

On range, cattle were observed licking termite mounds (Plate 10) trying to chew stones, bits of broken bottle and tins found on range. FN. Wilson's (1961) East African Nubus licked the ground soon after drinking in the morning. Theiler (1924) described perverted eating habits of B-deficient cattle and indicated that mild deficiency is shown by osteophagia, but severe deficiencies by allotriophagia when anything, including even a live tortoise, (H.H. Green 1925) was eaten. In furtherance of "nutritional wisdom", Katz (1937) argued that the animal's decision to eat bones is due to a subconscious irresistible

need to restore its biochemical phosphorus. Gordon and Tribe (1954) however attribute this behaviour to chance, learning (after Scott 1937) and imitation of learners. Gordon & Tribe oppose instinctive recognition because (a) cattle which chew bones do not show a predilection for all P-rich materials e.g. mineral phosphate, and precipitated calcium phosphate and sodium phosphate (b) pica does not disappear invariably when aphosphorosis is remedied. Their experimental design however should have allowed the use of other senses in addition to taste to differentiate troughs. In (b) the presentation of phosphorus as precipitate may have disgusted the animals, the physical form was thus a limiting factor. (c) The persistence of pica despite the correction of the aphosphorosis was probably due to (i) other deficiencies, (ii) the animal becoming addicted to bone-chewing by the end of the remedy.

The instances of depraved appetite observed in this work were probably manifestations of moderate mineral deficiency. The herdsmen recognised it as a craving for salt and said in their home country (Niger) they supply Rock salt (Kawu)-lick and pica is prevented. Need for mineral lick is therefore indicated. Alternatively, the mineral may be applied as topdressing on the herbage. This may however induce vegetational changes and should be experimented upon cautiously.

(V) SENSES USED IN GRAZING

(a) Sight

To graze the animal probably needs to see the herbage. At Katmansu a blind heifer would not graze and was culled. As ruminants are colour blind (Trautmann and Fiebeger 1944, Tribe and Gordon 1949) probably the only function of sight is recognition of form and position of the feed and other objects. Sight is probably limited in species selection (Tribe 1950). However, the observed range animals sometimes seemed to go straight for Griffonia and Milletia in the middle of thickets.

(b) Tactile sense

The muzzle of cattle is richly imervated (Nisbet 1956) and probably is the sole aid to selection of tender herbage from coarse stemmy or spiny ones. Tribe (1950) says it is a coincidence that the tender herbage is also nutritious.

(c) Olfactory sense

The grazing animal is all the time sniffing herbage as it feeds, but Tribe (1950b) showed that in sheep it is not the most important.

(d) Gustatory sense

Gustation is the final discriminating sense in selection. It is suggested that taste might be influenced by physiological need operating through the blood system (Von Skramlik 1922, Moncrieff 1944, Richter and Campbell 1940 etc. cited by Tribe 1950).

That all these senses are employed is shown by the mode of probing a new herbage species. An animal which had presumably come across Vitex for the first time, first 'muzzled' and sniffed it over and over again. It then took a leaf in its mouth and chewed cautiously, slowly, pausing after each bite: apparently sample-tasting the species. Finally it tore off the leaf and swallowed it, and went on to take more Vitex leaves.

vi. FACTORS AFFECTING FEED INTAKE

Authors are at variance as regards the use of the terms 'appetite' and 'palatability'. 'Appetite' has been used generally to designate the "desire for food or drink". However Corbett (1961) used 'appetite' to describe the rate or extent of feeding, whilst Bruce and Kennedy (1951) extended the term to cover physiological and psychological functions culminating in the urge to eat: thereby including 'palatability'.

'Palatability' has been used interchangeably with 'preference' by Ivins (1952). Young (1948) Cowlishaw and Alder (1960) embraced all plant characteristics or conditions initiating selection by the animal in the concept of 'palatability'. Other authors find no dividing line between 'palatability' and 'appetite' since the higher the 'palatability' the higher the bulk intake.

There is thus need for standardizing the terminology. There is much controversy in the literature as regards the factors determining palatability, bulk intake of a feed and the end of the feeding act.

The factors controlling feed intake may be thought of as belonging to two phases of the feeding process: (a) factors which initiate grazing behaviour; (b) those which maintain the behaviour so aroused.

Some of these factors may be identified (i) in the animal and (ii) the plant, and these biological factors are influenced by the environment. The biological factors are so intimately interrelated that their discussion involves some repetition.

A. ANIMAL FACTORS

Cattle will normally avoid toxic species. The range cattle observed always carefully avoided Elaeochorbia drupifera - a very deadly species.

Nachmann (1959) mentions the possibility of this avoidance based on instinct. He goes on to say that such selection could have profound evolutionary significance. Those animals perceiving nutritious species as palatable will be favoured, by natural selection and the

struggle for existence. Instinctive avoidance of toxic plants could be based on intolerance of certain olfactory and/or gustatory stimuli.

The habit is probably learnt by associating ill-feeling with sublethal doses of certain species and well-being with intake of other species. The common observation of heavy fatality when adult animals are transferred from one region to another where the pasture species are unfamiliar to the animals supports the learning theory.

Another possible mechanism of learning is imitation of others, from parental example, for instance.

The theory of 'nutritional wisdom' namely, that animals are able to distinguish useful species from harmful ones, is popular in the literature (Harris 1933b; Evaard 1915, 1929; Ellison 1948; Stapledon 1948). R. Nilson and O. Eydin (1960) cited sugar deficient cattle suffering from acetopenia refusing grain but accepting sugar which seems to cure a certain form of the disease. A similar mechanism may explain the alleged ability of local animals to cure themselves of some maladies by selecting certain herbs.

The theory of nutritional wisdom has been challenged widely (Tribe & Gordon 1950). Animals are known to have died after avidly eating toxic herbage species, otherwise untouched, contaminated with insecticide (Rachel Carson 1962). Calves and heifers on self-feeding took more crude protein than necessary for health (McLandish, 1923a, b, 1924). Lambs failed to balance their ration when self-fed on corn and protein supplement (Gordon and Tribe 1950). These objections should be tested over prolonged periods when the animals' learning ability or inability can be shown.

Scott (1946 et seq) categorized 'appetites' as follows:

- (a) Simple preferences;
  - (b) Learned appetites;
  - (c) True hunger.
- (a) Simple preferences not related to nutritional value but due to odour, consistency etc.
- (b) Learned 'appetites' - based on ability to learn by experience that a feed gives a feeling of well being.

- (c) Hungers - reflecting physiological need and requiring no learning process.

The present observations tend to support nutritional wisdom in that (i) the animals grazed longer on the mixed species which are more nutritive than either alone (See Figs. 1, 9, 18, 31);

- (ii) they selected useful species and avoided the toxic ones e.g. Elaeophorbium drupifera.

- (iii) Sometimes they seemed to go straight for Millettia thonningii, Griffonia simplicifolia or Banfia nitida in the middle of thicket.

In this light it may be said that though the legumes were more nutritious than the grasses, the animals did not graze as much of them as the grasses because above a certain limit the legumes may tend to cause digestive upset.

b. Rate of grazing

Mabey & Ross Innes (1964) found that intake per unit time was equal on browse and grass, and the feeding duration was proportional to drymatter intake. In the current Nungua trials, feeding times corresponded closely with the respective drymatter intakes.

INTAKE INDICES AND FEEDING TIMES - NUNGUA

'Grewia alone'	<u>Drymatter Intake</u>		<u>% Total Time</u>	
	<u>lbs.</u>	<u>Index</u>	<u>Score</u>	<u>Index</u>
10 - 11 - 65	64.23	115.0	42.2	120.6
12 - 11 - 65	55.82	100.0	35.0	100.0
<u>Mixture</u>				
Grass	88.05	161.2	38.3	173.0
Browse	54.63	100.0	22.1	100.0

The desultory nature of grazing on 'Grewia alone' is apparent - higher intakes per unit time were recorded for the Mixture than for the 'Grewia-alone'. This difference shows that intake rate differs from sward to sward, and may be associated with Hardison's (1956) finding that jaw rates differ with sward.

These corroborate Brumby (1951) Castle et al (1950); and Waite, McDonald and Holmes (1951). Duckwood and Shirlaw (1958) and Balch (1958) measuring jaw movements mechanically found no significant relationship between dry matter intake or crude fibre consumed, and the rate of biting, but associated higher % crude fibre with more chewing before swallowing. They also associated the highest speed eating with low dry matter and crude fibre content of herbage.

Bites per minute is genetically fixed and varies with individual and breed (Hancock 1954). Johnstone-Wallace and Keith Kennedy (1944) observed 50 - 70 bites per minute with up to 90 per minute on good grazing. Tall herbage was grazed more slowly due to mechanical difficulty. Jaw movement counts at Ashaley Botwey were as follows:-

99 secs. 94 secs. 78 secs.

95 secs. 101 secs. per 100 bites

and at Katamansu: 120 secs. 130 secs. 129 secs. 118 secs. 124 secs.  
per 100 bites.

Though these figures are fragmentary, they tend to indicate the applicability of Hancock's findings to the local animals. The different phases of this study can only be compared with caution because among other variables the Katamansu animal would have less per hour than the Ashaley Botwey animal due to the greater abundance of feed. Similarly it would be expected that, other variables held constant, at Mungwa and Kpong, the intake per bite would be greater than at Ashaley Botwey where much of the herbage was only then sprouting, from burning. That Katamansu vegetation was tougher than Ashaley Botwey may have contributed to the slower jaw movement of the Katamansu animal, as Wallace and Kennedy found (1944).

Nonetheless comparisons within each of the three phases of this study may be quite valid. It may for instance be assumed safely that the dry matter intake ratios at Kpong were 75: 60: 57 respectively on the mixture, pangola and Centrosema (Figs. 9, 18). The following Intake Indices may therefore be drawn up. for Kpong.

<u>Species</u>	<u>Intake Index</u>
Centrosema alone	100.0
Pangola alone	105.3
Centrosema-Pangola mixture	131.6

c. Physiological Need:

Physiological requirements as affecting selectivity, have been discussed above. Various workers have correlated milk production and liveweight with bulk intake (Brunby 1959 ; Musangi 1965; Wardrop, 1953; Shirlaw & Duckwood 1958). Others have found no such relationship (Waite and Holmes 1951) (Mancock 1950).

If age, liveweight and class of cattle (bullock or cow) are reflected in the grazing period, then the feeding time of the range animals can only be compared to the Nungua and Kpong animals after they have been corrected for the feeding required for (a) milk production; (b) walking and the age effect.

d. Fatigue of mouth parts:

From the cyclic nature of grazing behaviour, it may be suggested that fatigue of jaw muscles might be the cause of cessation of feeding, requiring periodic rests before resumption. This would mean that animals with strong jaws will have longer grazing cycles than weak-jawed animals. Further, tough herbage would be grazed in short cycles. CG Balch (1959 et seq) has reported lack of evidence to support this jaw-fatigue hypothesis.

In the 'woody pasture' trials and on the planted pastures, the periodicity of grazing suggests boredom as a possible factor. Thus from Fig.31, and Tables 5 and 7, it can be seen that though the trials

of the 10th and 12th November were meant for browse only, the animals spent a good deal (c.9.3%) of their time trying to graze the few millimetres of grass left after the sheep had grazed it down. Again, 'creaming' behaviour commenced after a partial fill on the planted species. If boredom is a factor then the animals can be attributed with the urge to seek variety in feeding. This would suggest that within limits, the greater the variety, the greater the intake should be.

On range, there was no well defined periodicity. The fatigue effect was probably masked by the grazing pattern forced on the animals according to the availability of vegetation along the grazing route followed. Secondly the urge to feed to fill in the relatively short time available may have superseded the tendency to stop grazing because of fatigue.

e. Fill and Rate of Ruminant Passage.

C.C. Balch (1958) studying 7 cattle with rumen fistulas, receiving a variety of diets, measured the flow of reticulo-ruminal digesta and found no evidence to disprove his theory that roughage may be consumed till a certain degree of fill of the reticulo-rumen. He postulates that the rate of <sup>passage of</sup> reticulo-rumen contents determines the feeding pattern - his view is shared by Blaxter (1960). This seems to explain the observed cyclic nature of grazing. This aspect of nutrition has not been studied much. The rate of flow may however depend on crude fibre content of the feed as suggested by Vander Ploeg & Kleg (1955) as much as on the activity of the digestive system: (Crampton F.W. 1960). Voluntary intake would seem largely determined by the rate of rumen microfloral activity: the faster the breakdown and flow of digesta, the more frequent the occurrence of hunger and hence of grazing activity.

Herbage factors inhibiting microfloral activity might thus depress intake e.g. lack of vitamins A, D, E, which cannot be synthesised in the rumen. Over a period, given the same animal, the grazing time should therefore be longer on the planted pastures than on the range species which are deficient in these nutrients (Lansbury, 1958a, 1959a, 1960; Oyenuga 1955a, 1958; Rose Innes and Mabe, 1964; Rose Innes, 1959).

(f) Social Facilitation:

The enhancement of feed intake by the presence of others of the breed or species has been recorded for different animals (Bayer 1929; Harlow 1932 and 1933; Tribe 1950). This effect may be due to a feeling of security or imitation only. The phenomenon has been variously termed 'mimesis', 'allelomimesis', 'biosocial facilitation', 'psychosocial cooperativeness; etc. (Armstrong E.A. 1951).

Experts are at variance as regards the cause of this phenomenon which is extended to many other behavioural traits.

The groups observed varied from 5 to over 200. The extent to which varying numbers contributed to the observed differences is obscure. It may however be significant at least in the Kpong split-herd trials. Added to the effect of smaller size will be that of wanting to join the other lot i.e. the Red herd wanting to join the Green group and vice versa. This tendency perhaps reduced the grazing times in the split-herd trials, and the larger herd size may have contributed to the longer feeding time for the combined herd grazing mixed species on a free choice basis.

Musangi (1965) claimed social facilitation to explain the increase in grazing time of combined herds of East African Zebu and Friesians. He, however, also recorded that the two breeds herded separately. It would rather be expected that social facilitation, if operating, would be negative in incompatible herds such as these. One would doubt if the increase would be sustained over many more trials than the three only which this author had.

(g) Previous grazing experience; Novelty reaction:

It might well be that the change from the usual rough natural grazing to the luxuriant more nutritive planted pastures affected the grazing behaviour of the Kpong animals.

The validity of such a 'novelty reaction' may be established by repeating the recordings several months after the initial recordings on introducing the animals to the pastures. One week may not have been

enough to stabilise their behaviour on a new pasture. The observed decrease of feeding times on the planted pastures may have been a manifestation of this reaction: the grazing times tended to decline as the Centrosema recordings proceeded i.e. as the 'novelty effect' wore off. On 'Pangola alone' and 'Free choice' treatments, the effect was not obvious in the observation period. (See Fig.9 and section b above). This reaction, if true, would further detract from comparisons between the Kpong and Nungua cattle, and the ranging animals (on very familiar grounds).

There was no 'acclimatisation' period at Nungua but the species were familiar to the animals. However a familiarising period would have been worthwhile, because (i) the frequency of the browses in the plots was c.40/acre compared to 0.04/acre on range (Rose Innes and Mabey 1964), (ii) they had never been confined in small paddocks of the size of the plots, (iii) they had been part of a large herd.

The novelty effect, a 'response decrement', may be explained as a habituation, (Thorpe 1951), i.e. "The waning of a response as a result of repeated stimulation which is not followed by any kind of reinforcement. It is relatively of enduring nature and is thus regarded as distinct from fatigue and sensory adaptation". His definition of 'learning' may also be said to apply since the effect has been produced "as the result of experience" and being distinct from "fatigue, sensory adaptation, maturation and the results of surgical or other injury".

#### h. Physiological Adaptability to the environment, feeding centre and S.D.A.

An animal's response to environmental changes may affect its pattern and duration of feeding behaviour.

R. Passmore and F. Ritch (1957), located 'feeding' and 'satiety' centres in the hypothalamus promoting and inhibiting, respectively, the act of feeding. Brobeck (1948) postulated that heat production is the stimulus to which these centres respond. He agrees with Balch and Campling (1962) that heat stress limits intake. Findlay et al (1954) and Brody (1956) showed that the animal's heat tolerance determines its

grazing behaviour. Anorexia under high ambient temperature and humidity, is explained as a way of avoiding increase in heat load by eliminating specific dynamic action (S.D.A.) (Findlay et al *ibid*), and S.D.A. has been related to satiety (C.C. Balch 1958a).

Under tropical conditions, Musangi (1965); Horrocks et al (1964), Lampkin et al (1958) found that temperate cattle grazed for the same period as tropical cattle. The apparent anomaly in the behaviour of the animals of Musangi (1965) et al, may have been due to local ameliorative influences such as altitude and cool breeze which make the climate temperate like.

The animals observed in the present study were all indigenous well adapted stock, thus wide differences in behaviour must be attributed to other causes than physiological adaptation.

#### i. Chemostatic control:

Buttersworth (1965) quotes Manning et al (1959) as saying that the level of acetic acid in the blood may limit intake. Kroger and Carroll (1964) worked with gypsum and alfalfa pellets and concluded that one of the factors affecting appetite when gypsum is fed is an anion - cation imbalance.

No observation was made in the present study to confirm or to refute chemostatic control but boredom may be caused by blood levels of certain metabolic products of the diets. The cyclic pattern of feeding may be associated with levels and kinds of metabolites liberated into the blood stream. (See 'Physiological Effect' - section (d) of 'Plant Factors').

j. Herd Differences:

VARIATION WITHIN HERD

Pangola

Red Herd

<u>Date</u>	<u>Deviation (d)</u>	<u>d<sup>2</sup></u>
1-8-65	3.03	9.18
5-8-65	8.76	76.74
23-8-65	1.04	1.08
25-8-65	2.91	8.47
27-8-65	1.76	<u>3.10</u>
Total		<u>98.57</u>

Green Herd

30-7-65	7.02	49.28
3-8-65	0.24	0.06
7-8-65	1.71	2.92
26-8-65	5.77	33.29
28-8-65	0.33	0.01
30-8-65	1.73	2.99
3-9-65	0.68	<u>0.05</u>
Total		<u>89.20</u>

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<u>Sum :</u>	98.57
	<u>89.23</u>
	<u>187.77</u>

Degrees of freedom = (5-1) + (7-1) = 10

Estimated variance = 18.77.

