

A Study of the Mineral Content and Feeding Value of Natural Pastures in the Union of South Africa.

IV. The Influence of Season and Frequency of Cutting on the Yield, Persistency, and Chemical Composition of Grass Species.

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INTRODUCTION.

THE mineral surveys of natural pastures in the Union of South Africa inaugurated in May, 1930, and on which a first report was published by du Toit and associates (1932), have been greatly extended during the last two years. At the present time more than 200 samples of pasturage as grazed by the animals are being collected every month from chosen farms distributed all over the country. In order to interpret correctly data so obtained it is necessary to study the seasonal variations in chemical composition of individual species of indigenous grasses under controlled or known conditions at fixed stages in their vegetative growth because of the known variability in mineral and protein content as growth advances towards maturity.

Furthermore such a study provides data on the feeding value of individual species of grasses which compose pastures and therefore on the economic utilization of such pastures which is often attainable in practice by bearing in mind the relation between feeding value and stage of growth. This relation is of course of paramount importance when the problem of pasture research is considered from the practical aspect of pasture improvement. Stage of growth determines palatability perhaps to a greater extent than any other single factor and likewise also feeding value—both factors which cannot be lost sight of when the object of pasture improvement, viz., to provide more and better grazing for the animal is considered. The investigation of the chemical composition of individual species of grasses at various stages of growth as reported in this article was therefore undertaken as a supplementary study to the determination of the feeding value of South African pastures (du Toit *et al.* 1932, 1935). This study will effect the accumulation of data on fundamental aspects of pasture improvement such as feeding value in relation to growth, digestibility as affected by the maturity of the pasture, light which chemical analysis may throw on animal production on pasture, etc. In short, the plot work was undertaken because it creates an opportunity of introducing the animal factor into pasture studies. Hence factors which affect the feeding value of pastures for the animal, as for instance stage of growth, productiveness of the pasture, palatability, digestibility, etc., are being stressed in this investigation of which the present article may be considered as something of the nature of a progress report.

The plots under consideration in this article were too small to study yield conclusively and larger plots have subsequently been established, but it was considered well worth the extra work to weigh all the samples obtained from the different frequencies of cutting and to study these weights in conjunction with the chemical data with the object of arriving at tentative conclusions in respect of species of grasses which could with advantage be studied on larger plots at a later date.

The investigation on the species established in plots was initiated in February, 1932, and a preliminary report was published by du Toit *et al.* (1934). In the present paper it is proposed to deal with the results obtained from a further 12 months' work on the same grass species in conjunction with the data from the previous year.

TABLE I.

Date.	Rainfall in inches.	Showers of note with dates in brackets.	Average hours sunshine.	Average maximum temperature in °F.	Average minimum temperature in °F.
Feb., 1932	4.85	0.66 (2), 1.05 (4), .30 (5), 1.40 (17), 0.43 (19), 0.20 (25), 0.48 (28)	7.7	86.0	61.0
March, 1932	2.08	1.58 (9), 0.29 (20).....	6.9	84.0	58.0
April, 1932	0.77	0.17 (23), 0.23 (24), 0.31 (26)....	8.1	82.0	49.0
May, 1932	0.15	—	8.6	75.0	40.0
June, 1932	Nil	—	8.4	73.0	34.0
July, 1932	Nil	—	9.0	71.0	30.0
Aug., 1932	Nil	—	9.6	77.0	36.0
Sept., 1932	0.88	0.87 (20).....	8.8	82.0	49.0
Oct., 1932	1.76	0.88 (3), .58 (4), .18 (28).....	8.1	84.0	56.0
Nov., 1932	2.54	0.72 (7), 0.22 (10), 0.28 (19), 0.40 (22), 0.24 (25), 0.37 (30)	8.5	81.0	59.0
Dec., 1932	3.54	0.50 (4), 0.56 (14), 0.35 (16), 0.54 (24), 1.30 (26)	7.4	87.0	61.0
Jan., 1933	1.54	1.06 (15).....	8.2	89.0	61.0
Feb., 1933	0.70	0.29 (19), 0.36 (28).....	8.5	91.0	60.0
March, 1933	2.06	0.32 (1), 0.90 (3), 0.42 (8), 0.34 (15)	8.6	88.0	55.0
April, 1933	1.05	0.85 (2), 0.16 (18).....	8.8	78.0	50.0
May, 1933	0.07	—	8.8	82.0	41.0
June, 1933	0.35	0.35 (22).....	8.0	67.0	32.0
July, 1933	0.01	—	8.0	70.0	36.0
Aug., 1933	Nil	—	9.0	70.0	40.0
Sept., 1933	0.42	0.42 (1).....	9.0	75.0	46.0
Oct., 1933	0.46	0.11 (26), 0.25 (27), 0.10 (28)...	9.0	90.0	54.0
Nov., 1933	14.55	Evenly distributed over month, 10 days on which no rain fell	6.7	81.0	59.0
Dec., 1933	6.20	2.36 (13), 0.24 (14), 1.00 (15), 1.40 (26), 1.08 (31)	7.5	83.0	60.0
Jan., 1934	7.54	2.02 (2), 1.15 (13), 0.45 (16), 2.00 (29), 0.68 (30)	7.0	85.0	62.0
Feb., 1934	2.75	0.23 (3), 0.21 (8), 0.69 (9), 0.68 (13), 0.28 (19), 0.58 (23)	7.4	84.0	63.0
March, 1934	1.43	0.15 (11), 0.31 (25), 0.97 (26)....	7.5	86.0	58.0

In March, 1933, the work was extended to include eleven additional species, newly established, and the results of their analyses for the period March, 1933, to February, 1934, will be discussed in a separate section of this report. The method of establishing the grasses and of taking monthly, two-monthly, etc., samples was the same as that described in the first report on the plot experiments, and will not be dealt with here. The first samples were taken on the 28th March, 1933, and then on the same date of each succeeding month until February, 1934.

All the new grasses were well established towards the end of 1932 or early in January, 1933. As stated in the previous paper the grasses received no further attention except for occasional weeding. The work was, therefore, done throughout on grasses subjected to the prevailing climatic conditions.

METEOROLOGICAL DATA.

The outstanding features in the climatic conditions for the period February, 1932, to January, 1933, have already been indicated (du Toit *et al.*, 1934). Mention need only be made of the fact that it was a period of exceptionally low rainfall, a total of 17.43 inches, which is about 12 inches below normal, being recorded. Table I gives a summary of the general meteorological conditions for the full period under discussion. It was thought advisable to give not only the total but also the approximate distribution of the rainfall for every month.

The readings were taken at the Onderstepoort Veterinary Institute at a distance of about half a mile from the experimental plots and may be considered therefore to represent the rainfall at the actual site of the experiment.

The rainfall for the latter half of the growing season 1932-33 remained low, two light showers towards the end of February, fairly well distributed precipitations for the first half of March and a good shower on the 2nd April being recorded. The usual dry period followed except for an isolated shower in mid-winter when rain has generally very little effect on growth, on account of the low day and night temperatures.

No falls of note were registered until the beginning of November (1933) which was a month of exceptionally high rainfall. There were only 10 days on which no rain fell and over 14 inches were recorded for the month. The average daily hours of sunshine and maximum temperatures dropped from 9.0 and 90.0 in October to 6.7 and 81.0 respectively in November, while an increase for both these growth factors were noted for December. There were no significant changes in the average daily hours of sunshine and maximum temperatures during January and February, 1934. The average minimum temperatures increased steadily from 54.0° F. in October to 63.0° F. in February.

During December and January good average rainfalls were registered while the figure for February dropped to only 2.75 inches. March was comparatively dry. Precipitations of 0.31 and 0.97 inches were recorded for the 25th and 26th respectively, but these showers had very little effect on the herbage cut on the 28th of March. The average maximum temperature was slightly higher than during the preceding months.

For the period November, 1932, to February, 1933, the rainfall was in marked contrast to that recorded for the period November, 1933, to February, 1934, only 8.3 inches being registered for the former period while during the latter period heavy downpours totalling 31.0 inches occurred.

SECTION 1.—OLD ESTABLISHED SPECIES.**I. MONTHLY CUTS.**

The number of monthly cuts obtainable from plants growing under natural conditions is necessarily largely dependant upon the prevailing climatic conditions. The growing season in this part of

the country commences with the first rains, usually in September, and terminates with the cessation of summer rains in about April. The discussion of the chemical composition and yield of herbage cut at monthly intervals is therefore limited to the available data for the growing seasons falling within the experimental period.

Of the eleven species on which work was started in February, 1932, one, *Rhynchelythrum roseum*, died completely during the winter of 1933.

Table A in the appendix gives the dates of cutting, the yield of dry matter,* and the percentage composition of the dry matter of each cut, together with a short description with regard to the stage of growth, of the monthly cuts for the period February, 1933, to March, 1934, for the ten remaining species to be dealt with in this section of the paper.