VARIATION BETWEEN HERDS

Pangola

<u>Herd</u>	<u>Deviation (d)</u>	<u>d<sup>2</sup></u>	<u>Frequency x d<sup>2</sup></u>
Red	4.93	24.30	121.50
Green	3.52	12.39	86.73
	Total		<u>208.23</u>

Degrees of freedom = 1

Estimated variance = 208.23

$$F, \text{ ratio} = \frac{208.23}{18.77} = 11.06$$

F, (table) at (0.1% level) = 21.04

at 1.0% " = 10.04

VARIATION WITHIN HERDS

CENTROSEMA

Red Herd

<u>Date</u>	<u>Deviation (d)</u>	<u>d<sup>2</sup></u>
30-7-65	23.72	562.60
3-8-65	5.21	27.14
7-8-65	7.34	53.88
26-8-65	18.26	333.40
28-8-65	4.61	21.25
30-8-65	5.40	29.16
3-9-65	7.95	63.20
	Total	<u>1,090.63</u>

Green Herd

<u>Date</u>	<u>Deviation (d)</u>	<u>d<sup>2</sup></u>
1-8-65	8.91	79.39
5-8-65	11.04	121.90
23-8-65	1.42	2.02
25-8-65	7.31	53.44
27-8-65	11.23	<u>126.10</u>
Total		<u>382.85</u>

Sum :  $1,090.63 + 382.85 = 1,473.48$

Degrees of freedom = 10

∴ Estimated variance = 147.35

VARIATION BETWEEN HERDS  
CENTROSEMA

<u>Herd</u>	<u>Deviation (d)</u>	<u>d<sup>2</sup></u>	<u>Frequency x d<sup>2</sup></u>
Red	1.81	3.28	22.93
Green	2.53	6.40	<u>32.01</u>
Total			<u>54.94</u>

Degrees of freedom = 1

∴ Estimated variance = 54.94

F<sub>1</sub> ratio =  $\frac{54.94}{147.35} = 0.37$

F<sub>1</sub>(table) at the 5% level = 4.96

The grazing time differences between the 2 herds (Red and Green) were insignificant at the 5% level on Centrosema. On the other hand on Pangola they were insignificant at the 0.1% level but significant at the 1% level.

This may mean that the two herds reacted to Centrosema similarly whereas on Pangola the Green herd grazed significantly more than the Red herd. Thus though the animals were of similar breed the Green herd relished Pangola more than the Red herd. Variation of relative palatability of different herbage, from animal to animal is hereby supported.

B. PLANT FACTORS AFFECTING PALATABILITY AND INTAKE

(a) Texture:

Coarse fibrous material has lower digestibility, slower reticulo-rumen passage and gives slower recurrence of hunger (Balch et al 1962, Moore 1964, Gampling 1964).

Halley's (1953) grazing time decreased as the sward became more mature and coarse. Dodsworth and Campbell (1953) found 19% more dry matter intake in the dry season than in the wet season. Butterworth et al reported a similar trend in 1961.

On the contrary, Butterworth (1965) working with sheep and Pennisetum purpureum found increasing grass maturity accompanied by decreased intake and prolonged grazing time:

<u>Maturity of grass, days.</u>	<u>30</u>	<u>50</u>	<u>70</u>
Eating time, hours	6.5	7.75	8.60
" hours/kgm.	0.65	1.00	1.46
Bulk kgm/day	10	7.75	5.89

The conflict may be due to different levels of fibre and/or dry matter content in the herbage. Dry matter intake increases as fresh flush matures due to progressive decrease in intercellular water (Poijarvi 1943), cited by Waite 1963, and Dodsworth and Campbell 1953). Butterworth (1965) possibly operated above the critical fibre level whereas the other authors worked below this level.

(b) Hairs etc.

Cattle avoid hairy and thorny herbage species e.g. Rogersia anthoxyloides, Capparis erythrocarpos, C. thoningii, Imperata cylindrica, except occasional bites.

Tough and woody parts of plants are not touched till softer parts have been consumed. This effect is more obvious in paddocks. The animals progressively defoliate the pasture from the top. Young tops of Capparis spp. are readily accepted when the thorns are young and soft.

(c) Taste and Odour:

The taste and/or odour of the feed may prevent the animal from or induce it into eating more. Thus though bites of Lothricochloa intermedia, Cymbopogon giganteus and Ctenium newtonii are acceptable at times, it is dubious if much of them would be eaten, supplied alone. This factor may be important in comparing grazing times at Mungwa with those at Kpong and on range: the Ctenium population of the plots was high.

Thomas et al (1961) cited by Van Soest (1965) reported poor consumption of high moisture silages where the juice appeared to contain an unpalatable substance.

Dung and urine-soiled herbage is rejected and dung stained parts of the coat are not groomed. However Tribe (1955) found that if dung soiling is widespread, herbage grazing is resumed after a few minutes.

Our cattle never grazed the soiled patches, probably because wholesome herbage was in copious supply.

(d) Physiological effect:

The feed may cause physiological disorders and tend to inhibit further intake by the animal through a neuro-humoral mechanism. Van Soest (1965) agrees with this view. Thomas's silage (Thomas et al 1961) may have been due to this upset rather than to an odour or taste as suggested in section (c). The reduction of feeding time on Centrosema (Figs.9, 32) with the passage of time may have been partly due to a similar effect over a period.

Average % of Centrosema in the diet during the first week, 29-7-65 to 6-8-65, was 56.33% of the intake of the 'mixture'. In the second part, 19-8-65 to 2-9-65 the average was 50.70%. (Fig.32, Tables 9-11). On 'Centrosema-alone' the intake rate as % of feeding time per day declined as the recordings proceeded whereas on 'Pangola-alone' and on the 'Mixture' consumption time differed little.

<u>Treatment</u>	<u>Feeding time as % of Total Time</u>		
	<u>1st Week</u>	<u>2nd Part</u>	<u>Difference</u>
' <u>Centrosema</u> -alone'	68.26	49.11	19.15
'Pangola-alone'	59.67	59.65	0.02
Mixture	74.05	73.47	0.58

Butterworth et al (1961) working with Pangola, concluded that at the same dry matter level increasing protein content of herbage increased intake. A feeling of well being similar to the corrective effect of sugar on the acetoneemic cattle cited in section (a) of 'Animal Factors' may have operated in this case too.

The greater dry matter intake of mixed browse - grass than browse alone at Nungua (also reported by Mabey and Rose Innes 1964), and the longer grazing time on Centrosema - Pangola than on either component alone, may be due to a feeling of physiological well being attendant upon the taking of the mixture (Figs. 1, 7, 9, 18, 13 and 14). On the other hand the variety in the diet may have reduced boredom (see sections (a) and (i) of 'Animal Factors').

(e) Nutrient content:

Various authors have found correlations between nutritive value and palatability and intake. Blaxter (1960) cites Fisser (1941), Blaxter (1944), FAO (1955) and Crampton (1957) to support his view that level of intake is a direct function of the nutritive value per pound weight of feed. This is to be distinguished from selection as a result of nutritive value. (Section (iii) above.). If the converse is true then the longer the grazing period by animal, the higher the nutritive value of the pasture, other variables being constant. This does not explain day to day fluctuation of appetite. Blaxter's view, however supports the suggestion that cattle obtain greater benefit from mixed pastures than from monoculture.

Hobbs et al (1945), Saltonstall (1940) Woolfolk (1950), Hardison et al (1954), Cook (1959), Blaser et al (1960) have linked appetite with protein content of the feed.

Working with silage, Allen & Porter (1954) have related volatile fatty acids content to appetite.

Hardison et al (1961) and Elaser et al (1960) have correlated ether extracts with appetite.

Potassium and phosphorus content is linked with herbage selection (Leigh 1961). Sheep have been reported to select vegetation growing on mineral soils in preference to peaty soils (Hunter 1960).

Sugar content has been associated with palatability (Plice 1951 & 1952); Waite (1963); Cowlshaw and Alder (1960); Kare and Halpern (1961). Mollasses spray has been used to make unpalatable plant material acceptable. Saccharine and Sodium - cyclohexyl sulphamate make manure-soiled herbage palatable. Tannic acid has rendered hays more palatable (Hawkins 1955); but in 1953 Wilkins et al found negative relations.

Coumarins and tannins, are known to decrease forage palatability.

ML't Hart (1960) suggested that the low palatability of some subtropical grasses following nitrogen dressings may be due to reduced dry matter but R. Milford (1960) attributed this to lowered soluble carbohydrates and possibly increased nitrates.

The explanation of palatability on the basis of nutritive content has been challenged; H.O. (1932) showed that Sugar, protein and vitamins are probably not the reason for their being selected. Woodman and Evans (1930) found no correlation between mineral content and palatability of plants. Davies (1925) has said that sheep prefer young plants but that it is mere coincidence that the younger parts are also more nutritious. Tribe (1949) cites Tiemann and Mueller (1933) to say that there is no conclusive relationship between palatability and nutritive value of a feed.

If cheap 'palatability-depressants' can be obtained, they may find possible use in deferring grazing of portions of pasture for dry season reservation. Their effect, immediate and residual, on both stock, herbage and man, together with their cost of application will have to be investigated first. If feasible, their use may obviate fencing costs

in developing improved dry season grazing incorporated in natural grass-land. All the herdsmen need to <sup>do</sup> then would be to direct the animals to the season's grazing which may be close to the reserved pasture.

Natural differential palatability may be applied in row-planted pastures where palatable rows are taken first, the less palatable species being reserved for the next season.



Plate 8

Differential burning. Note fresh burn in foreground, unburnt herbage in middle portion to the right, and on the left background.



Plate 9

Cow browsing in thicket. Ear notching is not for numbering but ownership identification.

Y. THE MIXTURES V/S THEIR COMPONENTS

The evidence adduced above shows that comparisons of grazing times in the three parts of this study can only be done with reservation. Valid comparisons are possible within each part, and also between Katamansu and Nungua because the grazing conditions were similar.

Each legume-grass mixture was eaten over a longer period than either component alone. (Figs. 9, 13, 14 and 18). Tables 7 - 11.

	<u>Average Grazing Times</u>	<u>Intake Index</u>
Centrosema-Pangola	8.8 hours	131.6
Pangola alone	7.6 "	105.3
Centrosema alone	6.8 "	100.0 (Base)
Grewia - grass	7.2 "	
Grewia alone	5.8 "	
Katamansu Range	7.5 "	
Ashaley Botwey Range	8.3 "	

The contribution of browse to the diet of the ranging native animal could not be measured accurately by means of the stopwatch since browsing seldom formed an exclusive activity for any measurable period. Invariably a bite or two of browse were followed by some grazing. The greater frequency of browse species at Katamansu would be expected to be associated with longer feeding time. <sup>than at Ashaley Botwey.</sup> The opposite result observed may be attributed to the regime of grazing - dawn and afternoon grazing at Ashaley Botwey contrasting with one continuous grazing period at Katamansu. Younger stage of maturity and thus lower drymatter content coupled with scarcity of herbage may have contributed to longer feeding time at Ashaley Botwey than Katamansu.

Occasionally an animal spent upwards of 3-4 minutes in a thicket selecting browse (see plate 9). More browsing was done at Katamansu than Ashaley Botwey the times spent being c.20 - 30% and 10 - 20% of total feeding time respectively. The most important species selected include Millettia thonninii, Daphia nitida, Griffonia simplicifolia, Capparis spp., in that order at Katamansu. At Ashaley Botwey they are,

in descending order, Capparis spp. Nephia nitida, Millettia blommingsii, Griffonia simplicifolia. Others eaten are Diosyros species, Myrsocarus species, Mitchia reflexa, Securinga virosa, Pagara zanthoxyloides. The creeping herbs Sarcostemma viminale and Conselina nulliflora are grazed despite their wiry nature.

Non palatable shrubs are Gardenia species, Lantana camara, Combretum phasalense, Elasophorbia drupifera and Vernonia species. The herbaceous ones are Uraria picta, Desmodium species and Rhynchosia minima.

Rose Innes and Mabey (1964) found that intake of Griffonia grass mixture (3.3% of live-weight), was 50% more than grass alone and 70% more than Griffonia alone. In the Grewia grass trial at Rungwa, 4.5% of live-weight in terms of dry matter was taken, compared to 1.9% of Grewia alone. The data are too scanty for statistical comparisons but the tendency for animals to eat more of the varied diet is illustrated.

Oyemga (1958) estimates that mature tropical cattle require a minimum of c.0.5 - 0.75 lbs. of digestible protein per head daily for rapid growth. Lansbury (1960) estimated about 1.5 - 2.8% of live weight per day of dry matter was consumed by a 500lb local bullock (Corroborated by Miller 1959). He doubted if dry matter intake would exceed 2.5% live-weight per day and took 2.0% as a conservative estimate. Lansbury's estimate based on stalled bullocks is probably on the low side for range cattle. Higher intake under natural conditions, as much as 4.5% cited above, may be due to greater comfort, less boredom and stimulated appetite due to variety in the diet.

In terms of a grass diet only, Lansbury's 2% level would supply about 0.16lb. digestible protein per head per day and would fall short of the requirements for the growth envisaged by Oyemga. Marshall et al (1961) working on Zebu cattle in East Africa agree with Lansbury. Assuming a conservative 3.0% live-weight intake of dry matter on range, with a browse-grass ratio of 20:80, 3% crude protein in dry season grass, 40% digestible protein in grass, 20% crude protein in browse of 80% digestibility, 600lb. West African Shorthorn bullocks would consume

about 0.75lb. digestible protein per day under dry season conditions as obtained at Katamansu during these observations. At Ashaley Potwey digestible protein consumption would be 0.37lb. per head per day based on 10:90 ratio of browse to grass intake.

This explains partly why Katamansu cattle are in good condition in the peak of the dry season compared to Ashaley Potwey animals. In the wet season when grazing <sup>is</sup> lush, browse intake is reduced since grazing is confined to within c.1 mile radius of the kraals, where browse is not copious.

If these browse species could be multiplied on range, animals might take greater advantage of them in the dry season. Possible approaches to this problem have been suggested (Rose Innes 1965).

C. ENVIRONMENTAL STRESS

The environment in which appetite is satisfied may greatly affect feeding habits (Tribe 1950). Stresses which may limit intake include heat load, fly worry, condition of the ground, thirst and available space. Some of the probable effects of these on grazing behaviour are discussed below.

(a) Heat Load:

Any factor tending to elevate body temperature will tend to reduce appetite (vd. section A(h)). Ambient temperature, saturation deficit, air movement, availability of shade and drinking water may therefore combine to inhibit intake.

There was little variation in ambient temperatures at Ipong during the recording periods, about 70°F to 86°F being the minima and maxima respectively for the whole period. The slight rise in temperature at noon, from about 70°F to about 80°F (average temperatures for 06.00 hours and 12.00 hours) did not cause any noticeable effect on grazing behaviour. (Figs. 22, 28 and 29).

This range of temperature may be within the limits of thermal neutrality for the local cattle. For Zebu cattle, the limits are estimated at 50°F to 80°F. (Troy 1956), Ragdale et al (1950) quoted by Conrad (1966) noted no marked decline in TDN intake of Zebus till ambient temperatures reached 90°F to 95°F. However another possible factor is the short duration of <sup>high</sup> ambient temperature, it declined from 80°F <sup>at noon</sup> to 74°F at 06.00 hours with a soothing breeze prevailing in the late afternoon. Similar reasons may apply in other cases recorded about negligible effect of high temperatures. Hancock (1954) found no temperature effect on the behaviour of cattle even though ambient temperature varied from 50°F - 80°F. Castle et al (1950), Taylor (1951), Waite and Holmes (1951), have similarly observed little temperature effect on grazing time. But Hughes and Heid (1951) thought high temperatures may have been a partial cause for decreased grazing time they observed.



Plate 10

A termitarium licked by cattle



Plate 11

A cow grazing in the shade

(b) Saturation deficit:

Data on Saturation deficit were not available. The contribution made by saturation deficit fluctuations to the daily and regional differences in grazing behaviour is thus obscure. Generally a high saturation deficit will encourage heat dissipation by transudation and perspiration, and tend to induce more grazing. This would be even more important at these high ambient temperatures. Waite (1962) says at 90°F, a relative humidity change from 20% to 40% reduced intake by 15%. The effect of saturation deficit may have been considerable during these observations.

(c) Shade:

On range the animal frequently grazed under shade (Plate 11) a few seconds at a time, occasionally spending as much as 4 minutes standing idle under shade. Calves more frequently sought shade at Katamansu. In the artificial pastures, animals were observed seeking shelter in one another's shadow, thus tending to huddle together when resting in the early afternoon. A situation which would prevent free circulation of air and tend to counteract the "desired" effect. The lack of shade in the paddocks is keenly felt and needs to be remedied. However whether the cost of planting shade trees, including the space so 'lost' by grazing species, is justifiable in terms of animal production is questionable, if humanitarian motives are discounted. The solution may be found in planting palatable shade trees e.g. Millettia, but this species would require protection from cattle until it is an established tree. Appetite depressants may be used here (see sec.(e): "Plant Factors").

(d) Thirst:

Thirst has been shown to reduce feed intake (Balch et al 1953). Thirst caused distress, when one day at Kpong, the water troughs on Pangola were empty. The animals broke through the electric fence and drank from the trough in the Centrosema section (Fig.33). However there was no overt sign prior to the stampede which disrupted recording.



Plate 12

Cattle grazing partly submerged Tanner  
grass.



Plate 13

Calves sleeping in their kraal.  
Note neck flexure.

Grazing scores were similar to other days for the same period. The need for the water may have been partly for cooling.

(e) Fly pestering:

Fly worry is known to reduce milk production by as much as 20% (Knippling and McDuffie 1956). This depressing effect probably operates partly by directly disturbing the cows and causing 'hold up' of milk, and partly by decreasing grazing time as the cows spend some time driving away flies. Hafez and Schein (1962) share this view.

Fly pestering was considerable at Kpong probably because the observation period was humid and also the area is tsetse and tabanid infested being on the verge of the forest. Simulium may have been the reason for the constant tail twitching, but tsetse and tabanid caused acute pain and often a stampede.

(f) Ground Condition:

Kpong cattle avoided puddled and flooded portions of the paddocks. The available acreage was thus reduced but there was ample grazing. At Katamansu, cattle grazed partly submerged Tanner grass in the dam. (Plate 12). Soggy ground is thus avoided only when there is alternate grazing.

(g) Available space:

Stocking rate affects feed per acre and space per animal, and could thus influence grazing behaviour. There was no sign of distress due to restricted space even with the Nungua animals which had 0.05 per beast. This is not surprising because feed was ample and there was no crowding.

(h) Rainstorm and Wind:

Heavy rain reduces grazing time. The animals grazed downwind if the force of the driving rain was not strong. In a strong blast, grazing ceased, but such lost time is said to be recovered in the subsequent grazing period. (Hancock 1953, Aite and Holmes 1951; Castle et al 1950)

Though it rained during the observations, only once was

it heavy enough to disrupt feeding. The animals stampeded when a storm started. About ten minutes later when the wind declined somewhat, grazing was resumed but the animals headed downwind. This continued for about 45 minutes, when they were driven back by the herdsmen, homewards. At Kpong a driving rain forced the animals, still grazing, to drift downwind till they were stopped by the fence. These observations agreed with Hancock's (1953).

Rose Innes (1963), observed that cattle graze into the wind according with Bonser et al (1940), Weaver and Tomanak (1951) and Allred (1950) in this respect. On both artificial pastures and range, the cattle in this study were observed to graze irrespective of breeze direction. Perhaps the conditions for windward grazing were lacking on the ranges and pastures at the time of this study.

## 2. RUMINATION

Cudding behaviour was not recorded for the free grazing animals as they did not ruminate on range. The animals on the restricted woody pastures did not show any definite pattern (See Figs. 8, 13, 14 and 31), but this is hardly surprising as more recordings would be required to establish such a pattern as recorded for the Kpong bullocks (Figs. 3 and 8). As would be expected the peaks coincided with the inter-grazing troughs.

The act of cudding was observed at Katamansu in the kraals where an animal chewed about 52 times in 62 seconds per bolus (mean for 21 recordings). The swallowing and regurgitation took 3 - 7 seconds (average, 4 secs.). Another animal chewed 62 times in 68 seconds (average for 18 recordings). These figures cannot be held as representative, being so scanty. Standing cudding accounted for 70-75% of total rumination time.

At Kpong only about 25% - 30% total ruminating time was spent lying down. Occasionally an animal cudded while walking and was recorded as standing.

The change from cudding to grazing or idling is abrupt but the grazing animal will idle awhile before commencing cudding. The recording technique masked this tendency. It is therefore not apparent from Fig. 31: "Detail activity chart" at Mangwa.

The advantage to the animal of the ruminating habit is most apparent on range. The animals ingest actively throughout the ranging time and regurgitate to remasticate thoroughly when they are back in the kraals, thus maximising the use of the available ranging time. At dawn when there was ample time, A haley Botwey animals ruminated for a considerable time (Fig. 27).

### 3. I D L I N G

There was little idling on range due to the need for economy of time. (Fig.16). Some idling must have occurred at dawn at Ashaley Botway but could not be recorded because of the darkness, it was included in cudding time. On the whole there was more idling at Katemansu than Ashaley Botway and this ties up well with the more continuous grazing at Ashaley Botway (Figs. 25, 26, 16 and 17).

At Kpong, idling averaged 13% of total activity time on the mixture, 22% on Pangola and 25% on Centrosema. About 25% of total idling time was spent lying down on the mixture, compared to a.30% on the either component. This is similar to the figures for cudding.

The idling pattern for Kpong and Fungua was less definite than cudding. Two peaks roughly coincide with the troughs of grazing just before closing at Sundown (Figs. 3, 6, 7, 13 and 14).



Plate 14

A calf rising from the lying position.



Plate 15

A cow lying down. Note alert ears.

#### 4. L Y I N G   D O W N

Lying down was not observed on range except with Katamansu young calves. In lying down a well-defined sequence of movements is followed - the forelegs are flexed to the kneeling position, then one hind leg is placed forward as the body lowers on to it. The result is a reinclination on the flank while the sternum placed erect, supports the fore quarters. Occasionally an animal may stretch on the side clear of the limbs but this posture is temporary. The neck which is usually held erect in front, the head resting on the chin, may at times be flexed on to the chest for short periods. In calves the neck may be folded in this position for protracted periods. (Plates 13,14, 15).

Occasionally an animal was observed to rise and lie down almost immediately on the opposite flank. Scarcely any animals lay down for as long as fifteen minutes at a time, but these activities were not timed to avoid recording errors in the major grazing activities.

At Kpong the animals always lay down at a particular spot near the electric fence such that when they were divided into the two herds, they were as near as possible to each other, but at a safe distance from the live wire. (Fig. 33). Perhaps the explanation lies in competing drives, the desire to graze and the herd instinct. The desire to join the others was superseded by the urge to satisfy hunger. When hunger was assuaged, i.e. at the end of each grazing cycle, they rested and the other drive resumed predominance and the two herds tended to come nearer but the instinct of self preservation came into play determining the avoidance of electric shock. The resting places were therefore fixed as the resultant of these forces.

Towards the end of the grazing cycle, the whole herd grazed up to the resting place, some lay down while others stood or even continued to graze; others followed, may-be several minutes later while some of the first were rising up. The whole herd was seldom observed all lying down at any one time.

The lying posture affords economy of energy - it costs a fully fed steer 12% less than in the standing posture. The consistency with which the habit was exhibited (Figs. 5 & 19) suggests lying down is a true rest activity. One animal at Kpong was observed to close its eyes for several seconds. Otherwise only young calves were observed to close their eyes in this position and would not be aroused easily. Whether the cattle closed their eyes in the lying position at night was not recorded but there is no evidence in the literature to that effect.

Brownlee (1950) argued that constantly active salivary glands and frequent eructation, normal functions of adult ruminants, render it impossible for such animals to lose consciousness. However salivation and belching need not be voluntary actions and could go on like breathing in sleep. Young calves without active rumens do not lose consciousness. Moreover in the idle-lying periods, lying down with loss of consciousness would not interfere with rumination. Salivation and eructation therefore do not explain this retention of consciousness during sleep.

Furthermore Balch (1955), and Sobalk and Amadon (1928) have shown that the lying posture interferes little with reticulo-rumen function. They said that tilting the organ laterally or dorsoventrally would cause displacement of the fluid material in the reticulum and ventral rumen. Whether cattle sleep or not depends on our understanding of 'sleep'. It may be said that young calves close their eyes during sleep but adult cattle do not.

It has been recorded that cattle lie down less when it rains (Harker et al (1956)). Thus animals would be expected to stand more on rainy nights and therefore tend to rest more on the ensuing days. This was not borne out by the behaviour of the animals in the Kpong recordings. The following table illustrates this lack of evidence:

<u>Date</u>	<u>Rain previous night</u>	<u>Lying time % of total</u>		
		<u>Mixed</u>	<u>Herd on Panzola</u>	<u>Herd on Centrocema</u>
6th August	Showered	1.96	-	-
7th "	0.03"	-	12.3	15.1
23rd "	1.0"	-	12.9	10.7

<u>Dry Nights</u>		<u>Lying as % of Total Time</u>	
		<u>Pangola</u>	<u>Centrosema</u>
26th August	no rain	19.5	28.4
28th "	"	13.1	15.4
30th "	"	15.9	17.6

Probably precipitation was not heavy enough to force the animals up from the lying position (i.e. to disturb rest). Thus lying time on the ensuing days was not affected.

Change from lying to standing posture was sometimes voluntary but frequently a resting animal was forced up by another. This may be play behaviour. On rising up from the lying position, an animal usually arched its back, its tail raised, and stretched out its limbs with its back curved in. This reflex is suggested by Brownlee (1950) and Thorpe (1948) as due to a building up of "reaction specific energy" which, when a certain tension has been reached, tends to release itself as the animal rises up. The reflex was not exhibited when an animal was startled from rest.

## 5. STANDING

Though standing accounts for c.20%, 25%, 28% of total time on mixture, Pangola and Centrosema respectively, at Kpong it was not exhibited in any definite pattern (Fig.4). On the 'woody pasture', standing time was c.30.5% and 38.3% of total time on 'Crewia alone' and on the 'Mixture' respectively, no definite pattern was evident here either (Fig.20).

Standing behaviour may thus be regarded as non-definitive compared to the more positive habits like cudding and lying down, which fall into well defined cycles.



Plate 16  
Cattle drinking



Plate 17  
A herd being led from kraal  
to watering point. Note  
forward pointing horns of the  
leader: an effective weapon.

## 6. DRINKING BEHAVIOUR

Water intake was not measured but drinking frequency was recorded. At Kpong, water was available in the paddocks whereas at Nungua, the animals were taken to water at predetermined times, viz., 05.55 hours, 12.00 hours and 18.00 hours G.M.T. On range the cattle were taken to the nearest watering points along the grazing route.

Generally range cattle were watered once daily. At Kpong they drank more frequently, (twice or more daily) on Pangola - Centrosema than on either component alone (usually once daily). Related to the intake times, Tables 9, 10 and 11, this tendency agrees with Stromminger (1949) and Lepkovsky et al (1957), who said that higher dry matter intakes were accompanied by increased water intake.

Cattle generally drink as a group (Plate 16) but occasionally an individual would be grazing while others drank or the majority grazed while a few individuals went to the watering trough. On range whole herds watered in 5-7 minutes but the individual drank for 1-3 minutes only, at a time, sometimes only a few seconds. Grazing intensified after drinking: This may be viewed as a corollary to the finding that thirsty cattle eat less: (Phillips 1960, Falch et al 1953).

The releasers of drinking behaviour are obscure. Various authors suggest neurohumoral processes. Wolf (1958), traces it to changes in serum osmotic pressure, and Gilman (1937) explains it by cellular dehydration. There is strong evidence that there are thirst and drinking centres in the hypothalamus and several controlling factors have been identified: Andersson and McCann (1955a, b., 1956, 1960); Greer (1955) and Holmes et al (1960) mention stomach load, thus agreeing with Stromminger (1949).

East African cattle are believed by their herders to be able to smell water behind hills (Harker & Rollinson 1961). At Kpong cattle on Plot 2 (Fig. 34) (Free Choice) failed to locate the water troughs on the

Pangola section though they grazed close to them. They instead came all the way to the Gentrossma section to drink. Their inability to smell the water may have been due to the direction of the wind, which blew from the cattle to the troughs.

## 7. EXPLORATION BEHAVIOUR

Exploratory behaviour was observed at Kpong where the animals had to accustom themselves to unknown surroundings.

In a strange situation, cattle are alert, their ears erect, the eyes wide open, the tail twitched more frequently, and are ready to take to flight on the least sign of danger. They tend to congregate and move round the new abode, probing any unfamiliar objects if there is no interference. Thus they would stretch their neck from a distance, the ears horizontal and perpendicular to the head, and cautiously muzzle the herbage hung on the electric wire in the training area. When they were shocked they jumped back and stared at the wire in 'awe', never going near again. However one animal required repeated shocks to learn to avoid the wire. This was repeated with any unfamiliar object. Where the object was harmless e.g. the recorder's ladder-seat, the animals approached cautiously as before, sniffed, and muzzled the object, then cautiously licked it at first then proceeded to lick it 'in earnest'. This they did even to the recording board and the recorder's boots, after familiarising themselves with the presence of persons.

Unfamiliar herbage was similarly probed. An animal was observed to sniff Vitex leaves all over, then it licked and held the leaf between its jaws, cautiously chewing slowly again and again, its ears erect, eyes widely opened, before taking one bite off, masticating and waiting awhile, then biting more leaf off and swallowing it.

On first entering the paddocks because they had been night-starved before, they proceeded to graze ravenously along the fence in a closely packed group; before drinking, the troughs were similarly investigated. Thereafter they walked straight to the waterers and drank as needed.

## 8. GROUP RELATIONS

### (i) LEADERSHIP - FOLLOWERSHIP:

On trek to or from grazing, cattle are led (Plate 17). The leader is chosen by combat. The herd leader sometimes precedes her herdsmates by as much as 20-30 yards. When on pasture leadership ceases to operate. In all the range herds cows were leaders, the bulls trailed behind and courted.

### (ii) HERDING INSTINCT:

Cattle are gregarious and one animal isolated, panics and is apt to flee from the least disturbance. The Kpong cattle demonstrated this herding instinct in the difficulty encountered in separating them into the two groups of six <sup>each</sup> (i.e. Red and Green). The first attempt took over three quarters of an hour. Later, separation became progressively easier. The reasons may have been (i) increasing experience in handling the animals, (ii) increasing familiarity of the animals with persons (iii) the bullocks' 'recognition' of their subgroups (Red or Green). The Red group however never had a leader to the end of the observations. It may therefore be argued that they were not 'aware' of any subgroupings, they recognised their original group of 12 and 'owed allegiance' to their general leader, Number 39. As No. 39 was always visible to the Reds, both at pasture and in the 'kraal', there was no need to replace him. On unfamiliar grounds cattle herd more closely than on well known areas, thus the Kpong cattle tended to disperse more while grazing, towards the end of the observations.

Once, they mixed up with 5 other bullocks of the "bullock herd", there was segregation, each group staring at the other. The experimental herd thus proved to be an established entity.

### (a) Cattle tracks

Cattle tend to walk in queues. The result is a network of paths on range especially at Ashaley Botvey (Plate 19). The advantage



Plate 18

Gully erosion started as  
a cattle track.



Plate 19

Crisscrossing cattle tracks.  
Note tendency to queue up.

is ease of movement in thorny bush etc. but the erosion hazard is tremendous. Gulleys are developing especially on slopes. Plate 18. The habit may have been learnt by experience or may be instinctive.

(b) Homing

Cattle are supposed to have a strong sense of direction. When on range they can run back to their kraals by the shortest course when terrified or when night falls and it rains. The opportunity of observing this did not occur. The animals know their ranges very well but how they can determine the shortest route is obscure. Despite the numerous crisscrossing tracks each herd goes along the right one to their kraal.

Once at Ashaley Botway, another herd which had to cross our path at about 60° to their kraals stopped when they met our cattle till our procession passed, before continuing on their journey. Other animals from another herd mixed with the observed herd on the grazing grounds. They probably became aware too late and had to break off at right angles to their homes though their herdmates had gone out of sight and visibility was very poor at 18.45 G.M.T.



Plate 20

Agonistic behaviour: Physical contact. Note head positions - directing horns against opponent: forward pointing horns advantageous.

## 9. AGONISTIC BEHAVIOUR

Agonistic behaviour comprises all manifestations of confrontation including aggression, defence and flight. King and Gurney (1954) defined aggression as the initiation of a fight. Schein and Fohrman (1955) serialised aggressive behaviour in the following sequence:

- (i) approach - passive or active;
- (ii) threat - i.e. "aggressive intention movement". (Tinbergen 1952);
- (iii) the physical contact - (a) butting (b) fighting. Sometimes there is no contact, the weaker animal fleeing at the threats of the aggressor.

The passive approach has been termed "Chance approach meeting" by Hafez and Schein (1962), but this has been described by Schein and Fohrman (1955) as "significant and decisive".

The active approach is deliberate and decisive. Schein and Fohrman (1955) have identified it with "hard breathing, lowered head, slow deliberate movements, occasional pawing, then a physical contact ensues if the attacked does not flee".

### The Threat:

When animals are as close as 5', 'manifesting aggressive behaviour', eyeing each other, the horns if present are directed against the opponent. The threatened animal either returns the challenge or flees to a safe distance.

### Physical Contact (Plate 20):

Butting is sometimes followed by combat (fighting). It may be preceded by snorting, and slow movements, head down. The opponents may circle each other a few seconds to several minutes trying to gain advantageous flanking position and avoiding a frontal impact. The flanked animal endeavours to regain a frontal attacking position, if unsuccessful, it retreats and may be pursued for a brief distance by the victor.

### Clinch:

This is rare, being found in prolonged fights characterising equal matches. The heads are slipped from the end-on position to the legs of each other, between the thighs and the udder.

The outcome of any confrontation depends on age, weight, sex, horn shape and experience. As the herds observed had been well integrated, leadership had been well established thus no active confrontation could be observed except at Kpong where there was prolonged fighting, (about 70 minutes) about 10 days after the herd had been isolated from the station's bulls and bullocks. What initiated this was not identified nor was it possible to record the matches and their outcomes. However this did not change the leadership which was established the first day at pasture after a series of fights.

At Matamansu, bulls in different kraals always challenged each other when their herds came together, as they frequently did (i) going out in the morning, for as much as 2 hours, (ii) at watering points on range (iii) on converging in the plain, 1 mile to the kraals, at sundown. The challenges took the form of bellowing, pawing the ground, staring at each other, eyes protruding, heads down, the back arched, hair on back of neck, erect. These never culminated in physical contact as herdsmen were quick in intervening.

Combats were frequent between cows in the 3-kraal herd (the observed herd) at Ashaley Botwey. The immediate causes were not identified but combatants always came from different kraals but leaders were not involved. Bulls of the same kraal did not fight.

There are considerable sore marks on the ribs and flanks of the range cattle - abundant record of incessant fighting. This may be due to (i) the constant addition to the kraals of growing calves and purchases and subtraction of older animals for sale, thus always upsetting the leadership-followership stability, (ii) the presence of horns on the animals.