The composition of the dry matter of the monthly cuts of one and the same species does not vary markedly, and if a general survey of these figures for all the grasses is made it will be noted that the percentages of individual constituents from month to month tend to fluctuate in a manner similar for all grasses. Consequently, month to month averages for all the species combined was decided upon as a basis for discussion rather than a consideration of the fluctuations of each grass separately. A study of Table A in the appendix reveals the fact that the deviations from such a generalisation, due to differences in response to climatic conditions by individual species are not numerous, although not entirely absent.

The average yield and composition of the dry matter of the ten species from month to month for the whole experimental period is given in Table II below. For the purpose of bringing out the seasonal variations more clearly the data are put into graphical form in Fig. I.

Discussion of results of monthly cuts.

(a) Season 1931-32.

Due to the fact that the investigation was begun in February, 1932, data for only three monthly cuts are available for this growing season. A feature in the composition of the dry matter for the three months, February, March, and April, is the inverse relationship between crude protein content and crude fibre content, the latter constituent shows a downward trend from February to April, whereas crude protein rises from February to March with a further slight increase in April. These results are in harmony with work carried out by Archibald and associates (1932) at the Massachusetts Agricultural Experiment Station, U.S.A. The average daily maximum temperatures decreased from February to April while the average daily amount of sunshine was actually higher in April than in either February or March. It cannot, therefore, be said that the lower figure for crude fibre in April, as opposed to the values for February

* All analyses in this paper are given as percentages on absolutely dry basis.

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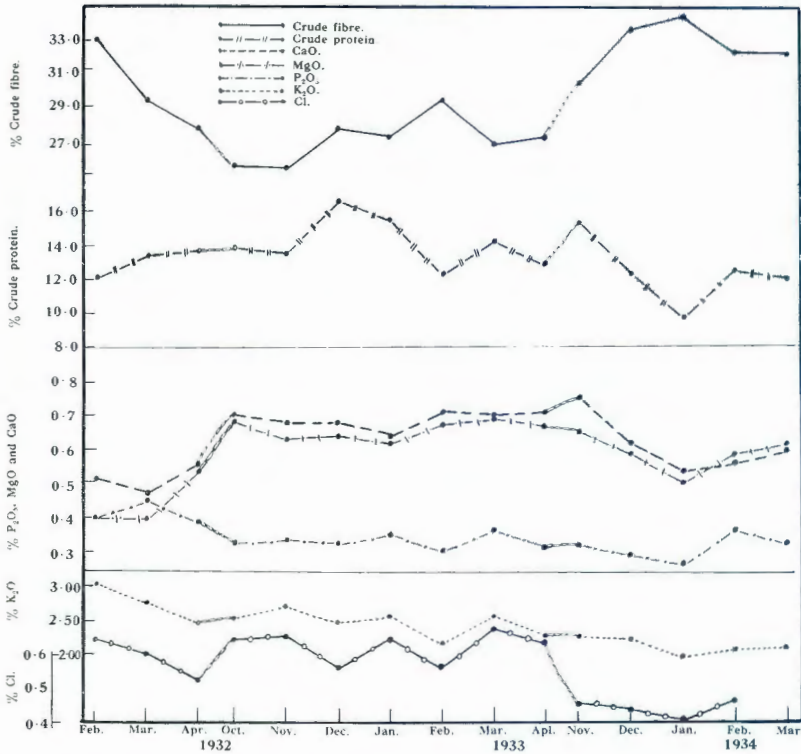
TABLE II.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble Ash.	Crude Fibre.	Total yield in gms.
February, 1932.....	.41	11.9	.51	3.01	.40	.18	.64	—	33.0	300.0
March, 1932.....	.46	13.4	.47	2.76	.40	.14	.60	—	29.5	200.0
April, 1932.....	.39	13.7	.59	2.41	.54	.15	.52	—	28.1	90.0
October, 1932.....	.33	13.8	.70	2.50	.68	.24	.64	—	25.9	65.0
November, 1932.....	.34	13.7	.68	2.72	.63	.16	.65	—	25.6	63.0
December, 1932.....	.33	16.6	.68	2.45	.64	.15	.56	—	28.1	82.0
January, 1933.....	.35	15.3	.64	2.57	.63	.19	.64	—	27.5	75.0
February, 1933.....	.30	12.3	.70	2.17	.67	—	.56	—	29.5	40.0
March, 1933.....	.36	14.1	.69	2.55	.69	.20	.67	—	27.1	60.0
April, 1933.....	.31	12.8	.71	2.25	.67	.19	.63	—	27.5	46.0
November, 1933.....	.32	15.4	.75	2.26	.65	.37	.45	4.93	30.6	136.0
December, 1933.....	.29	12.4	.62	2.21	.59	.31	.43	4.31	33.7	140.0
January, 1934.....	.27	9.8	.54	1.96	.50	.16	.40	3.85	34.4	160.0
February, 1934.....	.37	12.5	.57	2.06	.59	.15	.46	4.45	32.3	80.0
March, 1934.....	.33	12.0	.60	2.12	.62	—	—	4.41	32.2	50.0

and March is attributable to a diminution in amount of sunshine (Archibald *et al*, 1932), rather may it be interpreted that less lignification had taken place in the April sample than in the February and March samples, or, in other words that the grass was at an earlier stage of growth in April than in February or March (c.f. Table B in appendix of previous paper).

Phosphate and lime show opposite tendencies in that the peak value for the former constituent in March corresponds with the lowest figure for lime at the same date, a finding in agreement with

Fig. 1.



Woodman's (1926) conclusions in this respect. Reference to Table I giving the general meteorological conditions shows that the rainfall decreased from February to April. The amount of growth decreased similarly over this period (c.f. Table 2) while, as stated above, the April samples were at an earlier stage of growth than the February or March samples. In view of the findings of Richardson and associates (1931), viz. that nitrogen assimilation and the absorption of essential nutrients are most active at the filtering stage and that photosynthesis rises to a maximum shortly after the flowering stage the lower value for phosphate in the April sample as opposed to those for February and March is rather surprising. It is difficult at this stage to discuss the percentage composition of the samples in relation to soil moisture as is done by Richardson and associates (*loc. cit.*).

Such considerations do not fall within the scope of this article but it may be pointed out that the low level of soil saturation which no doubt existed during April may be responsible for a relatively low figure for phosphate corresponding with high values for lime and crude protein in the April herbage. (Richardson, *loc. cit.*) Mention should also be made of the low values obtained for P_2O_5 in the green leaves of Bechuanaland grasses by Henrici (1928) during periods of summer drought and the finding of this author that "there is a decided tendency to lower values towards autumn".

The potash and chlorine series of values in Table II both show downward tendencies from February to April while magnesia varies in a manner similar to lime.

(b) *Season 1932-33.*

The exceptionally dry weather conditions which characterised this growing season have already been referred to, the best rainfalls having been registered during December.

The inverse relationship between crude fibre and crude protein contents indicated for the period February to April, 1932, is again apparent for the latter half of the present growing season. The crude fibre tends to increase from October to February reaching its highest level for the whole period in the dry matter of the herbage cut at the end of the latter month. The average daily maximum temperatures vary similarly, the highest figure being recorded for February while at the same time this month was the driest for the season with a total rainfall of only 0.70 inches. Crude protein rises to a maximum for the season in December and then falls to a minimum in February. Phosphate shows little variations from month to month and tends towards a minimum in February and a maximum for the season in March.

Phosphate and lime again fluctuate in opposite directions throughout the whole season, the lowest and highest figures for the latter constituent occurring in January and April respectively.

A remarkable feature in the composition of the dry matter for this season is the consistently high values for lime in comparison with figures for phosphate, that must be looked upon as distinctly low. At no time does the phosphate level rise above the lowest figure for the previous season while the values for lime never fall below the highest figure obtained in April, 1932.

Magnesium like lime remains fairly constant with a minimum in January and then rising steadily to a maximum in March. The figures for this constituent remain, as in the case of lime, higher than the maximum for the previous season.

The graphs for the potash and chlorine values reveal similar changes for the period under discussion, slightly lower values for both constituents being obtained in February.

In view of the fact that the grasses comprising the crop for February were largely at an immature stage of growth (c.f. Table A in the appendix) it is interesting to note that the maximum for crude

fibre and minima for phosphate, crude protein and potash for the entire growing season occur in the herbage for this month. It was undoubtedly the driest month of the season, the shower of 0.29 inch registered on the 19th being the only rainfall for the month preceding the February cut. Such dry conditions would no doubt cause wilting of the young immature herbage and it is possible that the aerial parts loose water not only by excessive transpiration but by the roots as well. Water thus lost by the latter channel may carry certain salts which have not been organically bound, in solution, thus causing a migration of nutrients from the aerial parts to the soil (see Henrici 1928).