#### 10. EXERCISE AND PLAY

Sometimes two animals would clinch horns for a few minutes, each pushing slightly. Occasionally such contacts ended in grooming. Grooming animals may suddenly clinch horns this way. Probably this clinch is actually poll-scratching.

Forcing up of resting cattle by herdmembers may also be play. Cattle, especially calves, after a good fill were frequently observed to run about jumping and kicking in the air.

Some of these habits have definite uses in adult-life e.g. mounting and play-fighting with trees etc. It was perhaps for this reason that Carpenter (1934) Scott (1945), Vogel et al (1950), cited by Hafez and Schein (1962), described play behaviour as serving "adaptive purpose and shaping those motor patterns which may be of critical importance later in life". Others like frolicking and kicking may be better termed 'exercise'. Brownlee's view (1954) in concurrence with Schein's (1954) may better apply here than to the first less energizing type. They maintained that such activities are performed for their own sake with their own "drives, releasers, emotions, consummatory phase and goal".

Other expressions of play are vocalizing, snorting, headshaking, and pawing (Brownlee 1954). The releasers of such activities have not been identified but are associated with well fed healthy animals and good weather. All these sometimes share "new but not unfamiliar" objects or fields (Schein and Fehman 1955). The nibbling of straw by day old calves is not solely mimetic as claimed by Walker (1950), but is play behaviour exhibited by even isolated neonates. (see sec.12).



Plate 21

Grooming behaviour. Black cow solicits grooming from the white one.



Plate 22

Grooming behaviour. As the head is lowered, grooming proceeds towards the withers.

#### 11. GROOMING

Cattle spent considerable portions of their idling time grooming themselves and one another. Whether this was scratching in response to itching or simply coat grooming instinctively fixed, is difficult to say. It is probably both.

An animal may lick its legs, flanks, twist, perineum but solicits licking of the forehead, neck, and back, from other cattle. Plate 21. The petitioner slowly walks in front of one animal and places the part in front of his muzzle. The second animal accepts the invitation by licking the area so positioned. The licker's head bobs up and down as the tongue is worked in upward strokes only. If it is the neck which is licked, the beneficiary may raise its head showly as it is scratched and the licking moves up the head. If the head is lowered, the grooming proceeds towards the back (Plate 22). The beneficiary usually half closes its eyes as it appears to enjoy the grooming. Sometimes two animals mutually groom simultaneously, or they may take turns. Occasionally a dominant animal may drive out a weaker beneficiary and place himself in the grooming position to be licked. Brownlee would describe this as show of jealousy (Brownlee 1950).

Boddie (1946) says of grooming, "predilection sites for ringworm in cattle are the head, neck, root of tail, chest, abdomen or croup - less commonly". These are the most difficult to groom.

Where the coat is soiled with faeces the patch is not licked but presumably the hair is shed so that the patch goes off in 2 or 3 days.

The grooming habit made painting marks for identifying the 'Red' and 'Green' cattle at Kpong inconvenient, the markings came off in 3 or 4 days. The nostrils are licked very frequently presumably to remove phlegm and drive away flies.

Self scratching against anthills trees etc. may be exploited in the application of ringworm medicament if Boddie's (1946) predilection sites are those so scratched. Rose-Innes (1966a) cites Larkin (1954) who mentions self application of insecticide to get rid of Simulium flies.



Plate 23  
Neonate calf trying to rise



Plate 24  
Dam licking birth fluids from  
the ground and grazing herbage  
soiled with fluids. Note birth

## 12. MATERNAL AND FILIAL BEHAVIOUR

### (1) Birth:

There was a birth on range at Katamansu. Natural suckling was observed at Katamansu and Asheley Potway, and hand suckling at Hungua.

The Katamansu cow had been identified to be on term. She was restless, pined and lashed her twitch frequently. Her grazing was listless. She tended to avoid the group, but the herdsman drove the cattle in her direction to keep an eye on her. Eventually she broke off and had dropped a bull calf when she was found just about to start licking him.

The calving was in the shadow of a thicket (Plate 24). She sniffed the air from time to time, her ears erect, and could not be approached without disturbing her.

She continued to strain her self to expel the afterbirth and bellowed. After licking the calf 30 minutes she joined the grazing herd about 300 yards away and returned in 20 minutes, bellowing to the calf who did not respond till she was within c.5 yards of him. Meanwhile he had been making many futile attempts to rise from the orthodox lying position in which he was. His first success was c.55 minutes after birth, on the return of the dam from grazing (Plate 23). The neonate's first action on rising was motion towards the dam's hindlegs, nudging his way towards the udder from behind, his head up, neck stretched and floundering unsteadily on <sup>his</sup> legs. She kicked him down no less than thirty times preventing him from reaching the udder.

Meanwhile the dam grazed the herbage soiled with the birth fluids (Plate 24) and licked him continually. This taste was probably developed as a result of physiological changes consequent on birth.

Kicking may have been caused by her unreadiness to suckle; the conditions of let-down may not have been set then e.g. the inhibition of progesterone on prolactin-release, may not have subsided by then. His first spontaneous bellow was about 2 hours after birth.

The herdman scratched the cow's vulva and perineum and she calmed down, her tail head raised. The calf still floundered about her forelegs nudging her dowlap.

The neonate and his dam were left about 2 hours post partum. Walker (1950) who observed 3 dams and their calves for 9 hours after calving, reported 3 hours as the first attempt at suckling by the neonate: this being merely mouthing around the udder without obtaining much, the first real feed being 6 hours after birth.

The trial and error method of the calf probably aids it in learning to recognise the dam. After locating the teat, the error progressively reduces with subsequent successes till the calf is able to reach the teat directly at about 7 days of age. Since the calf ceases to suck other parts of the body after locating the teat, the satiating of hunger may be the desired goal.

A cow which had calved on range 3 days previously was retrieved and the recently delivered one was left on the range to be returned to the kraal on the third day. By then her calf would be strong enough to walk back with the herd.

(ii) Suckling:

Each cow knew her calf well and each calf could identify its dam. How long it took this relationship to be fixed was not determined.

At sundown, the homing cows bellowed incessantly from far out on range. Those with very young calves went home to suckle them - perhaps to reduce their udder pressure. The calves on hearing the calls of the cows returned the cry. Some calves found their dams at first attempt, others would try several times before success; sometimes a calf waited 'anxiously' calling while many cows passed but as soon as its dam came near, would dash for her. The dam's lowing turned into a brief grunt, then she nosed the calf and usually licked its head, etc., grooming it, while the calf found its way to the udder to have its only full suckling of the day. This description relates to all Ashaley

to  
Botwey calves and Katamansu calves less than c.5 weeks i.e. too young  
to accompany their dams to pasture.

Some dams refused to suckle their calves and were restrained  
with a rope; vicious ones carried a long trailing pole attached to a  
halter to facilitate restraint.

On range, the frequency of suckling per day was recorded for  
the leader and her calf, a four month old, (Fig.25), Katamansu.

SUCKLING FREQUENCY: KATAMANSU

12th January, 1966

<u>Time of Day</u>	<u>Duration</u>
11.30 hrs. GMT.	7 mins.
13.05 "	5 "
15.30 "	8 "
17.00 "	<u>4½ "</u>
Total	<u>24½ "</u>

14th January, 1966

<u>Time of Day</u>	<u>Duration</u>
11.45 hrs. GMT.	6 mins.
13.45 "	<u>8½ "</u>
15.15 "	<u>8½ "</u>
17.25 "	<u>5 "</u>
	<u>28 "</u>

15th January, 1966

11.30 hrs. GMT	6 mins.
13.45 "	5 "
15.05 "	9 "
17.00 "	<u>3 "</u>
Total	<u>23 "</u>

17th January, 1966

11.45 hrs. GMT.	5 mins.
13.45 "	5 "
15.15 "	8 "
17.25 "	<u>3 "</u>
	<u>21 "</u>

4th February, 1966

11.50 hrs. GMT.	Trace
13.00 "	8 mins.
15.25 "	7 mins.
17.40 "	<u>8 "</u>
	<u>23 "</u>

The dam invariably stood quiet for the first three minutes, then started walking with the calf following and suckling from behind between the thighs. She would sometimes stop a few more minutes. The dam may groom the calf as it sucks or just stand, or graze.

the following  
Range calving under local husbandry is open to hazards:

(i) Exposure is particularly high in the wet season. However wet season calves are carried by the herdsmen to the kraal at the end of the day's grazing. The task of chasing a straying herd while carrying a delicate calf with its dam following, perhaps the afterbirth still hanging, warrants modifying the system. (ii) Loss: though the cow knows her range very well and drinks and grazes as required, while 'abandoned' on range with her young, she could stray far out of her territory and lose her bearings. (iii) The risk of spreading reproductive disease is very high. (iv) The journey from range to kraal must be very exacting on the strength of the calf. Herdmen are however alert on their young calves, watching <sup>and</sup> seeing to it that the young are not left lying down obscured in a tuft of grass. (v) If the parturient cow goes out of sight, and calves unseen, any parturition complications may lead to losses (vi) Post partum disorders cannot be found to be remedied.

The system of range calving could be improved by reserving calving-paddocks for parturient cows. This should include a watering point.

(iii) Milking:

As reported by Polly Hill (1963) on the Accra Plains the Fulanis milk the animals for part of their wages. Milking is done once daily in the morning. The calves are kraaled (Plate 13) in the evening after sucking except those whose dams are not milked viz. less than 1-2 weeks. In the wet season, the age limit is much less as the dam's milk is then copious.

At about 06.00 - 06.15 hours milking starts at Katamansu. Ashaley Botway milking is done at 08.30 - 09.30. The calves are released from their pens one or two at a time, depending on the number of milkmen. They invariably go to their dams directly seldom calling. Only the very young ones (less than two weeks) need assistance from the milk man. When the udder is reached, the calf bumps till there is flow of milk; the dam licks its head, back, vulva and perineum and it shows 'joy' by tail-wagging. Suckling is done by the right hand side of the dam, (the calf is so trained by the milkman to facilitate his right handed milking habit). The calf will seldom suck when presented the left side but will find the right; the dam will change position to present the right side for sucking.

The sight of the calves is sometimes sufficient to elicit let-down in some dams. Other dams have to be stimulated by a brief sucking action by the calf which is then tied to the right foreleg and the milker proceeds to express milk manually into a calabash. Yields are very erratic and probably depend, among other things, on the animal as much as the enthusiasm of the milkman. Diurnal fluctuations must therefore be considerable. This aspect is being investigated by the author's colleague. After partial milking the calf is allowed access to the rest. It sucks frequently changing teats and bumping vigorously 39 bumps were observed in one suckling of 11 minutes following milking at Ashaley Botway.

Milking at Ashaley Botway seems to be more drastic than at Katamansu: (i) all teats are partially milked to nearly stripped, whereas at Katamansu, some teats are left for the calf; (ii) Katamansu calves above 5 weeks range with their dams and have access to the udder all day, whereas Ashaley Botway calves are grazed separately, suckling (partially) once in the morning and fully in the evening; (iii) there are more cases of bad teats at Ashaley Botway than Katamansu - the result of poorer husbandry. However with the 2 sucklings a day, there would be a high incidence of calf scours in the wet season, were milking not so drastic and the calf's intake not so restricted.



Plate 25

Hand suckled calves suckling  
each other's tests or udder

Udder bumping by the calf may indicate the difficulty in sucking. Bumping counts and teat changing frequency may be studied as a possible measure of the relative difficulty in sucking, and thus the relative deprivation suffered. A more direct technique will be to weigh the calf before and after sucking and devise a relationship with the milk taken by the milkman.

(iv) Hand suckling: Nungua

Three days of hand suckling observations were carried out on 2 neonates isolated in a pen<sup>and</sup> on 6 calves aged 1 - 5 weeks in a paddock furnished with concentrates and hay in addition to a little grazing available. The primary objective was to compare the behaviours of bucket fed and naturally suckled calves.

It was apparent that the calves did not show any inclination to drink milk from a bucket. It took about 20 minutes to get a gulp down the throat of one neonate. It would still not drink and a bottle was used. The milk was comfortably warm and was readily accepted by older calves. It may be inferred that though calves have an urge to 'satiat hunger' (Brownlee 1950) and Walker (1950), they also have the tendency to do so by sucking only: as evidenced by their sucking a finger dipped into milk. The tendency of bucket fed calves to suck one another's teats and udder further strengthens this view (Plate 25) Depraved-sucking (of calf by calf), may be regarded as play exhibited by bucketfed calves. Bumping is also released by the feeding action in finding the udder as shown by the calves thrusting their noses into the bucket-milk in a bumping fashion. Frequency of bumping therefore may not be a reliable measure of the relative difficulty in obtaining milk as suggested above.

(v) Calves on range: (Plate 26)

The 4 month old calf spent about 5 hours grazing. Its selective power was higher than that of adult cattle.



Plate 26  
Calves at pasture

Its diet was chiefly first and second succession stage grasses e.g. Digitaria, Dactyloctenium, Cynodon dactylon, Heteropogon contortus, Chloris barbata. Others are Brachiaria spp., Hyparrhenia dissoluta, Andropogon gayanus. It did not browse. It grazed for  $5\frac{1}{2}$  hours on the first day, and  $4\frac{1}{2}$  hours on the second (See Fig. 24).

CALF ACTIVITIES

	5 - 2 - 66	12 - 2 - 66
	From 11.05 To 16.55	From 11.35 To 16.49
<u>Activity</u>	<u>Time: Mins.</u>	<u>Time: Mins.</u>
Grazing	333	259
Walking	17	55
Total	<u>350</u>	<u>314</u>

## VI. CONCLUSION AND RECOMMENDATIONS

Conclusions have been drawn in the text but the more salient points may be repeated here.

1. A casual look at the dry season diet of free ranging local cattle gives the impression that they are more undernourished than their condition suggests. Their higher digestive powers and lower maintenance requirements do not fully explain this.

Closer investigation reveals that they get more than thought. The variety in the diet increases appetite and the woody browse species on range, mostly legumes, contribute about 0.58lbs of digestible protein per head per day. Furthermore, by their selection and creaming habit guided within limits by their ability (probably learned) to recognise useful species, they are probably getting more than these conservative estimates show. The good condition of the Katamansu animals at this time is thus understandable.

2. The local natural-grass husbandry practices are adequate in many respects but a few changes would multiply the benefits derived from range.

- (a) The judicious use of fire to rid the range of wiry tough grasses and induce fresh flush in the dry season, is commendable but care should be taken not to remove thickets. Burning has been condemned by many casual observers as wasteful. The same patch of grass is not burnt twice every year as some critics claim. Work in Northern Ghana (Hamsay and Rose Innes, 1963) and elsewhere has shown that there is little loss of soil organic matter as the heat does not penetrate deeper than the surface 2cms. of the soil. These fires probably help to check tick infestation. The periodicity of burning the same patch should however be lengthened, e.g. biannially instead of annually. The new flush should not be grazed till about 6 inches high.
- (b) Wet season upland grazing and dry season valley grazing is a useful rotation. It could be even more beneficial if more

nutritious dry season species are planted. Grewia carpinifolia, Millettia thonningii, Bahia nitida, and possibly Leucaena glauca could be tried on the upland soils: Griffonia simplicifolia is very slow to establish outside termitaria. Valleys and also windward slopes occupied by tall grasses may be sodseeded with Centrosema pubescens, Stylosanthes gracilis, Siratro, Desmodium spp. Drier slopes may be overseeded with Stylosanthes humilis, Indigofera sp., Dolichos lablab, etc. which endure long droughts. Where possible, as at Katamansu, alternate husbandry programmes could be worked out. These exercises would require much capital outlay which must be justified by the increase in animal production. The costs could however be reduced if abandoned farm lands are cultivated to the forage.

The optimum proportions of legume to grass required is not clear. Animal production trials on various ratios could indicate the most useful ratio.

- (c) Dawn grazing does not appear to add much to the intake, as the animals rapidly adapt to the system of management imposed on them. However it merits further study.
- (d) Salt should be provided in the kraals and/or outside them for the animals to lick just before and after ranging.
- (e) More watering points are required at Ashaley Botway to prevent total denudation of the area around the two now being used. Small dams in some of the seasonal streams would be worthwhile. Ashaley Botway stocking rate is at carrying capacity and should not be increased further.
- (f) Spraying should be more regular and thorough. The use of hand spray guns of the type used to insect-spray rooms, would probably be better than cotton-dubbing. The tree rubbing habit may be used to make cattle smear themselves with insecticide. This would control ectoparasites and reduce Simulium trouble.

- (g) The animals must be dehorned to prevent goring wounds.
- (h) Burdizzo castration should replace spermatic cord pounding.
- (i) The system of milking and the standard of hygiene must be improved.
- (j) Selection pressure should be raised to rid the herds of cows of poor mothering ability, with bad teats, unable to drop a calf every year.
- (k) Woodcutting should be restricted to nim and other uneaten species. These recommendations call for an effective extension service and some will need cooperative effort.

3. Pasture herbage intake is determined by a complex of plant, animal, and environmental factors; feeding duration may therefore only be assumed to reflect bulk intake if the prevalent conditions are alike.

4. Cattle quickly adapt to routine and modify their habits (including feeding) to suit ranging circumstances. Thus when allowed a lengthy grazing period on high quality pasture, they will ruminate and graze alternately. Herbage selection is also more evident then. Otherwise rumination is deferred and the little available ranging time is economised by grazing intensely.

5. Well fed cattle will play, exercise and groom. Starved, listless animals scarcely display such activities.

6. Parental care in cattle is almost exclusively maternal. The sire's part is in the form of protection spread over the whole herd - if he leads the group. In those instances where he courts behind in the procession, his main care is to fight back any male intruder.

7. The dam's habit of licking her birthfluids etc., the newborn calf's affinity for its dam and its tiresome nosing, muzzling and nudging in search of her teats are probably very significant in the development of the thorough knowledge each has of the other. This profound intimacy makes instant identification possible even in a large herd.

8. Handfed calves suck each other's udder and testes, often ingesting hairs which fatally obstruct the reticular orifice. The habit may be held

to indicate that suckling behaviour is inborn as the only method of satiating hunger. That probably is why the calf ceases to nudge its dam once it finds her teats.

9. Cattle seem to be endowed with "nutritional wisdom", whereby they tend to avoid intake of toxic material but eat more of beneficial feeds. Thus they sometimes:

- i. reject poisonous plants,
- ii. graze more when the feed is:
  - (a) tender and easily digestible,
  - (b) more nutritious,
  - (c) more varied and probably more balanced,
- iii. strive to balance their diet if the feed is deficient in minerals by developing predilection for bones (osteophagia), earth (geophagia) etc.,
- iv. develop strong taste for sugar when acetoneemic, thereby apparently promoting alleviation of certain forms of the condition.

10. Terminology in feeding behaviour studies need standardisation. The following are suggested:

- i. Hunger - desire for food.
- ii. Palatability - an attribute of gustation. Palatable feeds are eaten, non palatable ones are rejected. Degrees of palatability are recognisable. Different feeds may have different degrees of palatability to different animals. More palatable feeds are preferred.
- iii. Acceptability - Feed eaten is acceptable, if rejected, it is unacceptable. Gradations of acceptance should not be recognised. The acceptability of a particular feed may differ with time, place, animal etc.
- iv. Creaming - should be reserved for choice of more tender parts before tougher parts irrespective of plant species.

- v. Selection - choice of certain plants while others are rejected.
- vi. Appetite - bulk of food relished. The keener the appetite, the greater the food intake.
- vii. Fill - maximum intake i.e. the capacity of digestive tract.

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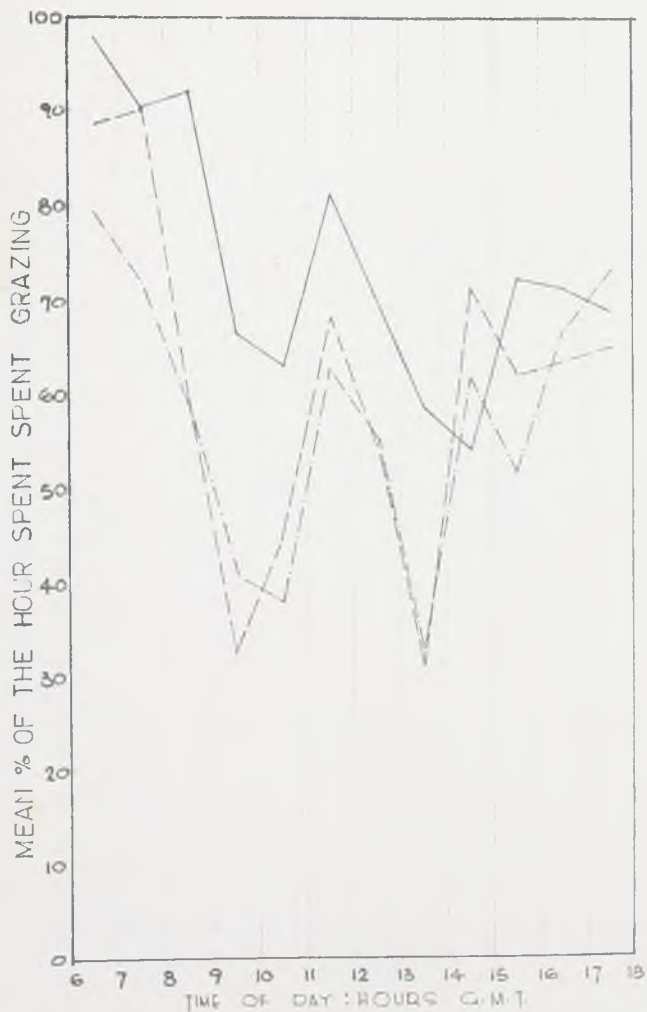
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FIG 1  
GRAZING BEHAVIOUR: OVERALL HOURLY MEANS: KPONG



PANGOLA — CENTROSEMA

PANGOLA

CENTROSEMA

FIG 3  
CUDDING BEHAVIOUR: KPONG  
ON HOURLY BASIS

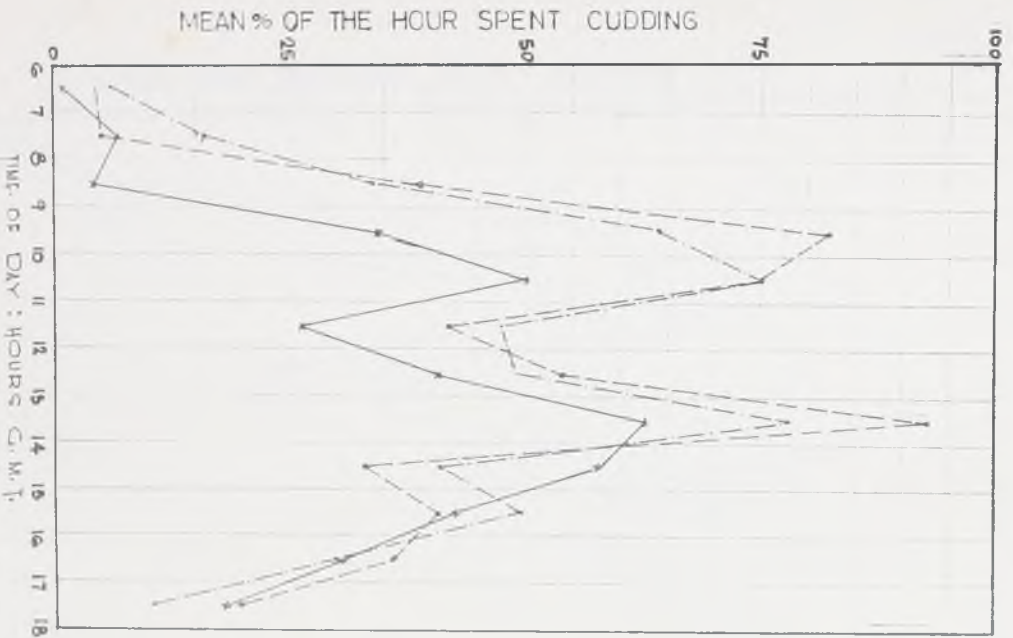
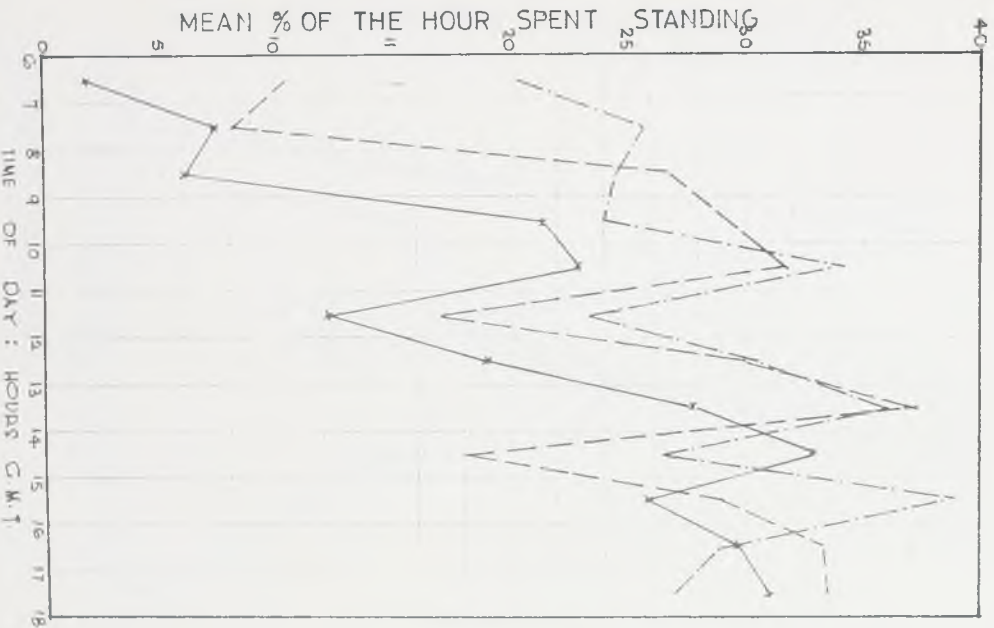