(c) *Season 1933-34.*

Practically no growth took place after the light showers of September and October with the result that the first monthly cuts for this season were taken at the end of November.

The herbage for November was mainly in an immature stage of growth; in the case of a few species only did flower-heads begin to appear. Exceptionally high values were obtained for the crude protein content of most species, especially *Urochloa pullulans* and *Panicum maximum*.

As stated previously copious rains fell during November but the amount and intensity of sunshine were less than during the previous and succeeding months. Climatic conditions appear to have been more favourable for rapid growth during December and January when the combined rainfall for the two months was slightly less than the amount registered for November alone, but, nevertheless apparently sufficient to maintain a high level of soil moisture saturation. The result was that the composite herbage crops for December and January attained a higher degree of maturity than that for November.

Following upon a rapid decline in the rainfall from January to March the amount of growth decreased similarly. As a matter of fact growth practically ceased after the March samples were taken, only three species showing sufficient growth at the end of April for the usual monthly cuts.

The average composition of the dry matter of the composite monthly cuts from November to March is in close agreement with the stage of growth attained by the grasses. Generally speaking, all the inorganic constituents and crude protein fall from maxima in November to minima in January followed by secondary peak values in February when climatic conditions favoured slower growth than in January (see Table A).

Crude fibre, on the other hand, shows an opposite tendency, the lowest figure was obtained in November after which the value for this constituent steadily rose to a maximum in January. The inverse relationship between crude fibre and crude protein content, which was shown to exist during the two previous growing seasons, is again in evidence, while the variations in the average values for the latter

constituent and phosphate display a close parallelism throughout the present growing season. The comparatively low values for these two constituents in the monthly cuts for January are worthy of note.

If a general survey of the data for the whole experimental period is made one is forced to the conclusion that in the absence of soil and climatic deficiencies stage of growth is the main factor influencing the mineral and protein content of pasture species. The effect of soil composition on the composition of herbage plants does not fall within the scope of this investigation while the data do not allow of definite conclusions in respect of the influence of climatic factors except in so far as they effect stage of growth.

Mention may however be made of the fact that phosphate values are low during periods of dry weather. This observation, if confirmed, may perhaps be explained on the basis of Richardson's findings that low soil moisture tends to produce herbage of a low phosphate content.

In any case, the composition of monthly cuts of herbage cannot be looked upon as markedly different from one another. During some months a slightly more or less advanced stage of growth is attained by a species when compared with its growth of the previous month and resulting in a slight decrease or increase in the percentage content of the constituents, but, on the whole, the monthly growths of the grasses studied must be looked upon as herbage of a comparatively high composition at a comparatively early stage of growth.

(d) Yield and Persistency of the Individual species.

It has been pointed out previously that the area cut was too small to study yield conclusively. If it is, however, remembered that the grasses were planted uniformly in rows containing about twenty plants each and that always the same row was cut in order to obtain monthly or two-monthly samples, as the case may be, it will be admitted that the production of dry matter by the twenty plants in the first row of one species during any one month is comparable with the production of dry matter by the same twenty plants during any other month of the year on condition that none of their vital functions have been adversely affected by the severe treatment.

In view of the fact that the area cut was small, as already stated, and that the weights obtained were not based on duplicate plots too much importance cannot be attached to the yield figures, especially when the yield from the first row of one species is compared with that from the first row of another species, but one is justified in drawing certain broad inferences for further investigation in respect of the relative yielding capacities of individual species subjected to a system of cutting at monthly intervals *under the climatic conditions obtaining during the experimental period.*

Table III below gives the total yield in grams from month to month as well as the gross yield for the whole of the experimental period February, 1932, to March, 1934, for each of the ten species studied.

TABLE III.
(Yields in grams.)

	<i>Pennisetum</i> <i>ciliare</i> .	<i>Eragrostis</i> <i>superba</i> .	<i>Amphilo-</i> <i>phis</i> <i>insculpta</i> .	<i>Cynodon</i> <i>dactylon</i> .	<i>Setaria</i> <i>gerrardii</i> .	<i>Urochloa</i> <i>pullulans</i> .	<i>Hypar-</i> <i>rhemia</i> <i>hirta</i> .	<i>Panicum</i> <i>maximum</i> .	<i>Cybo-</i> <i>pogon</i> <i>plarinoides</i> .	<i>Themeda</i> <i>triandra</i> .
February, 1932.....	390	125	497	330	355	353	307	285	215	185
March, 1932.....	230	200	260	170	210	320	250	170	110	70
April, 1932.....	120	100	130	95	100	100	120	70	60	—
October, 1932.....	80	150	—	50	70	55	45	15	75	115
November, 1932.....	100	130	65	30	75	50	55	20	60	50
December, 1932.....	160	135	75	45	115	75	65	30	65	55
January, 1933.....	205	105	85	40	95	40	55	35	45	45
February, 1933.....	100	90	85	35	25	—	25	—	17	20
March, 1933.....	135	125	75	35	45	45	50	35	20	25
April, 1933.....	85	85	55	60	45	20	45	20	15	25
November, 1933.....	247	120	60	146	39	50	44	50	330	280
December, 1933.....	216	178	200	42	58	83	100	326	80	120
January, 1934.....	350	190	104	352	55	100	132	160	52	96
February, 1934.....	135	140	50	188	56	77	60	46	52	20
March, 1934.....	220	104	10	—	76	26	28	8	9	—
TOTALS.....	2,773	1,977	1,751	1,618	1,419	1,394	1,381	1,270	1,205	1,106

In considering the relative yields of these grasses it should be borne in mind that they received no further attention after being well established towards the end of 1931. The grasses were selected from locally growing species and the soil on which they were planted was of a type that is common in this area, viz., a sandy loam of fine texture. Any changes in the general condition of the plants during the experimental period may therefore be ascribed to the effect of the treatment, i.e. cutting at regular intervals, under the prevailing climatic conditions.

It will be both necessary and interesting to give at this stage short descriptions of the plots of individual species as to their state in January, 1934, a few months before the conclusion of the experimental period under consideration:—

Hyparrhenia hirta.—About 50 per cent. of the plants in the first row (monthly cut) are dead.

Themeda triandra.—Approximately 50 per cent. of the plants in the first row, 25 per cent. in the second and a few plants on the remainder of the plot are dead.

Cymbopogon plurinoides.—In each of the first and second rows about 25 per cent. of the plants perished.

Cynodon dactylon.—The individual plants have developed into a uniform sward covering the whole plot.

Amphilophis insculpta.—About 50 per cent. in the first row and roughly 25 per cent. of the plants in the second row are dead.

Eragrostis superba.—Only about 10 per cent. of the plants in the first row are dead.

Setaria Gerrardii.—Generally speaking, 25 per cent. of the plants on the whole plot are dead.

Panicum maximum.—Of the plants in the first row about 50 per cent. and approximately 10 per cent. on the remainder of the plot are dead.

Urochloa pullulans.—Of the first row only about 25 per cent. of the plants are dead.

Pennisetum ciliare.—With the exception of *Cynodon dactylon* this is the only plot where none of the plants established towards the end of 1931 died.

To summarise briefly, the plants in the first rows of the majority of the species suffered severely as a result of the treatment, in a few cases the second rows (two-monthly cuts) were badly affected while the number of plants which died in the third to the twelfth rows was negligible for the majority of the grasses. The plants subjected to lenient systems of cutting developed generally to fair-sized tufts, but the rows remained, with the exception of *Cynodon dactylon*, easily distinguishable from one another.

That plants in the first rows were dying was observed for the first time after the winter of 1932. It is obvious therefore that the results given in Table III are comparable only under the specific

conditions of this experiment and the weights thus indicate the monthly and total yields obtainable from each species when subjected to a system of cutting at monthly intervals under the prevailing climatic conditions. In the absence of climatic deficiencies or under less severe treatments the behaviour of individual species would probably have been different from what the results tend to suggest. But, at the same time, it is just such unfavourable climatic conditions that the natural pasture is subjected to under conditions of practical farming in this country.

The data in Table III undoubtedly suggest that of the ten species studied *Pennisetum ciliare* stands above the others in that it produced the greatest gross weight of dry matter and definitely proved itself to be one of the most drought resistant grasses, *Cynodon dactylon* being the only other grass which was not visibly affected by either drought or the treatment. *Eragrostis superba* takes second place as a producer of dry matter and was observed to be highly resistant to drought and artificial close-grazing. *Amphitophis insculpta* is third followed by *Cynodon dactylon* and *Setaria Gerrardii*. The latter grass lacks the persistency of the other species in that not only the first row, which was subjected to the system of cutting at monthly intervals, but the whole plot was affected by the treatment. *Urochloa pullulans* and *Panicum maximum*, while proving to be excellent grasses in respect of chemical composition, take only sixth and eighth places, respectively, as producers of dry matter. These two grasses, especially the *Panicum* species, do not stand up so well against drought and close-grazing as is the case with the *Pennisetum* and *Cynodon* species, but may be expected to compare more favourably with *Pennisetum ciliare* in respect of productivity if climatic conditions are more favourable. *Hyparrhenia hirta* produced approximately the same gross weight of dry matter as *Urochloa pullulans* but proved to be less resistant to the treatment and is of inferior quality as a stock feed. *Cymbopogon plurinoides* and *Themeda triandra* take last places in this method of deciding the yield of pasture species, both grasses appear to thrive best during the first half of the growing season, namely in October or November.

(c) *The effect of climatic conditions on yield.*

Owing to the size of the area cut and the harmful effects of the treatment under the adverse climatic conditions on the stand of grass in the first rows, it is not possible to make strict comparisons between the yields obtained for the various growing seasons falling within the experimental period. However, the influence of climate on the productivity of grasses during any one season may be indicated.

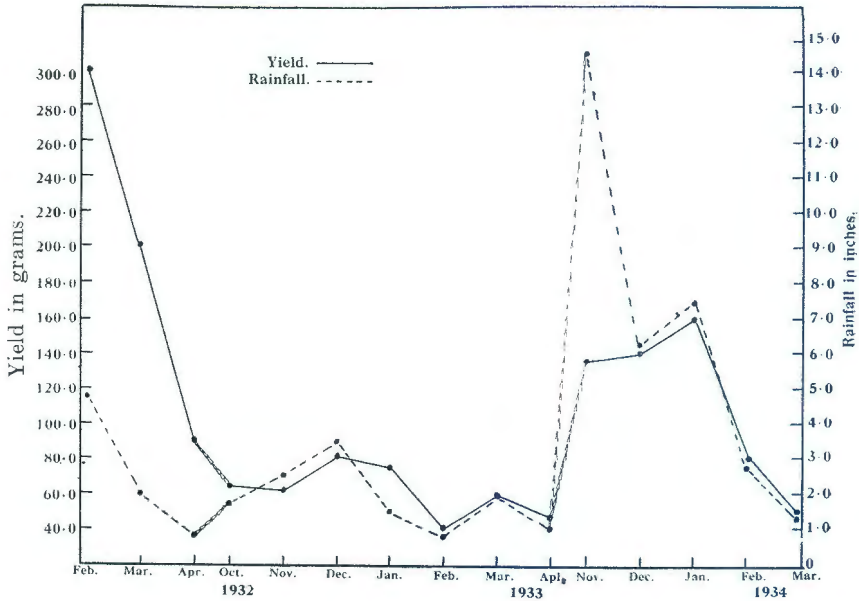
For the purpose of estimating the effect of rainfall on the yield of dry matter the average weights in Table II will be considered in relation to the rainfall data given in Table I. In order to bring out the influence of rainfall more clearly the relevant data are put into graphical form in Fig. 2.

With few exceptions the yield and rainfall curves fluctuate in a similar manner for the three seasons concerned. The average production of dry matter dropped from 300 grams in February, 1932, to

only 90 grams in April of that year, while the monthly rainfall decreased from 4.85 to 0.77 inches during the same period. The highest yield for the whole experimental period was obtained at the end of the first month of the investigation. This may largely be ascribed to the fact that none of the plants were as yet affected by drought or treatment.

The yields for the 1932-33 season were extremely low throughout, the best crop (82 grams) being obtained in December coinciding with the highest precipitation for the period. The low production figures were no doubt due in part to the fact that several plants were already dead at this time, but may mainly be attributable to the unfavourable climatic conditions, namely inadequate rainfall consisting mainly of light showers at infrequent intervals coupled with high temperatures.

Fig. 2.



There is an apparent lag in the effect of the rainfall on the yield for January. Reference to Table I reveals the fact that a fall of 1.30 inches was registered on the 26th of the previous month, two days before the herbage for that month was cut. That the yield curve does not drop in sympathy with the rainfall curve from December to January is therefore attributed to the fact that the precipitation referred to above could only have exerted its influence on growth during the early part of January.

The average productivity of the grasses during the first three months of the 1933-34 growing season was in marked contrast to the weights obtained during the previous season. The yields increased from a fair figure in November to a maximum (160 grams) in January and then dropped rapidly to the low value of only 50 grams at the conclusion of the growing season in March.

Heavy downpours were experienced in November followed by good average rains in December and January. The rapid falling off in amount of rainfall combined with high temperatures coincided with greatly decreased yields in February and March.

That the prevailing climatic conditions and not the number of missing plants were mainly responsible for low yields during the previous season is borne out by the higher productivity of the same plants, which were further reduced in numbers during the winter of 1933, in the present growing season.

Temperatures are generally high throughout the growing season and undoubtedly exert a modifying influence on yield. During periods of low rainfall, as was experienced during the greater part of 1932-33 season and in February and March, 1934, the high temperatures, through causing high evaporation of soil moisture, would tend to counteract the beneficial influence of rainfall on the production of dry matter.

At the same time it must be borne in mind that different species have different periods of optimum growth activity in the course of the season. The magnitude of a mixed crop during any one month will, therefore, in addition to climate, be influenced by the individual species contributing towards the mixed crop. In this connection it is of interest to note from the data of the 1933-34 season for individual species (c.f. Table III) that while the majority of grasses yielded their highest monthly crops during either December or January, *Cymbopogon plurinoides* and *Themeda triandra* gave optimum yields during November.

II. TWO-, THREE-, FOUR-, SIX-, AND EIGHT-MONTHLY CUTS.

The average values for the dry matter obtained from the ten species at each cutting have again been chosen as a basis for discussion. Table IV gives the mean composition and weights of the herbage from the different frequencies of cutting for the period February, 1932, to January, 1934, while the detailed data for the ten species over the latter half of the experimental period are presented in Tables B-F of the appendix.

The determination of the reaction of pasture species to varying systems of defoliation and the working out of the most efficient method of treatment with regard to the production of dry matter and essential nutrients are matters of considerable importance to the grazier. On account of the variable climatic conditions of South Africa it is realised that work of this nature will have to be extended over several years before any definite conclusions may be drawn.

It has been demonstrated in the previous paper on this work that when pasture species are allowed to grow to maturity their nutritive value is greatly decreased and that this decrease is further enhanced by allowing the grasses to become dry on the veld. At the same time too frequent defoliations impair the persistency of the grasses and may be expected to result in relatively low yields.

While it is, therefore, necessary for the purpose of optimum production by animals to have pastures containing a sufficiently high content of protein and essential minerals, it is equally important to space the rest periods in such a manner that the pasture may persist in yielding large quantities of nutritious food.

In considering the data from the present investigation it should be borne in mind that the herbage from a two-monthly, three-monthly, etc., cut does not necessarily represent the result of continuous growth during that length of time. As stated under "details of plot experiment" in the preliminary report a definite scheme of cutting at fixed intervals irrespective of the stage of growth was decided upon. This means that the dates on which samples for the different frequencies of cutting had to be taken were definitely fixed at the commencement of the experiment. During winter when practically no growth takes place no samples were, of course, taken. The result of this system is, to quote an example, that the four-monthly cut of September, 1932, was composed of young succulent growth following upon the first rainfall for the season in the second half of the month. Generally speaking, however, the interval between two cuts except during winter and the drought during the latter part of 1933 (until November, 1933) represents the length of time that more or less active growth did take place. These intervals could, of course, also be regarded as rest periods for the grasses between cuttings.

Discussion of Results.

(a) Season 1931-32.

The data for this season are limited to two two-monthly cuts in March and May, two three-monthly cuts in April and July and a four- and six-monthly cut for May and July, respectively.

The rapid falling off in nutritive value of the herbage if permitted to grow undisturbed from the end of January to maturity and then allowed to remain on the plots is demonstrated by the composition of the dry matter for a two-, three-, four-, and six-monthly cut in March, April, May and July respectively.

The two- and three-monthly cuts in May and July respectively bring out the effect of defoliations in March and April on the composition of the herbage resulting from growth during the respective rest periods. The insignificant amount of rainfall after March coupled with decreasing day and night temperatures as the season advanced to the dry and cold winter months had the effect of greatly reducing the productivity of the grasses. The weights for the dry matter of the two-monthly cuts in March and May were 800.0 and 130.0 grams, respectively, while the yield for the three-monthly sample in July was only 70 grams in comparison with 842.0 grams for the April three-monthly cut.

The smaller yields obtained from the aftermath cuts were in part compensated for by the better quality of the herbage, which was characterised by higher figures for crude protein, phosphate and lime, and lower values for crude fibre.