FIG 4  
STANDING ACTIVITY: HOURLY MEANS: KPONG  
MEANS FOR 12 DAYS

AMBIENT

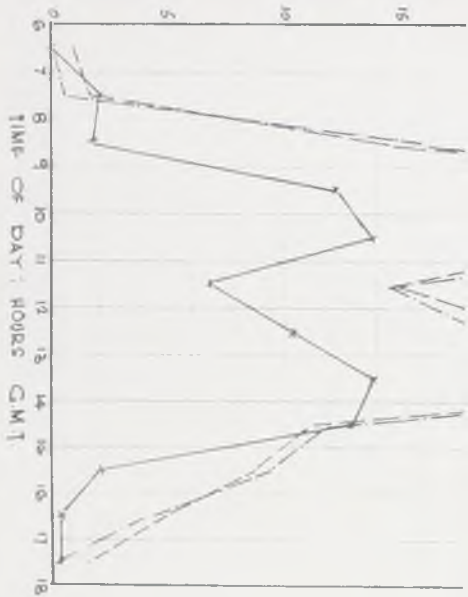
TEMP



PANGOLA - CLUTROSTMA

CLUTROSEMA

MEAN % OF THE HOUR



PANGOLA - CENTROSEMA

PANGOLA

CENTROSEMA

FIG 5  
LYING DOWN : HOURLY MEANS : KPONG  
MEANS FOR 12 DAYS

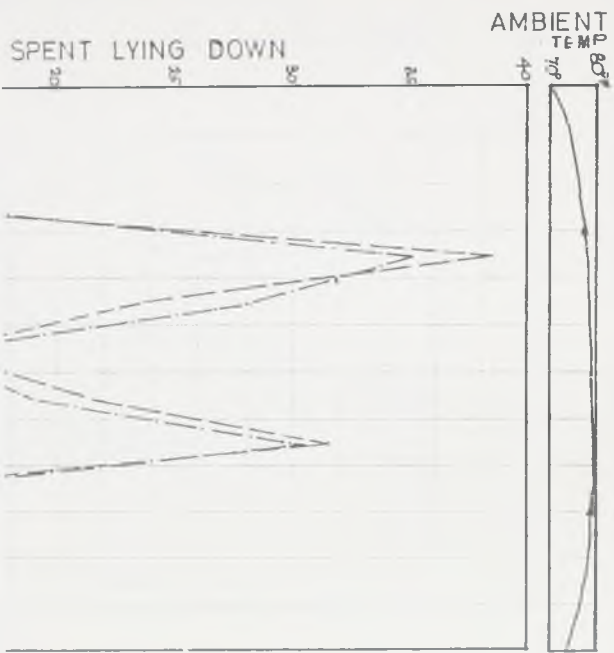


FIG. 6  
IDLING BEHAVIOUR: KPONG  
OVERALL HOURLY MEANS

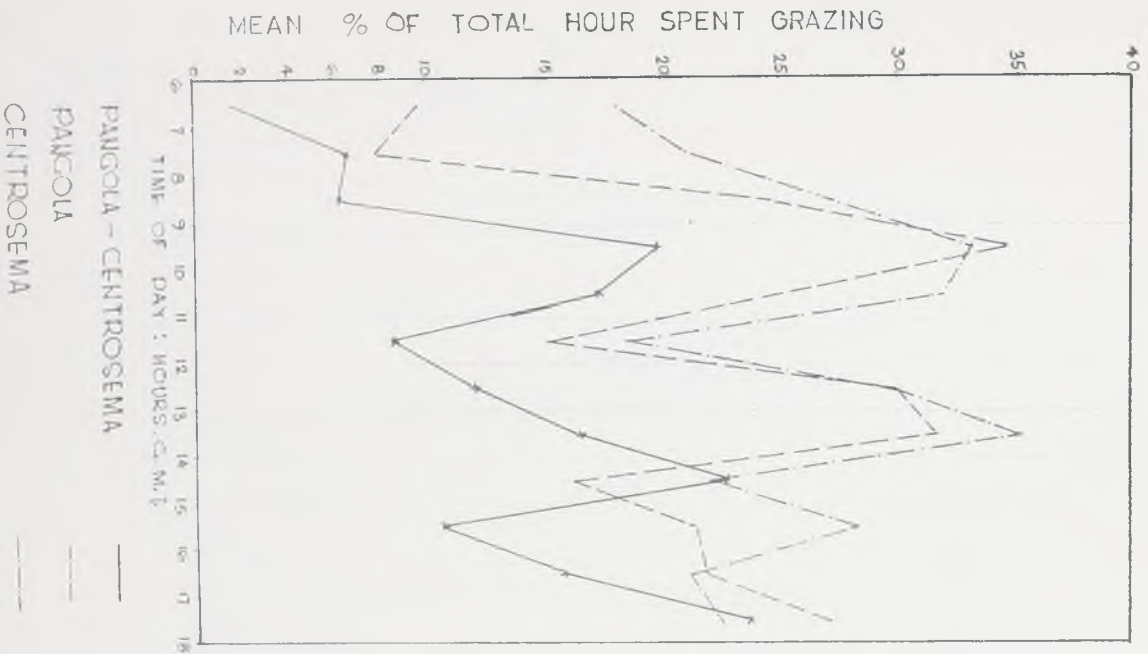


FIG 7  
IDLING BEHAVIOUR : NUNGUUA  
20 MINUTE BASIS

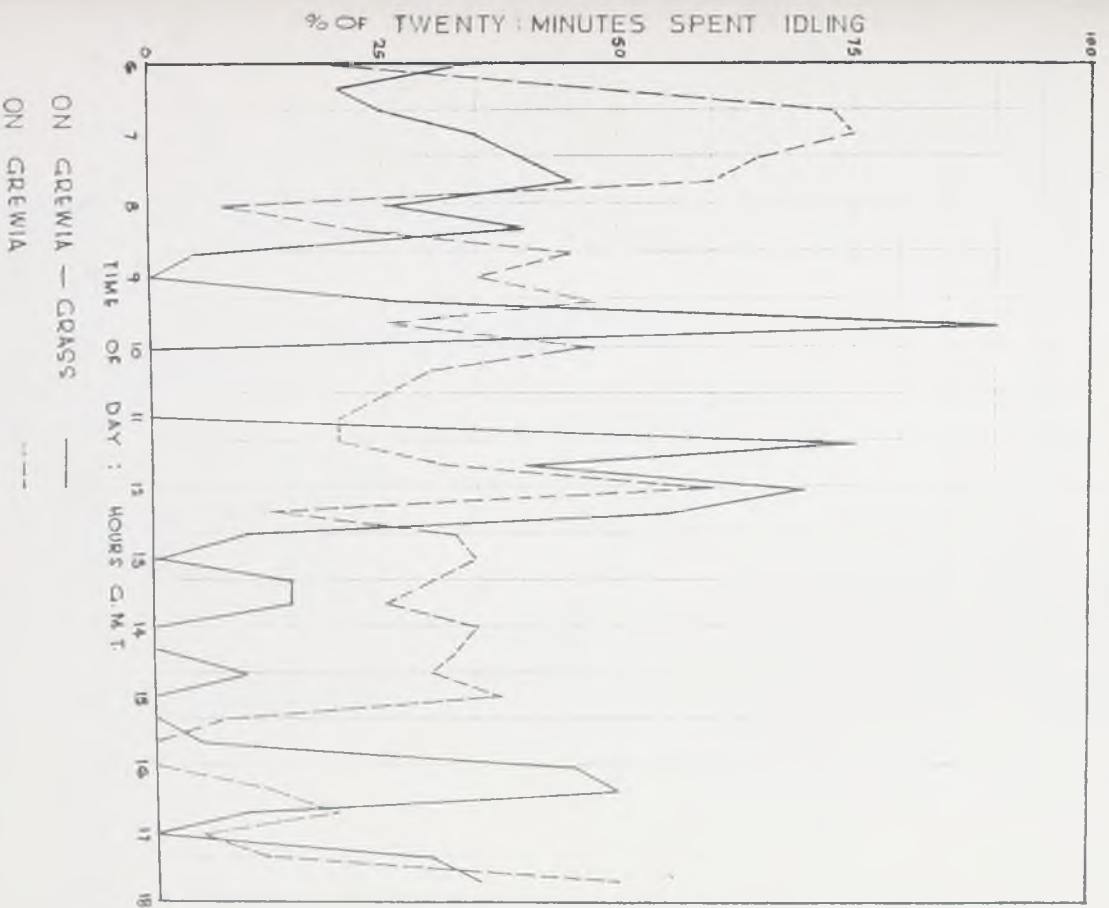


FIG 8  
CUDDING BEHAVIOUR : NUNGUA  
20 MINUTE BASIS

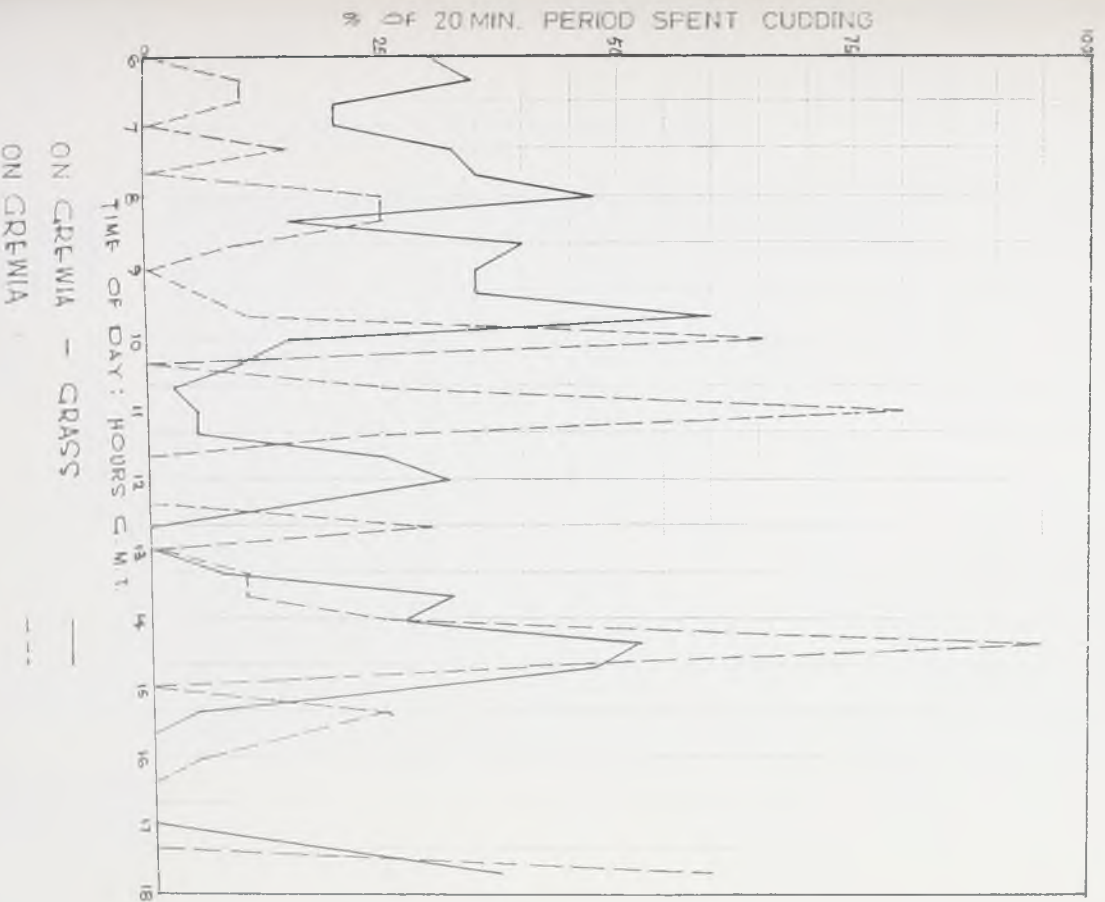


FIG 9  
 OVERALL DAILY GRAZING CHART  
 COMPARATIVE MEANS FOR 12 DAYS

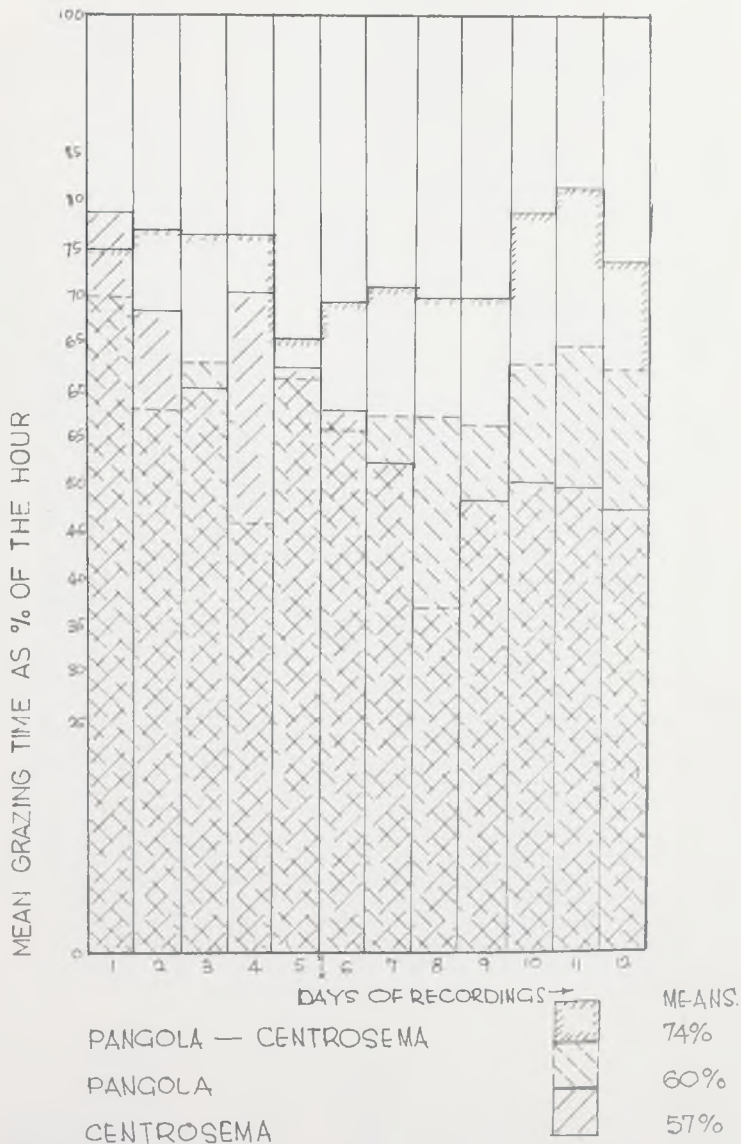
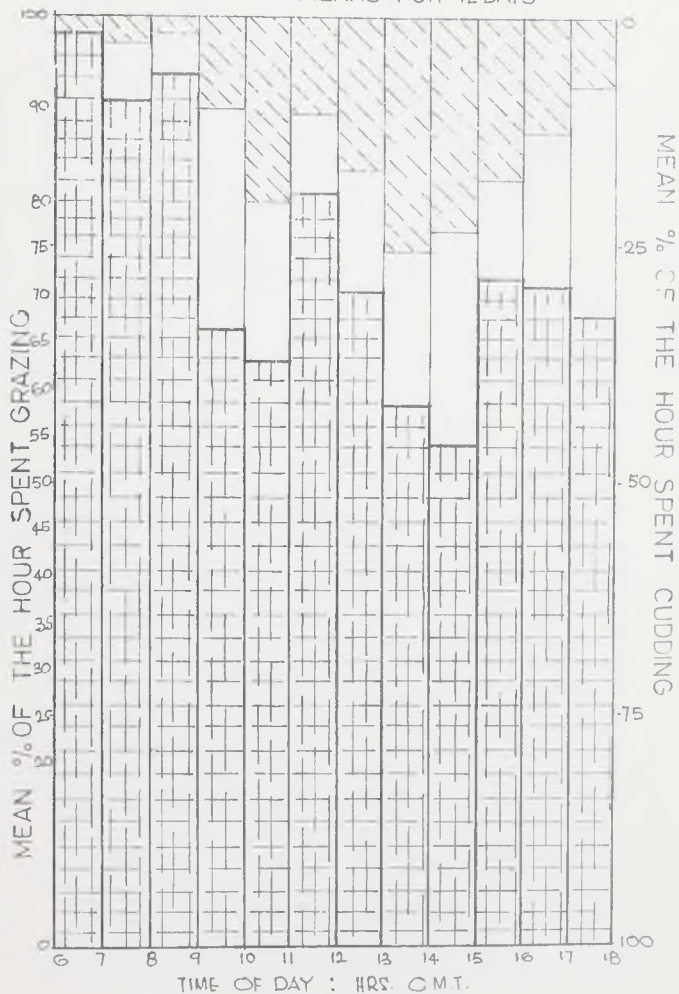