TABLE IV.

Date of cutting.	P ₂ O ₅ %	Crude protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble Ash.	Crude Fibre.	Total yield in grams.
TWO-MONTHLY CUTTINGS.										
March, 1932.....	.27	8.0	.40	2.08	.34	.15	.57	—	36.3	800.0
May, 1932.....	.31	11.4	.76	2.03	.60	.11	.62	—	26.8	130.0
September, 1932.....	.39	14.2	.69	2.32	.51	—	.57	—	27.2	72.0
November, 1932.....	.26	11.0	.72	2.45	.63	.14	.67	—	28.8	256.0
January, 1933.....	.26	12.0	.62	2.03	.55	.12	.66	—	31.1	406.0
March, 1933.....	.32	12.6	.68	2.51	.68	.20	.81	—	27.4	168.0
May, 1933.....	.24	10.2	.79	1.56	.72	.18	.76	4.27	27.5	76.0
November, 1933.....	.34	15.9	.79	2.34	.69	.35	.51	5.00	30.3	148.0
January, 1934.....	.19	7.7	.40	1.63	.45	.22	.38	3.33	37.9	490.0
THREE-MONTHLY CUTTINGS.										
April, 1932.....	.17	5.9	.46	1.54	.40	.13	.43	—	34.3	842.0
July, 1932.....	.27	10.9	.76	1.61	.64	.07	.79	—	26.6	70.0
October, 1932.....	.30	12.5	.72	2.57	.63	.14	.72	—	27.1	206.0
January, 1933.....	.23	11.4	.60	2.07	.52	.10	.61	—	30.6	500.0
April, 1933.....	.21	9.2	.66	1.63	.50	—	.55	—	27.4	218.0
January, 1934.....	.14	6.2	.39	1.30	.42	.15	.32	2.81	40.5	1070.0
FOUR-MONTHLY CUTTINGS.										
May, 1932.....	.13	5.0	.50	1.40	.39	.097	.42	—	34.6	845.0
September, 1932.....	.47	16.1	.78	2.72	.53	.11	.86	—	25.4	62.0
January, 1933.....	.22	10.0	.61	1.95	.49	.078	.59	—	30.0	514.0
May, 1933.....	.21	9.5	.79	1.37	.65	.11	.53	4.10	27.4	158.0
January, 1934.....	.14	5.8	.41	1.45	.41	.14	.34	2.98	39.4	920.0
SIX-MONTHLY CUTTINGS.										
July, 1932.....	.097	3.5	.52	1.22	.40	.055	.39	—	35.4	736.0
January, 1933.....	.21	9.1	.59	1.95	.48	.070	.56	—	29.9	642.0
July, 1933.....	.18	8.1	.83	1.11	.48	.085	.41	3.48	28.8	110.0
January, 1934.....	.15	6.4	.40	1.41	.42	.13	.35	2.92	39.8	818.0
EIGHT-MONTHLY CUTTINGS.										
September, 1932.....	.12	4.5	.58	.82	.39	.045	.23	—	35.0	763.0
May, 1933.....	.14	5.5	.61	1.05	.44	.049	.31	2.99	31.2	745.0
January, 1934.....	.17	6.0	.40	1.40	.43	.060	.34	2.86	41.8	1250.0

However, for the purpose of estimating the practical value of the different frequencies of cutting the yield and composition of the herbage from the two-monthly cuts in March and May should be compared with the four-monthly cut at the end of the latter month, the yield and composition of the herbage obtained from the three-monthly cuts in April and July should be considered in relation to the six-monthly cut in July, and lastly, the aggregate yield and composition of the crops from any one system with that from any other system.

The relevant data are given in Table V below.

TABLE V.
(Yields in grams.)

	Two-monthly cuts.	Three-monthly cuts.	Four-monthly cuts.	Six-monthly cuts.
Total dry matter produced.....	930.0	912.0	845.0	736.0
Total crude protein produced....	78.8	57.3	42.2	25.8
Total P ₂ O ₅ produced.....	2.56	1.62	1.10	0.71

It should be pointed out that growth was most active during February and March, thereafter falling off rapidly in activity to practically no growth after the end of May. The three-, four- and six-monthly hay crops taken at the end of April, May and July, respectively, may therefore be expected to be of a somewhat similar magnitude. The hay cut in July was dry with most of the seeds fallen out, consequently the smaller weight of hay for this harvest could partly be ascribed to losses through exposure to the weather.

There is no significant difference between the aggregate values for dry matter produced by cutting at two- or three-monthly intervals. An increase for any of these two systems over the weights obtained from single harvests in either May or July is, however, indicated.

The production of crude protein and phosphate is significantly higher under the two-monthly system than under any other method of cutting, the amounts of these nutrients decrease steadily as the intervals between cuts become greater.

(b) Season 1932-33.

The collection of samples for this period was commenced at the end of September following upon the first rainfall for the season on the 20th of September. Rainfall was below normal throughout and growth practically ceased at the end of April, the last sample taken in July, a six-monthly cutting, being composed entirely of dry herbage.

The eight-monthly cut taken in September, 1932, was largely composed of old growth from the previous season and will not be considered in discussing the results for the present season. The harvest eight months afterwards, in May, 1933, may be taken to represent undisturbed growth during the whole of the 1932-33 season.

In view of the fact that growth ceased at the end of April the aggregate yields of dry matter, crude protein and phosphate obtained under the different frequencies of cutting from September, 1932, to July, 1933, are comparable. For the purpose of bringing out the relative merits of the various systems more clearly the data are given in Table VI below.

TABLE VI.
(Yields in grams.)

	Two-monthly cuts.	Three-monthly cuts.	Four-monthly cuts.	Six-monthly cuts.	Eight-monthly cuts.
Total dry matter produced...	978·0	924·0	734·0	752·0	745·0
Total crude protein produced..	115·8	102·7	76·4	67·3	41·0
Total P ₂ O ₅ produced.....	2·73	2·23	1·75	1·55	1·04

Cutting at two-monthly intervals was initiated during the awakening period of the plants in September and the herbage for this first cut was entirely composed of young leafy growth.

The cuts for November and January both reached the hay stage (c.f. Table C in appendix of previous paper) in that all the plants were in full flower, the yield for the latter month being the highest for a single cut under this system for the season, following upon the best rainfall for the growing period during the previous month.

Two further harvests in March and May were obtained, the herbage for March was almost entirely in the flowering stage of growth, while in that obtained in May short leafy growth, affected by frost, predominated. These two aftermaths made considerable contributions to the bulk of hay obtained in November and January.

The majority of grasses were in the flowering stage when the first cut under the three-monthly system was taken in October. The longer rest period during the ensuing three months when growth was most active for the season was responsible for a greater yield in January than was obtained at the same date from a two-monthly cut. At the same time the herbage was more mature, the seeds of fully half of the ten species responsible for the yields were beginning to fall out.

There was only one relatively small aftermath cut at the end of April composed partly of dry herbage in varying degrees of maturity.

It would appear that a moderate hay crop at the flowering stage might be more favourable to aftermath production than a heavy hay crop at the post-flowering stage taken at the same date. In view of the fact that two cuts were taken after the two-monthly cut in January as against only one subsequent to the three-monthly cut of the same date, such a conclusion must be regarded tentatively but is nevertheless borne out by the work of Stapledon (1924). Meteorological conditions and the growth habits of the individual species composing a mixed pasture are other factors which may influence the results.

Following upon the commencement of the four-monthly system with a pasture cut, that is, in the pre-flowering stage, in September, a late hay crop was harvested four months afterwards, i.e. at the end of January. Although the actual weight of hay obtained from this cut is not greatly in excess of the weight from the three-monthly crop of the same date the smaller aftermath crop in May tends to add weight to the tentative conclusion drawn above in regard to the influence of a heavy hay crop on the production of aftermath.

Working with drills of cocksfoot and swards Stapledon (*loc. cit.*) concluded that the yield of both hay and aftermath were influenced to a considerable extent by the date of "putting up" to hay, that is to say the date on which the herbage was cut for the last time before the hay crop. In this connection it is interesting to compare the aggregate yields obtained from the two hay crops under the two-monthly system in November and January and the weights of the single hay crops from the three-, four-, and six-monthly cuts at the latter date, when the dates for the first cuts in each case are regarded as "putting up" dates and the weights of such first cuts not included. The relevant data as well as the total aftermath production following the hay crops under the different systems in January are given in tabular form below.

TABLE VI (b).
(Hay and Aftermath in Grams.)

	Two-monthly system.	Three-monthly system.	Four-monthly system.	Six-monthly system.
"Putting up" date.....	27/9/32	27/10/32	27/9/32	27/7/32
Weight of hay.....	662·0	500·0	514·0	642·0
Weight of aftermath.....	244·0	218·0	158·0	110·0

The evidence suggests, firstly, that two hay crops during the most productive part of the season (November to January) result in a higher aggregate yield than is obtainable from a single harvest, secondly, that a single crop from plants "put up" to hay during the dead period (July) is responsible for a greater bulk of hay than a single crop resulting from plants cut for the last time during the awakening period (September or October), and, lastly, that heavy hay and relatively heavy aftermath crops do not occur during the same season, while two aftermath crops after a "flowering stage" hay cut outyield a single aftermath cut following upon a "waning flowering stage" hay crop.

From a consideration of the data given in Table VI it may again be concluded that, while there is no significant difference in the production of dry matter during the entire growing season by the two- and three-monthly systems, and the gross yield of dry matter is decreased by lengthening the intervals between cuts to four, six or eight months, the system of cutting at two-monthly intervals appears to be the most efficient in respect of the production of crude protein and phosphoric acid.

As stated previously the eight-monthly cut taken in May represents undisturbed growth for the entire growing season. The hay was described as "mainly brown, seeds falling out" and weighed approximately the same as the aggregate yields from the four- or six-monthly cuts. The percentages phosphate and crude protein of the hay from this single harvest were the lowest for any of the cuts taken during the season. A system of reserving certain areas during the growing season for winter pasture is still extensively practised in some parts of the country and apart from poorer production of dry matter indicated for such a system by the present investigation the phosphate and crude protein content of this type of grazing is quite insufficient for even poor milk production under ranching conditions where no supplementary feeding takes place.

Compared with the practice referred to above the system of pasture management suggested by the results of cutting at two-monthly intervals indicates the direction in which the potentialities of our grasslands could with advantage be explored. Moderately good figures for both crude protein and phosphorus were obtained for all the two-monthly cuts, depending largely on the degree of maturity reached by the herbage of the respective crops. Thus, the pasture cut with which the system was initiated in September gave higher values for P_2O_5 and protein than any of the subsequent harvests. All other mineral constituents remained high throughout, while the figures for crude fibre were not much higher than were obtained in the herbage from a more severe system of cutting, previously discussed.

The composition of the herbage from the first cuts of the three- and four-monthly systems in October and September respectively, is comparable with that obtained from a monthly cut while the January yield from these two systems contains slightly less crude protein and phosphoric acid than the herbage obtained at the same date under the two-monthly system. The values for these constituents in the aftermaths of the three- and four-monthly systems vary similarly from the figures obtained in the aftermaths of the two-monthly system. Line values are throughout higher and potash figures generally lower in the aftermath cuts under all systems compared with the values for these constituents in the respective hay crops. All aftermath harvests are characterised by relatively low values for crude fibre.

Judging from the composition of the six-monthly cut in January the hay is slightly less nutritious than that obtained under the four-monthly system at the same date, while its aftermath harvested in July shows the poorest composition compared with any crop under all systems for the entire growing season, with the exception of the eight-monthly cut in May.

(c) *Season 1933-1934.*

The data for this season are limited to a pasture cut under the two-monthly system in November and hay crops for all the systems in January. As previously stated the rainfall for November was exceptionally high and was well distributed over the month. The light showers registered before this date had practically no effect on growth.

The pasture cut taken at the end of November from the second rows of the plots was composed entirely of young succulent growth, the composition of the dry matter was very much the same as that from the monthly cuts taken on the same date, and need not be discussed here.

Of greater interest is the effect of this pre-cut in November on the average yield of hay at the end of January in relation to the mean weights of the hay crops obtained from the third, fourth, sixth and eighth rows, which had been cut for the last time in April, May, July and May of the previous season, respectively. The average yields obtained in January from the respective rows of the ten species as well as the dates on which the plants were cut for the last time before the hay crops are given in Table VII below.

TABLE VII.
(Yields in Grams.)

	Two-monthly system.	Three-monthly system.	Four-monthly system.	Six-monthly system.	Eight-monthly system.
Cut for the last time on.....	27/11/33	27/4/33	27/5/33	27/7/33	27/5/33
Weight of hay in January...	490.0	1,070.0	920.0	818.0	1250.0

No data in regard to growth after January for the systems other than monthly cuts are available. The pronounced influence, however, of the date of "putting up" to hay on the hay crops at the end of January is again apparent from the data in Table VII. Generally speaking the plants cut for the last time towards or after the termination of the previous growing season produced approximately twice as much hay as plants cut for the last time at the pre-flowering stage in November of the present season.

It is difficult at this stage of the investigation to explain the variations in yield of the series of plants "put up" to hay at the conclusion of the previous season. Whether cutting for the last time in April, May or July will influence the hay crops at a specific date during the following season is a matter which will be investigated in the near future when it is hoped to have bigger plots and more definite conclusions in regard to factors influencing yield may be drawn.

Compared with previous seasons the hay crops obtained in January are relatively heavier; this is attributed to the favourable meteorological conditions obtaining since November.

A consideration of the chemical data given in Table IV reveals the fact that as a result of the favourable climatic conditions mentioned above the composition of the herbage cut at the end of January, that is after only three months undisturbed growth, is comparable with the poor quality hay obtained in May of the previous season after eight months undisturbed growth. Apart from the low

values for the more essential constituents, phosphoric acid and crude protein, all other minerals determined, with the exception of sodium, show greatly decreased values as against markedly increased values for crude fibre.

The analysis for the two-monthly hay crop shows slightly better figures than that for the other systems. Nevertheless the evidence seems to suggest that during the "zenith period" of growth of seasons with high rainfalls the intervals between successive cuttings will have to be reduced to something less than two months for the production of herbage of greatest feeding value. Earlier in this paper mention was made of the fact that comparatively low values were obtained even in the dry matter of the herbage resulting from cutting at monthly intervals at this period of the 1933-34 growing season. On the other hand, from evidence to be considered presently, a more drastic system of cutting will have a depressing effect on the yield of herbage. The data are as yet too scanty to decide upon a definite system but it is apparent that a golden mean between quantity and quality of herbage in relation to meteorological conditions will have to be found if the maximum feeding value of our grasses is to be obtained.

III. THE EFFECT OF CUTTING AT MONTHLY AND TWO-MONTHLY INTERVALS ON THE AGGREGATE YIELD OF DRY MATTER, CRUDE PROTEIN AND PHOSPHORIC ACID.

With the exception of the 1933-34 season when climatic conditions were above normal and the data incomplete it has been demonstrated that the highest aggregate yields of dry matter, crude protein and phosphate have been obtained by harvesting at two-monthly intervals. It will be of interest to compare these results with those obtained by cutting at monthly intervals over the same period. The data for the monthly cuts in February and March, 1934, are not included. The average aggregate yields of dry matter, crude protein, and phosphate, obtained by cutting the respective portions of the ten plots of grasses at monthly and two-monthly intervals for each of the three seasons concerned are given in Table VIII below.

TABLE VIII.
(Yields in Grams.)

	Monthly system.			Two-monthly system.		
	Dry matter.	P ₂ O ₅ .	Crude protein.	Dry matter.	P ₂ O ₅ .	Crude protein.
Season 1931-32...	590.0	2.50	74.8	930.0	2.56	78.8
Season 1932-33...	430.0	1.43	62.0	978.0	2.73	115.8
Season 1933-34...	436.0	1.28	54.0	638.0	1.43	61.3

In considering these results it should be remembered that the aggregate yields from each of the three seasons are not comparable one with the other, the data for the 1931-32 season relate to only the latter half of the season since the investigation was initiated in February, 1932, while for the last season data are given only up to the end of January, 1934. It is to be noted, however, that the whole of the dry 1932-33 season yielded but little more dry matter under the two-monthly system and a fair amount less under the monthly system than was obtained from a portion of the 1931-32 season under the two systems respectively.

The outstanding feature of the data in Table VIII is the greatly increased aggregate yields of dry matter obtainable from the more lenient system of cutting. This disparity becomes more exaggerated in proportion as the climatic conditions are unfavourable during the growing season as is apparent from the data for the 1932-33 season.

While cutting at monthly intervals produces herbage of higher feeding value during seasons of favourable meteorological conditions, the shortened interval does not appear to improve the quality of the herbage appreciably during dry spells. During the 1932-33 season the production of dry matter was more than doubled by a system of cutting at two-monthly intervals and at the same time the aggregate yields of crude protein and phosphoric acid were almost twice that produced by cutting at monthly intervals. At the same time the evidence seems to suggest that with more favourable growth conditions a smaller yield under the more drastic system of cutting might be compensated for by the better quality herbage, provided, of course, the grasses are able to stand the more drastic treatment successfully. In this connection the insignificant differences in aggregate yields of crude protein and phosphoric acid obtained for the two systems for the portion of the 1931-1932 season are worthy of note.