FIG 10  
 OVERALL MEAN HOURLY ACTIVITIES KPONG  
 PANGOLA—CENTROSEMA MIXED  
 MEANS FOR 12 DAYS



CUDDING



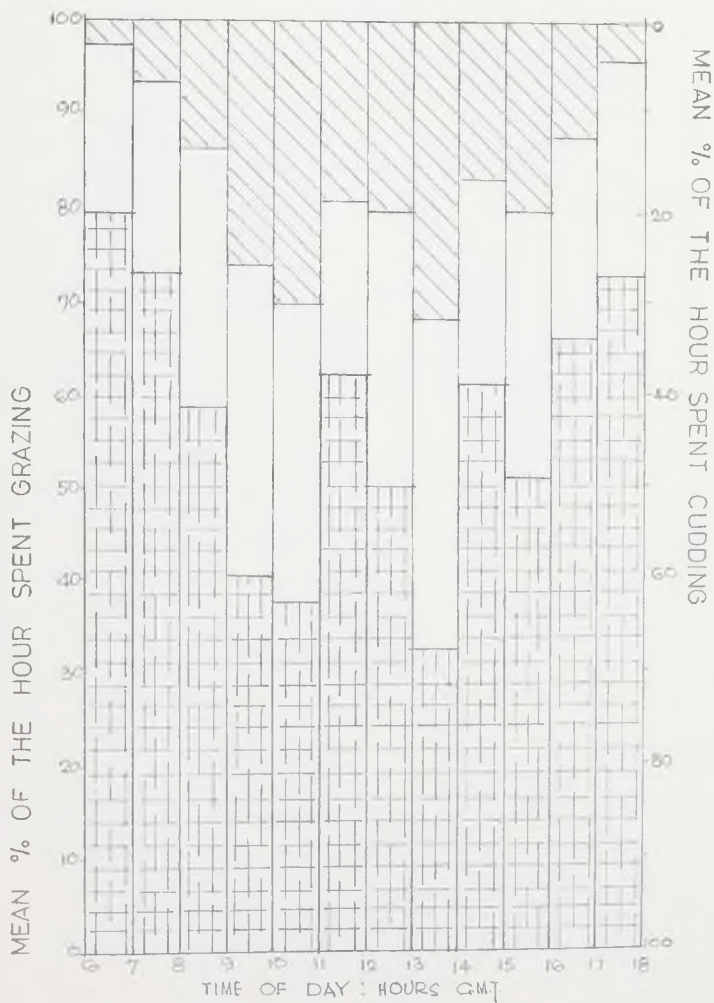
IDLING



GRAZING



FIG 11  
 OVERALL HOURLY ACTIVITIES KPONG  
 CENTROSEMA  
 MEANS FOR 12 DAYS






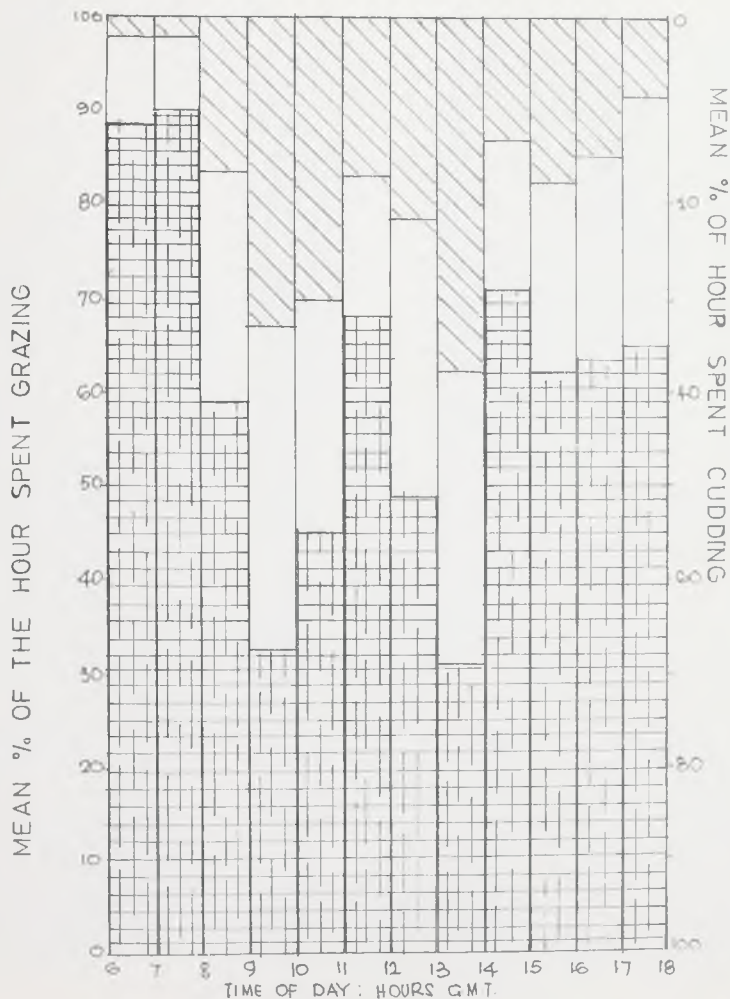

CUDDING   
 IDLING   
 GRAZING 

FIG 12  
 OVERALL HOURLY ACTIVITIES KPONG  
 PANGOLA  
 MEANS FOR 12 DAYS

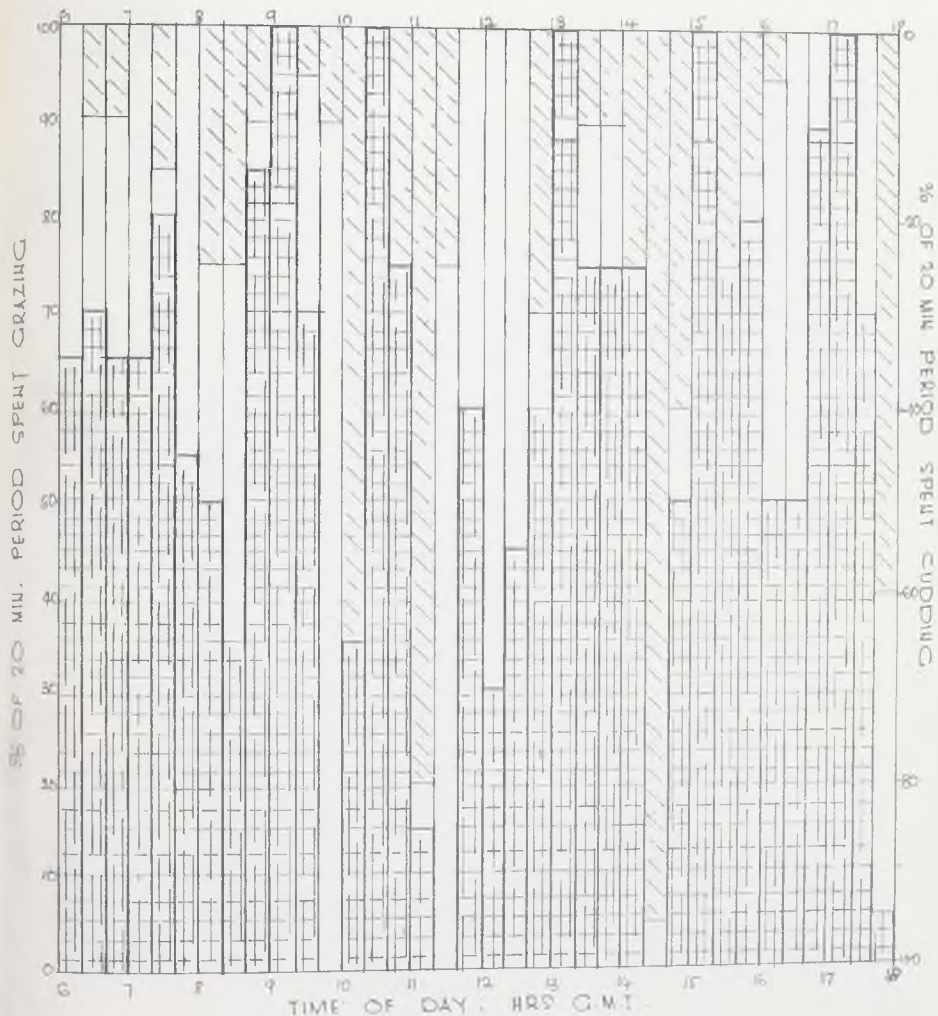


CUDDING 

IDLING 

GRAZING 

ACTIVITY CHART NUNGUA  
 GREWIA GRASS MIXED  
 20MINUTE BASIS






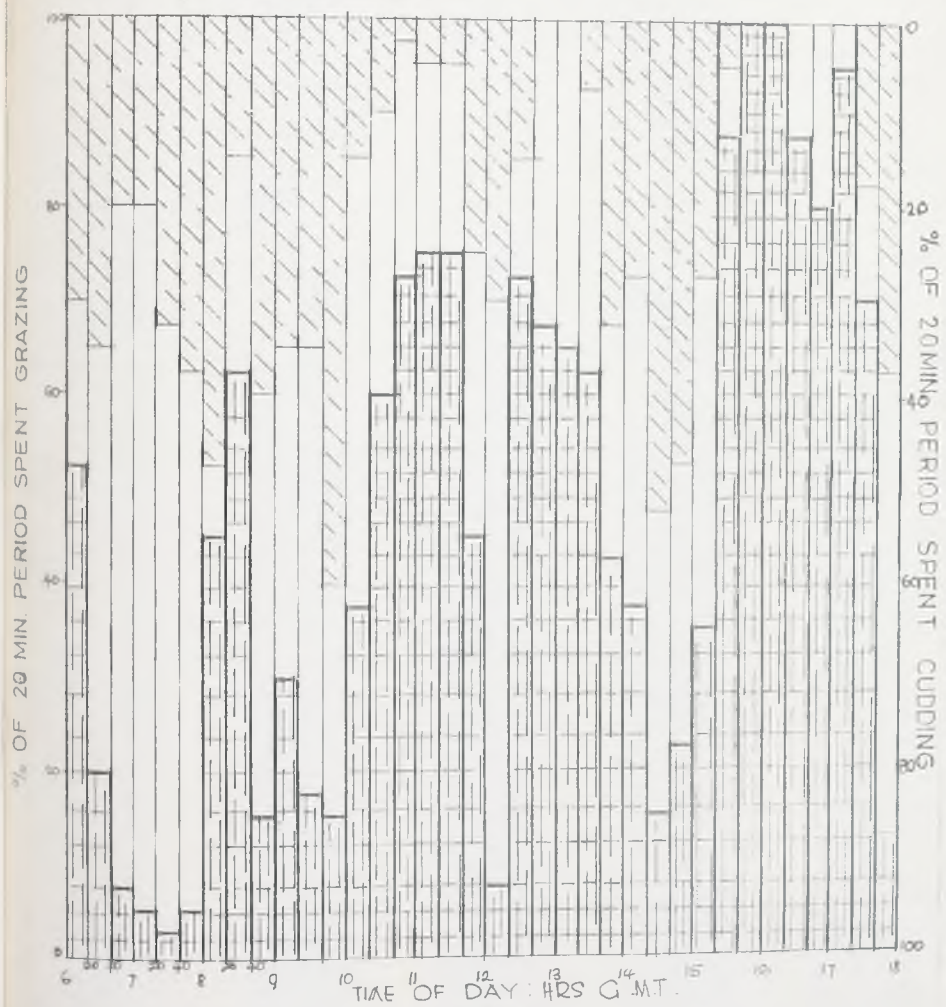
CUDDING   
 IDLING   
 GRAZING 

FIG 14  
 ACTIVITY CHART NUNGUA  
 GREWIA 'ALONE'  
 20 MINUTE BASIS






CUDDLING   
 IDDLING   
 GRAZING 

FIG 16

RANGE ACTIVITIES ASHALEY BOTWEY  
AFTERNOON ROUNDS

\*(A) AS DURATION OF ACTIVITY IN MINUTES

\*(B) AS % OF TOTAL TIME SPENT ON RANGE

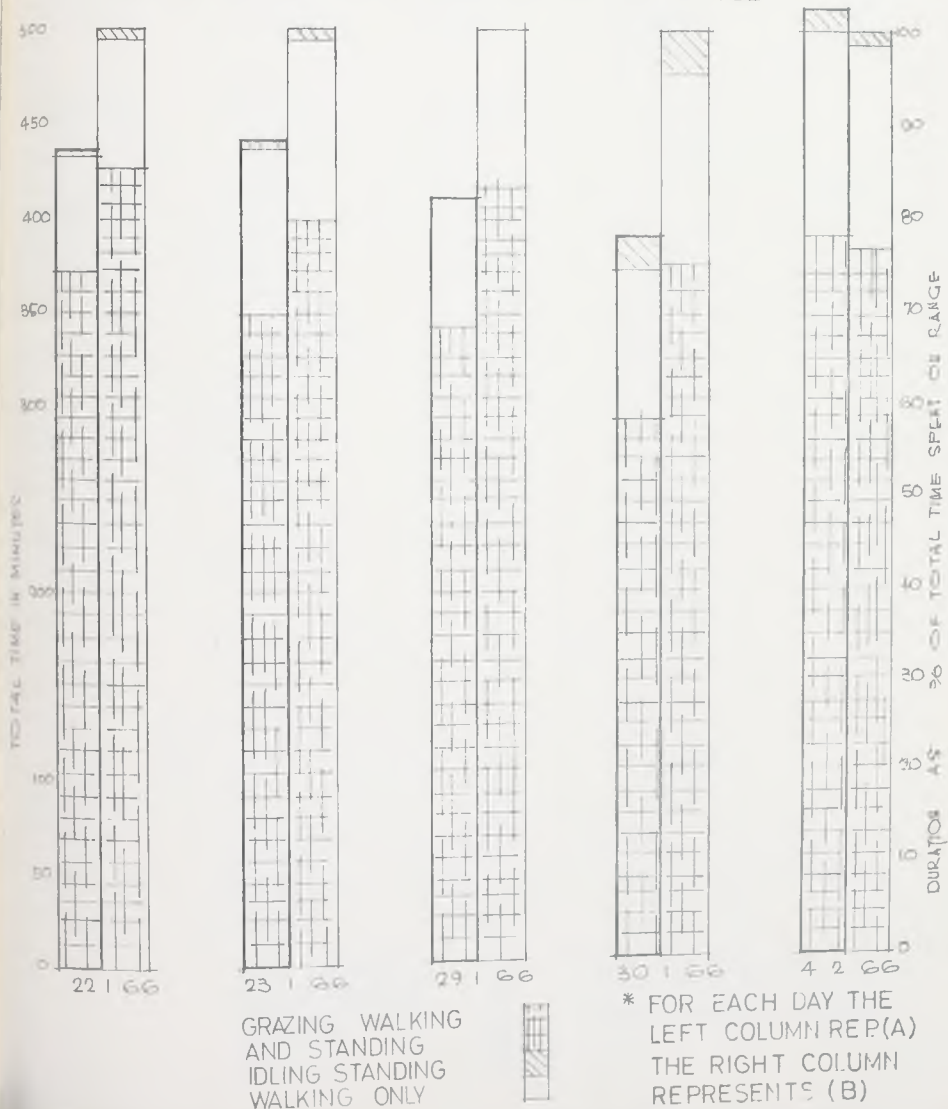


FIG 17

RANGE ACTIVITIES KANTAMANSU

- \* (A) AS DURATION OF ACTIVITY IN MINUTES
- \* (B) AS PER % OF TOTAL TIME SPENT ON RANGE

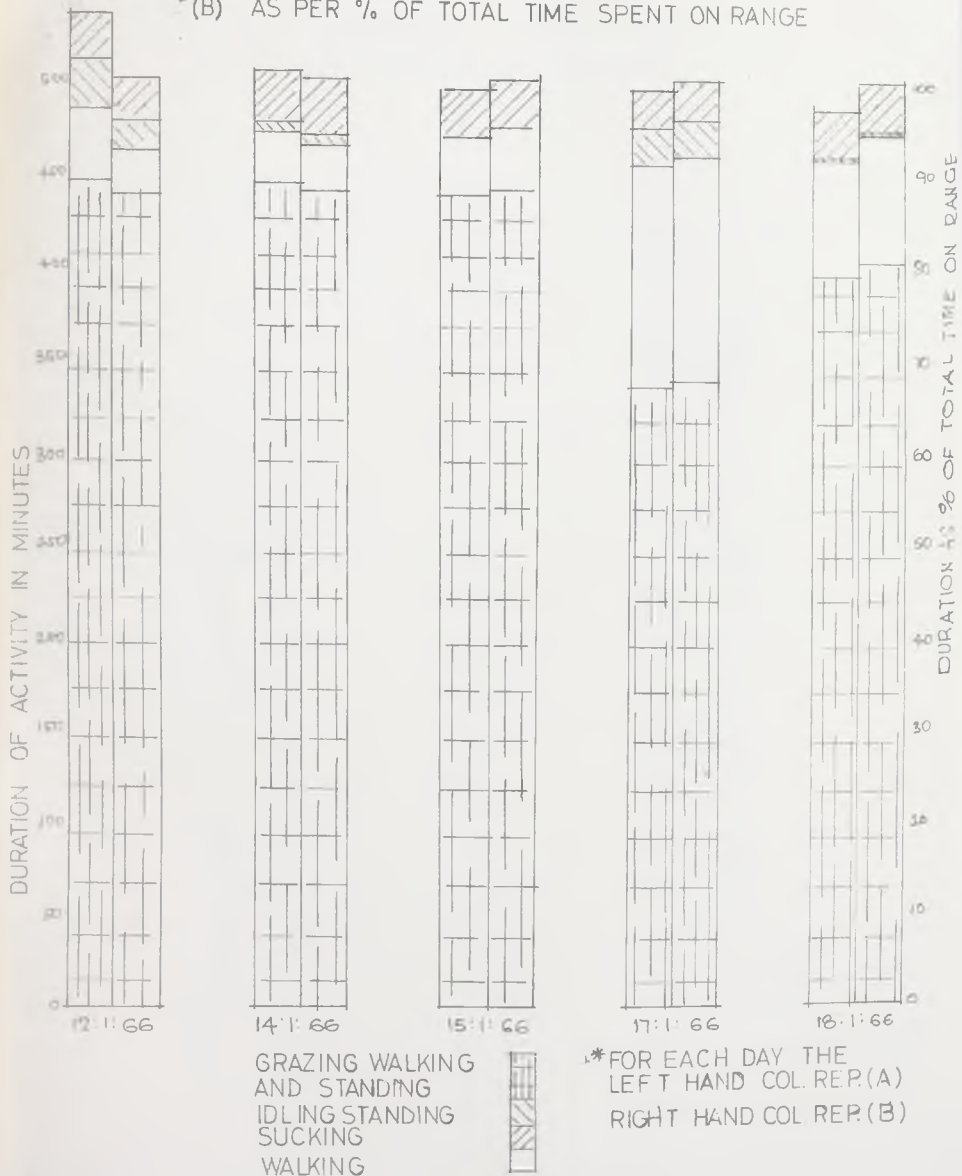


FIG 18

MEAN DAILY ACTIVITIES KPONG  
 COMPARATIVE HISTOGRAMS  
 PANGOLA(P) CENTROSEMA (C)  
 PANGOLA-CENTROSEMA (P-C)

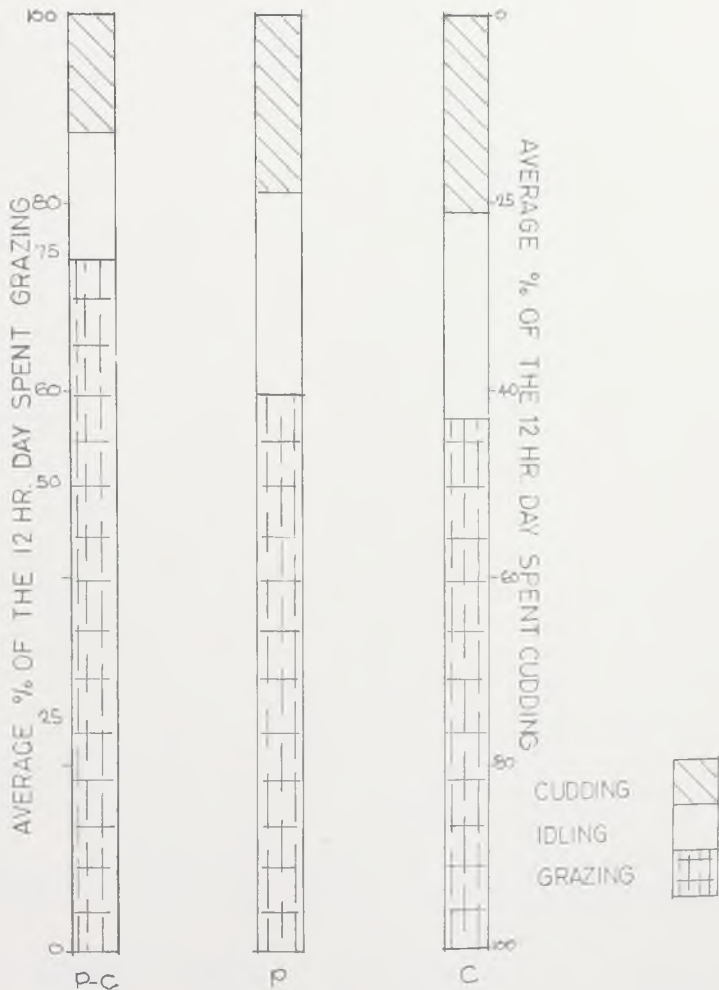
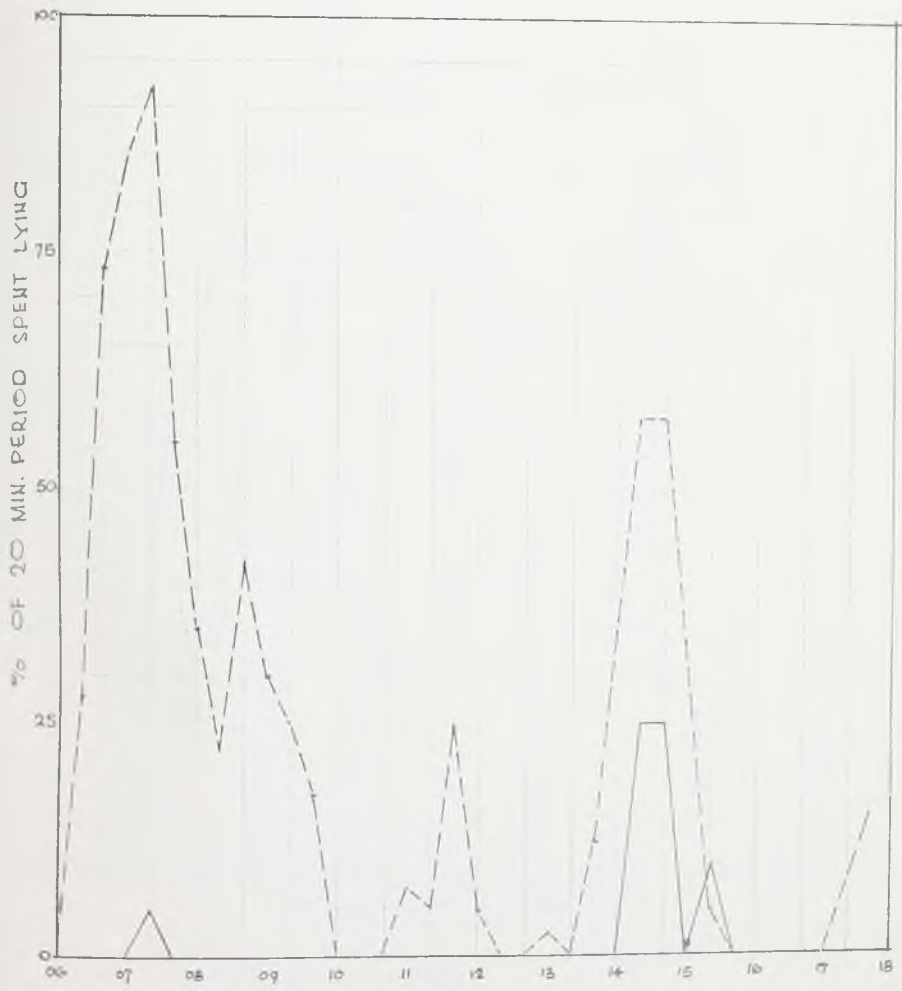


FIG 19  
LYING DOWN ACTIVITY: NUNGUA  
20 MINUTE BASIS



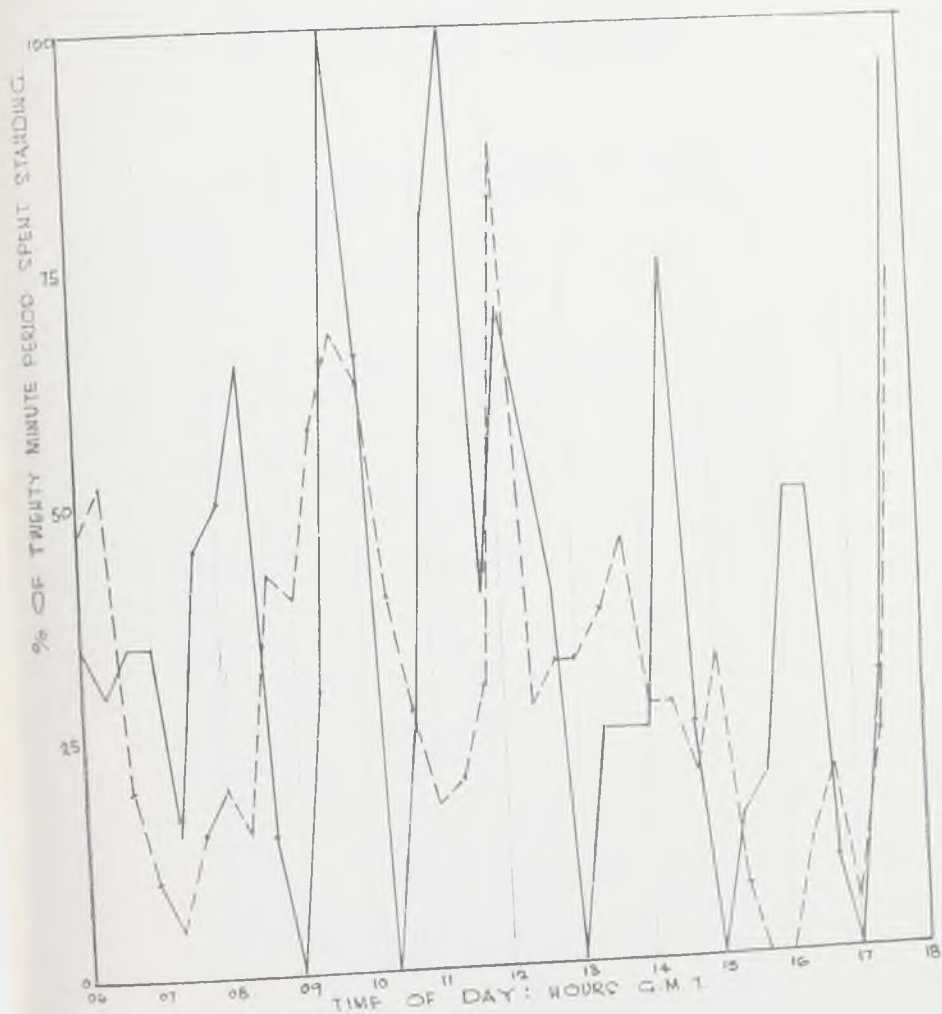
ON GREWIA - GRASS

—

ON GREWIA

- - -

FIG 20  
 STANDING BEHAVIOUR : NUNGUA  
 20 MINUTE BASIS

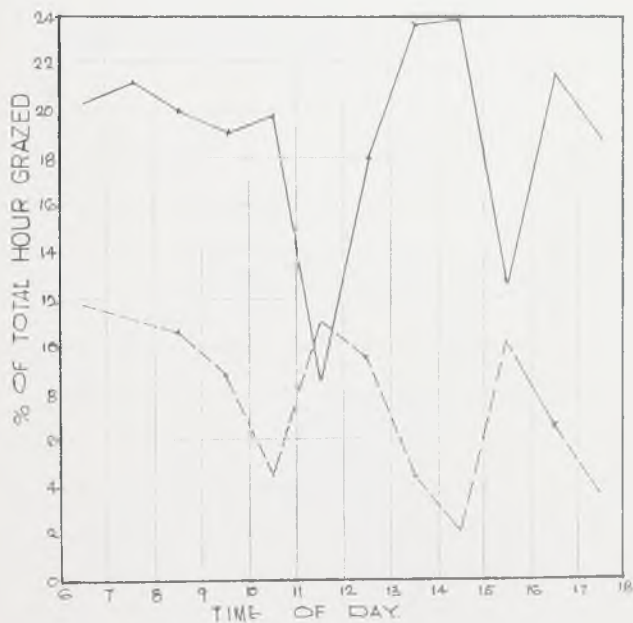


ON GREWIA — GRASS —  
 ON GREWIA — — —

FIG 22

PATTERNS OF GRAZING : KPONG  
PANGOLA — CENTROSEMA MIXED

COMPARISON BETWEEN MAX. & MIN.  
WITH RESPECT TO AMBIENT TEMP.