No data are available in respect of the effect of frequency of cutting on the development of the root systems of the plants although it was observed that the percentage of plants dying as a result of the various treatments was greatest in the portions of the plots cut at monthly intervals. This fact together with the depressing effect of drastic systems of cutting on the yield of succeeding seasons as pointed out by Stapledon (*loc. cit.*) may have been responsible for smaller yields under the monthly system than under the two-monthly system of cutting during the two seasons following upon the initiation of the investigation in February, 1932, but does not, on the other hand, explain yield in favour of the two-monthly system as indicated by the data for the first season of the experiment, when all the plants could be taken to have been in their pre-experimental condition.

It may be concluded that during dry seasons cutting at two-monthly intervals is definitely preferable to any of the systems studied in this investigation, while during periods of abnormal rainfall the most efficient system appears to be to cut the herbage at a date somewhere between one and two months depending upon the growth habits and resistance of the individual species composing the mixed pasture.

SECTION 2.—NEWLY ESTABLISHED SPECIES.

As already stated, in addition to the investigation reported on in Section one of this report work was started on eleven other species of grasses towards the end of the 1932-33 growing season. The grasses on all these plots were cut on the 28th February and the same system of taking samples for analysis, described in the previous publication, initiated on the 28th March. Owing to the lateness of the season when cutting was started few cuts were obtained for the monthly samples and growth was generally poor. No attempt will therefore be made to discuss the results for the portion of the 1932-33 season in detail, i.e. March-April, 1933.

Table G in the appendix gives the dates of cutting, the yield of dry matter and the percentage composition together with a short description of the stages of growth of the monthly cuts obtained from March, 1933, to March, 1934, while similar data for cuts obtained up to the end of February, 1934, under all other frequencies of cutting are presented in Tables H-M of the appendix.

DISCUSSION OF RESULTS.

I. MONTHLY CUTS.

Reference to Table G in the appendix reveals the following: Growth ceased after the April (1933) cuts in the case of five species while the remaining six species yielded the last but relatively small crops for the season at the end of May. In spite of the fact that the first good rains for the 1933-34 season fell in November two species *Chrysopogon montana* and *Elyonurus argenteus* began yielding small crops of herbage in August. It was possible to take monthly samples from *Alloteropsis semialatas* from the end of September, while *Antheophora pubescens* and *Eragrostis plana* yielded the first samples under this system of cutting for the season in October. Samples of herbage were also obtained from the *Eragrostis* sp. and *Paspalum dilatatum* plots from the end of August, but growth on these plots cannot be considered to have taken place as a result of the prevailing climatic conditions alone, since frequent watering of adjacent plots where new species were being established during August might have exerted its influence on growth on the adjacent sides of the *Paspalum* and *Eragrostis* plots. Following the first heavy rains for the season in November growth proceeded actively on all the eleven plots concerned.

The average percentage composition of the dry matter of the monthly cuts of the eleven species is given in Table IX below, the mean yield being included in the table. It is proposed to discuss briefly the results for the 1933-34 season only, those for March, April, and May, 1933, being left out for the reason already stated.

The dry matter of the composite sample for September, composed almost entirely of short leafy growth, is slightly richer in crude protein and phosphate and gives a lower figure for crude fibre than any of the composite samples collected during the season. This peak for phosphate in early spring is in agreement with the findings of Henrici (1928 and 1930). The data for September herbage samples

TABLE I X.

Date of Cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.
March, 1933.....	.43	14.0	.52	2.24	.46	.13	.78	—	32.0	154.0
April, 1933.....	.39	12.8	.54	2.03	.44	.14	.72	—	30.8	130.0
May, 1933.....	.41	14.0	.57	1.79	.43	.23	.71	4.04	26.9	37.0
September, 1933.....	.47	14.7	.56	2.30	.52	—	.57	4.33	27.4	68.0
October, 1933.....	.34	13.0	.54	1.77	.49	—	.52	4.12	31.6	62.0
November, 1933.....	.30	13.0	.50	2.18	.46	.20	.44	4.04	34.8	230.0
December, 1933.....	.33	13.3	.47	2.07	.42	.17	.44	3.83	34.1	130.0
January, 1934.....	.25	11.0	.39	1.89	.37	.14	.44	3.57	36.4	220.0
February, 1934.....	.32	11.7	.47	1.89	.40	.12	.45	3.99	34.6	150.0
March, 1934.....	.35	11.9	.52	1.92	.41	—	—	3.88	34.1	110.0

TABLE X.

(PERIOD OF GROWTH: 1 month, 2 months, etc., up to 12 months.)

Date of cutting.	P ₂ O ₅ .	Crude protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.
March, 1933.....	.43	14.0	.52	2.24	.46	.13	.78	—	32.0
April, 1933.....	.29	10.3	.59	1.69	.47	.14	.71	—	31.0
May, 1933.....	.19	7.8	.66	1.26	.51	.12	.64	3.34	30.4
June, 1933.....	.14	5.9	.71	.91	.49	.12	.52	3.04	31.4
July, 1933.....	.11	5.4	.75	.87	.53	.14	.47	3.11	31.5
August, 1933.....	.12	5.5	.76	.86	.50	.12	.48	2.96	32.7
September, 1933.....	.14	6.2	.62	.63	.35	.08	.23	2.31	32.9
October, 1933.....	.11	6.0	.57	.56	.29	.07	.21	2.50	35.1
November, 1933.....	.22	9.7	.49	1.74	.38	.11	.34	3.51	36.9
December, 1933.....	.18	6.7	.41	1.57	.36	.10	.28	3.03	39.4
January, 1934.....	.14	5.6	.33	1.37	.29	.08	.28	2.61	39.4
February, 1934.....	.13	5.6	.35	1.25	.32	.08	.25	2.69	40.0

in the present investigation are, however, too scanty for a definite conclusion. The species composing the mixed sample and the climatic conditions are factors which will no doubt influence the variations in phosphate content in the course of the growing season. There is, for instance, no appreciable difference in the P_2O_5 values of *Chrysopogon Montana* and *Eragrostis* sp. for September and March (c.f. Table G). A similar phenomenon was noted in the case of some of the older established species during the 1932-33 season (c.f. Table IV of previous paper).

Generally speaking, the average percentage composition of the monthly cuts of the eleven species vary in a manner similar to that of the other ten species, discussed in Section one of this paper, from November to March. Minimum values for all the inorganic constituents and crude protein and a maximum for crude fibre were again obtained in the composite sample for January. Phosphate and crude protein display parallel variations, while the latter constituent and crude fibre fluctuate in opposite direction from October to March.

It is difficult at this stage of the investigation to decide upon the best grasses among the species studied. *Allotroopsis semialata*s certainly gave the highest figures for phosphate and crude protein from month to month throughout the season, but yielded, on the other hand, a smaller aggregate weight of herbage for the period from September to March than any of the other species. *Ischaemum glaucostachyum* was the poorest in respect of phosphate and crude protein and was responsible for a relatively small aggregate yield of dry matter. *Chrysopogon montana*, *Eragrostis* sp., *Paspalum dilatatum* and *Elyonurus argenteus* appear to have stood up best to the dry weather conditions experienced from May to October, 1933, the last-mentioned grass showing green shoots even during the winter months.

Paspalum gave the highest aggregate yield of dry matter for the period September to March. *Eragrostis plana* and *Eragrostis* sp. were also high producers of dry matter under the system of cutting at monthly intervals. While yielding herbage of relatively high nutritive value the frequent defoliations seems to have impaired the yielding capacity of *Chloris gayana*.

II. SUCCESSIVE MONTHLY CUTS.

For the purpose of comparison with the data for the older established species reported on in the previous paper (1934) the average percentage composition of the eleven species for the period March, 1933, to February 1934, is presented in Table X at the following periods of growth: 1 month, 2 months, 3 months, and so on up to 12 months.

A rapid drop in the percentage phosphate and crude protein as the grasses mature is again in evidence, the herbage cut in July containing only about 25 per cent. of the phosphorus and 38 per cent. of the crude protein present in the crops for March. After a light shower in the beginning of September a slight improvement is noticeable for the samples taken at the end of the month. This increase in percentage

phosphate and crude protein disappears during almost two months of dry weather with the result that the percentage composition of the herbage cut at the end of October is similar to that of the samples harvested at the end of July. Contrary to the findings of the previous year a remarkable improvement in the percentage composition of the herbage occurs in the samples for November. Two factors, viz., excessive loss of mature herbage, low in phosphate and crude protein, due to strong winds during the dry weather of the greater part of September and October, and relatively large amounts of new succulent growth following upon the copious rains during November may be said to have been responsible for the greatly increased phosphate and crude protein values for November. Reference to the descriptions of the samples from individual species given in Table M of the appendix shows that old growth from the previous season must have disappeared completely from some of the plots during December or January. Conditions for new growth remain favourable to the end of January, 1934, but owing to the increasingly higher degree of maturity obtained by the herbage composing the samples for 10-, 11-, and 12-monthly cuts at the end of December, January, and February, respectively, the percentage phosphate and crude protein decrease gradually from November to February.