6-8-65    --    (66%) OF 12 HR. DAY  
2-9-65    —    (82%) OF 12 HR. DAY

FIG 24

CALF ACTIVITY ON RANGE: ASHALEY BOTVEY

5:2:66

GRAZING

WALKING




12:2:66

GRAZING

WALKING



DESULTORY GRAZING 

WATERING 

GRAZING TIME 5½ HRS. ON 5:2:66

4½ HRS. ON 12:2:66

# FIG 25

## ACTIVITIES ON RANGE : KATAMANSU



FIG 26  
AFTERNOON ACTIVITIES ON RANGE AHALEY BOTWEY

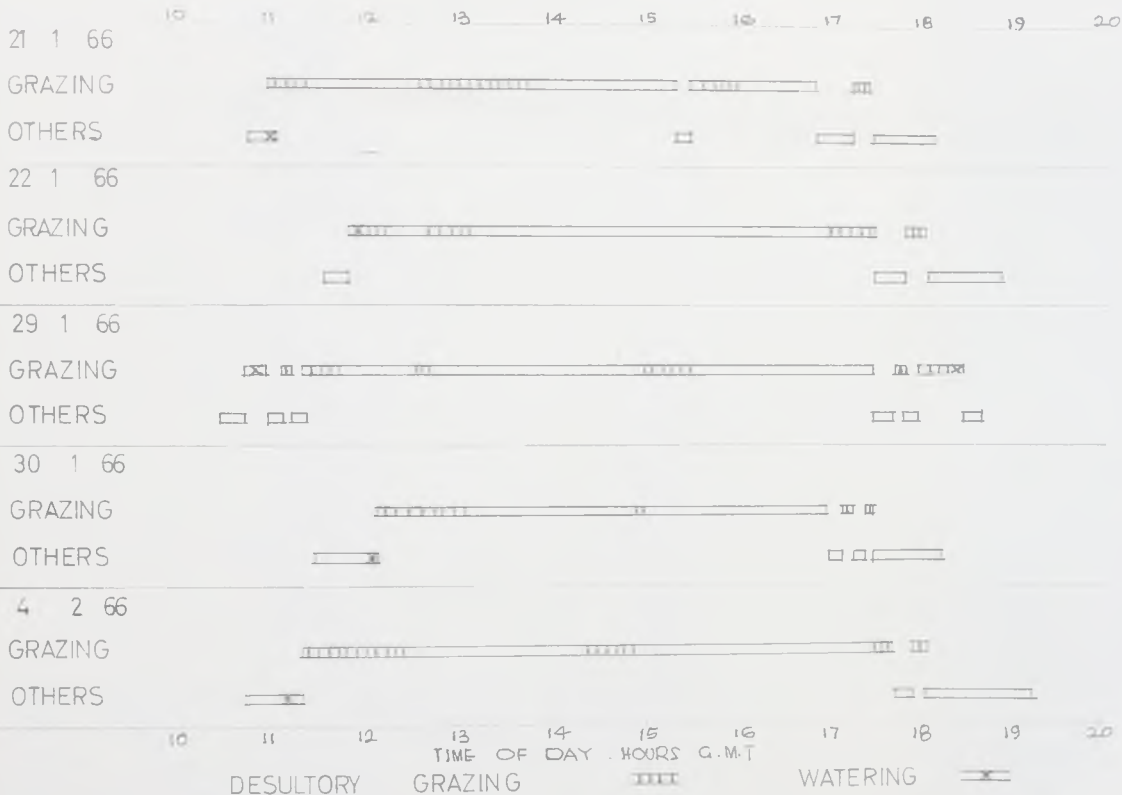
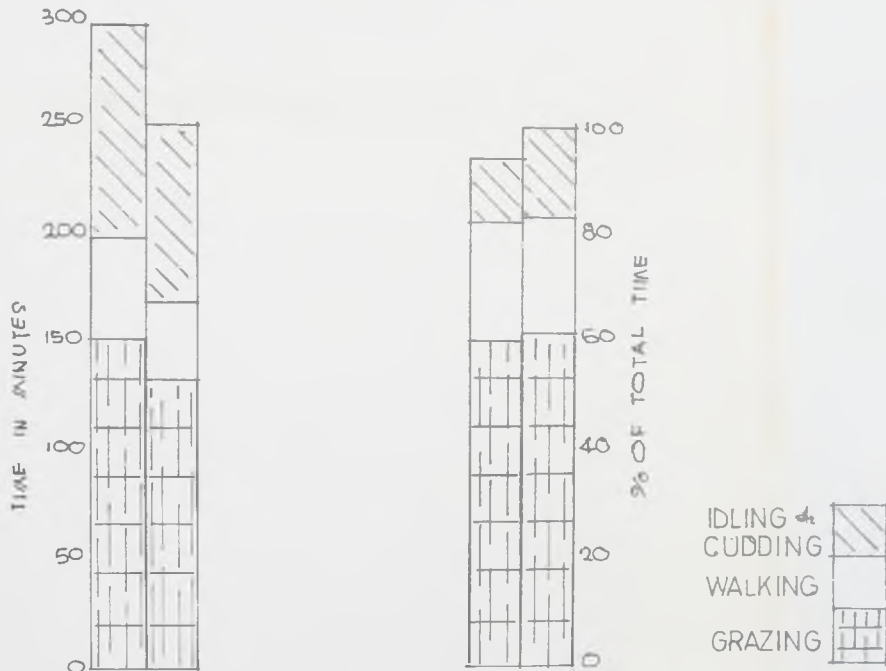


FIG 27

DAWN ACTIVITIES ON RANGE ASHALEY BOTWEY

28 1 : 66

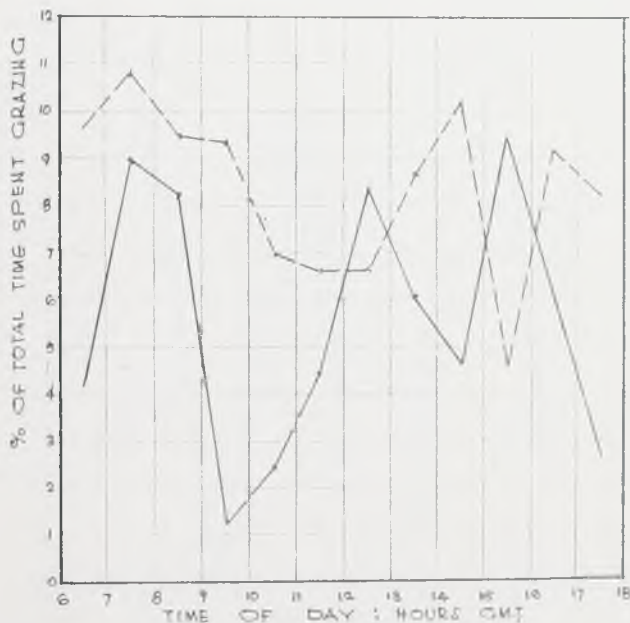
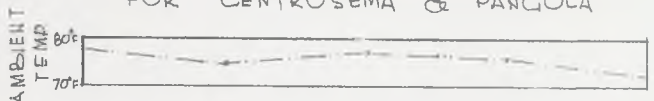
6 : 2 : 66



FOR EACH DAY THE LEFT HAND HISTOGRAM SHOWS THE ACTUAL DURATION OF EACH ACTIVITY. THE RIGHT HAND HISTOGRAM SHOWS SAME, AS %s. OF THE TOTAL PERIOD

FIG 28  
 PATTERN OF GRAZING Vrs. AMBIENT TEMP  
 KPONG 5-8-65

A DAY OF CONTRASTING SCORES  
 FOR CENTROSEMA & PANGOLA



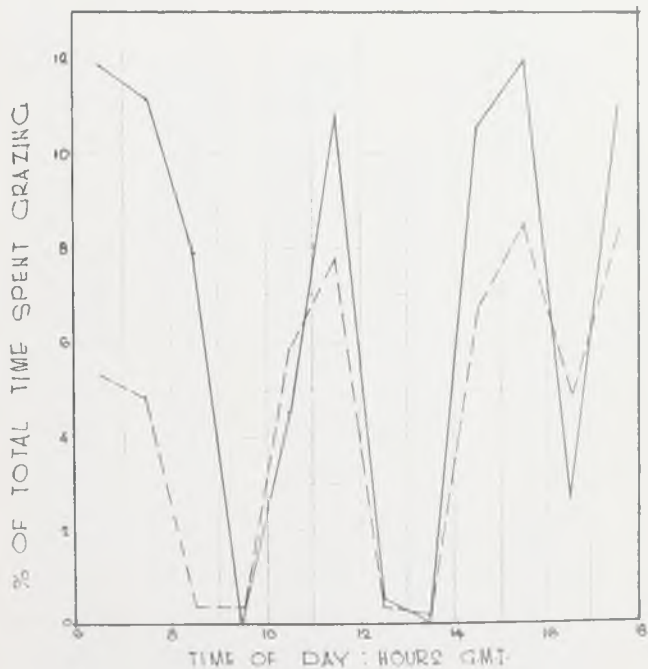
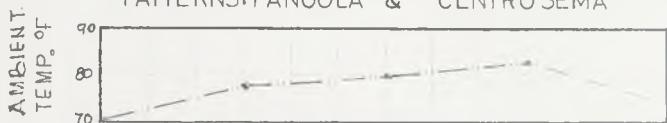
CENTROSEMA (GREEN HERD)      - - - - -  
 PANGOLA (RED HERD)            - - - - -  
 TEMP. °F                              - - - - -

FIG 29

PATTERNS OF GRAZING Vrs TEMP

KPONG 26-8-65

A DAY OF CONTRASTING SCORES BUT SIMILAR PATTERNS: PANGOLA & CENTROSEMA



CENTROSEMA  
PANGOLA  
TEMP 4F

--- (RED HEAD)  
— (GREEN HEAD)

FIG 30

ACTIVITIES ON RANGE ASHALEY BOTWEY  
 TOTAL ESTIMATED PERIODS DAWN & AFTERNOON TOTAL 5  
 A AS DURATION OF ACTIVITY (LEFT HAND COL)  
 B AS % OF TOTAL TIME (RIGHT HAND COL)

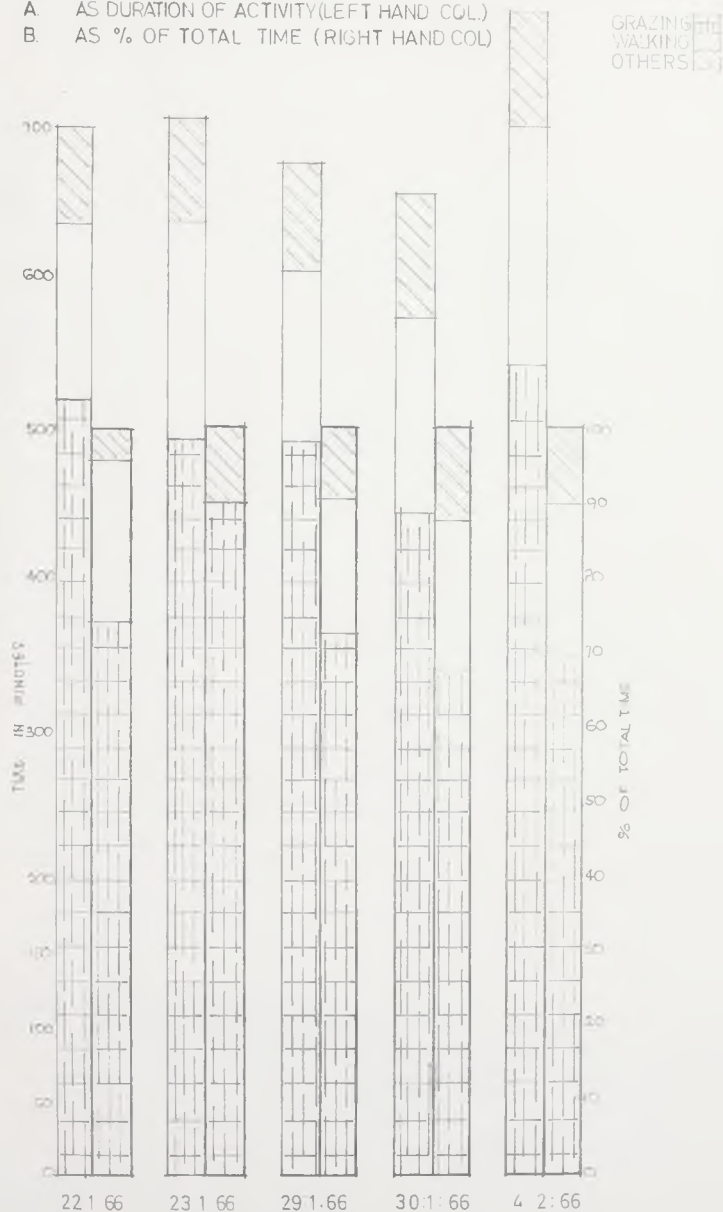
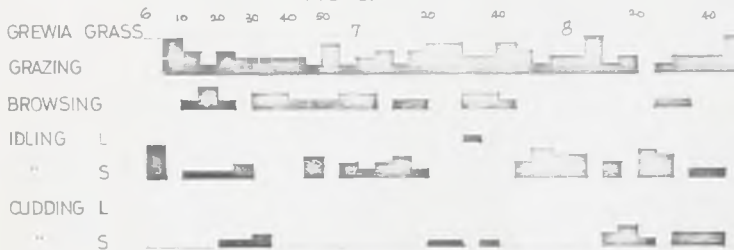
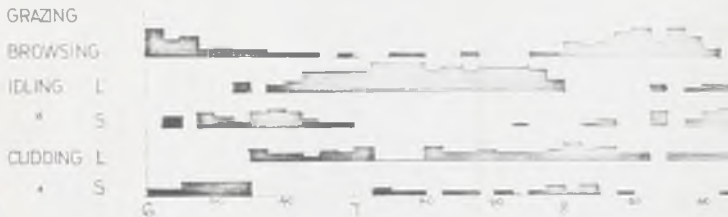


FIG 31



GREWIA ALONE



ACTIVITIES ON GREWA AND MATJIRA



TIME OF DAY





SCALE : ORDINATES.  
2MM ≡ 1ANIMAL

- ☒ WATERING
- L = LYING DOWN
- S = STANDING

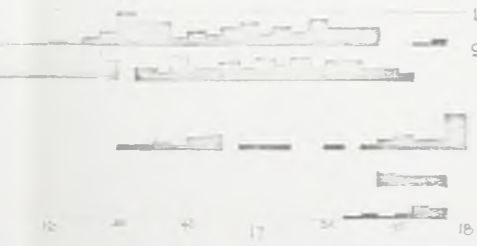
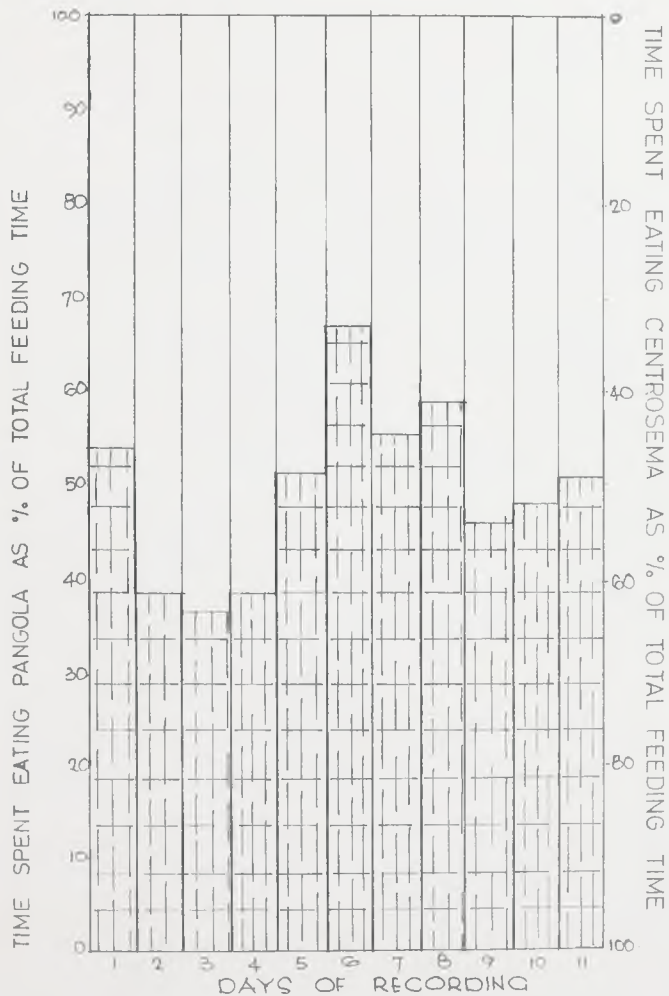



FIG 32  
 DAILY RATIOS OF INTAKE  
 ON CENTROSEMA - PANGOLA  
 MIXTURE



CENTROSEMA   
 PANGOLA 