The percentage of potash and chlorine show a persistent drop from March to October. It is to be noted that no improvement occurs as a result of new growth after the light shower in the beginning of September, a finding similar to the results of the previous season (du Toit, *et al.*, 1934). A striking improvement, especially in the percentage of potash is, however, brought about by the heavy rains of November. It has been suggested in the discussion of the potash figures in the previous paper that the old growth forming part of the mixed sample of herbage after new growth has commenced following upon the first spring rains contained a lower percentage of K_2O than the same old growth did prior to the rains. For the purpose of elucidating this point a number of mixed samples cut at the end of November have been divided into old and new growth and analysed separately. Table XI below gives the percentage composition of the October samples, composed almost entirely of growth from the previous season, and of the old and new growth portions of the samples cut at the end of November for two of the species studied. The analysis of the mixed samples for the latter month are included in the table.

A study of the results given in Table XI and reference to the data in Table X reveal the fact that the process by which minerals and protein are lost from the herbage portions of plants commences after approximately two months growth when the plants are fully mature, probably earlier (c.f. Richardson, *et. al.*, 1931, 1932), continues to at least November and appears to be aggravated by heavy rains as experienced during this month. The actual mechanism of the process has not been studied. In addition to the work of Richardson referred to above the finding of Henrici (1930) that re-migration of P_2O_5 from leaves and haulms to root and root neck takes place during autumn is of interest in this respect, while it seems quite plausible that rain may have a leaching effect on the constituents contained in old dry grasses which have been subjected to adverse

metereological conditions, such as frost during winter and the subsequent weathering of the dead aerial parts. Van Wyk (1933) believes that rain probably has a leaching effect on the constituents of grasses even at an active stage of growth. The fact that a large quantity of potash remains in a soluble form throughout the growth of the plant as demonstrated by Bartholomew and Janssen (1929) will probably facilitate leaching out of this constituent, and more so in old dead grass of the previous season's growth.

TABLE XI.

Anthephora pubescens.

Date of cut and description of growth.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.
October, 1933.							
Old growth.....	.09	6.1	.95	.53	.50	.021	.18
November, 1933.							
Old growth.....	.04	2.7	.56	.26	.43	.020	.06
New growth.....	.27	10.6	.43	2.35	1.10	.055	.71
Mixed growth.....	.22	8.8	.54	1.85	.97	.037	.56
<i>Paspalum dilatatum.</i>							
October, 1933.							
Old growth.....	.07	4.7	.58	.65	.32	.027	.08
November, 1933.							
Old growth.....	.05	3.4	.59	.23	.24	.020	.04
New growth.....	.37	14.2	.52	3.53	.48	.077	.48
Mixed growth.....	.22	10.7	.53	2.08	.41	.053	.26

However, from what has been said it is apparent that the proportion of new to old growth in the mixed samples cut after the first spring rains will largely determine the mineral composition of such mixed samples. A glance at Table A in the appendix of the previous paper shows that during October, 1932, the samples were composed mainly of dry mature herbage from the previous season while in the November (1932) samples old and new growth were present in approximately equal quantities, with the result that no improvement in the percentage composition of the samples, in spite of new growth, was found.

On the other hand, new growth predominated in the samples for November, 1933 (c.f. Table M in appendix) following upon climatic conditions which caused the removal of large quantities of old growth from the plots during October and favoured rapid new growth during November with the result already indicated.

From November to February potash and to a lesser extent chlorine values in Table X drop in a manner similar to phosphate and crude protein.

The lime, magnesia and soda values in Table X, while showing appreciable variations, do not appear to be influenced to any marked degree by the stage of maturity of the herbage. Lime and magnesia tend to increase from March to July, thereafter showing decreased values, especially during the months December and January when growth was most active. In this connection the findings of Richardson and associates (*loc. cit.*) are of interest. According to these workers calcium, unlike phosphorus, potash and nitrogen, is absorbed continuously throughout growth and the percentage intake tends to increase with the development of the plant. Furthermore, the suggestion of Maskell and Mason (quoted by Richardson) that the calcium, once in the cells of the plant is either precipitated or combined with tissue in such a way that little remains in solution would explain the consistency high values obtained for calcium in the samples from March to July as against greatly decreased values for phosphorus protein and potassium.

Sodium values which are remarkably low for all species except for the outstandingly high figures for *Chloris gayana*, show very little variation from March to August. Values decrease during September and October but improve again after good rains in November followed by a second drop in January and February.

Figures for crude fibre in Table X remain practically constant from March to September. A gradual rise to a higher level, which is maintained for the rest of the period under discussion, in December is indicated.

The general conclusions drawn from the data of the eleven species reported on in the previous paper apply equally well to the data for the species of grasses under discussion. Briefly, phosphorus and crude protein values are deplorably low as the period of growth advances beyond two months. Sodium values are generally low and the possibility of being present in inadequate amounts for production in certain pastures is suggested, while all other constituents determined appear to be present in abundance.

III. THE INFLUENCE OF FREQUENCY OF CUTTING ON THE PRODUCTION OF DRY MATTER, PHOSPHATE AND CRUDE PROTEIN.

For this purpose the data for the 1933-34 season alone will be considered. The six-monthly cuts taken at the end of February, 1934, represent undisturbed growth from the end of August and are comparable with the aggregate yields obtained from the one-, two-, three-, and four-monthly systems and resulting from growth during the same period of six months. The average percentage composition and yield of herbage obtained under the monthly system of cutting from the species studied are to be found in Table IX earlier in this paper while similar data relating to the other frequencies of cutting are given in Table XII.

TABLE XII.

Two-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble Ash.	Crude fibre.	Total yield in grams.
October, 1933.....	.28	11.2	.64	1.82	.53	--	.53	4.26	28.5	71.0
December, 1933.....	.22	8.9	.40	1.78	.37	.16	.45	3.33	37.9	636.0
February, 1934.....	.20	8.0	.37	1.54	.34	.12	.44	3.18	39.5	640.0
<i>Three-monthly Cuttings.</i>										
November, 1933.....	.26	11.8	.51	2.14	.44	.18	.46	4.01	36.1	289.0
February, 1934.....	.15	6.9	.33	1.36	.34	.10	.37	2.80	38.8	535.0
<i>Four-monthly Cuttings.</i>										
October, 1933.....	.26	11.0	.73	1.87	.57	--	.68	4.27	31.4	57.0
February, 1934.....	.13	5.1	.34	1.20	.32	.07	.31	2.63	40.1	1282.0
<i>Six-monthly Cuttings.</i>										
February, 1934.....	.12	5.4	.34	1.17	.32	.06	.30	2.62	39.8	1125.0

From the data in Tables IX and XII the aggregate production of dry matter, phosphate and crude protein for the six months September to February under all treatments have been calculated and are presented in tabular form below.

TABLE XIII.
(Yield in Grams.)

	Monthly cuts.	Two-monthly cuts.	Three-monthly cuts.	Four-monthly cuts.	Six-monthly cuts.
Dry matter.....	860.0	1347.0	824.0	1339.0	1125.0
P ₂ O ₅	2.68	2.88	1.55	1.80	1.35
Crude protein.....	107.0	115.7	71.0	71.7	60.7

In respect of dry matter produced there is no difference between the two- and four-monthly systems, while the single harvest in February shows a slightly lower yield than was obtained under either of these treatments. The aggregate yields of dry matter under the monthly and three-monthly systems are of a somewhat similar magnitude but are only about 60 per cent. of the weights obtained under the two- or four-monthly systems. The low yield under the three-monthly system affords additional evidence with regard to the influence of the date of "putting up" to hay on the subsequent production of dry matter.

Reference to Table XII shows that this system was initiated in November after the first good rains for the season. Growth actually commenced before this date but became active only during November. The effect of a defoliation during this month on the production of hay in January under a two-monthly system has been demonstrated by the results given in Table VII (see Section 1). In the case under consideration the hay crop was harvested a month later, in February, but was nevertheless influenced in a similar manner by the late pre-cut of November.

While, as stated above, the yield of dry matter under a two-monthly system does not exceed that obtainable under a four-monthly system the gross production of the essential nutrients phosphate and protein under the former system of cutting is greater than under any of the more lenient treatments, a finding in agreement with the conclusions drawn from the data of previous seasons discussed earlier in this paper. The possibility that a smaller yield will be compensated for by a better quality of the herbage obtained from a more drastic system of cutting during periods of favourable climatic conditions is again suggested by the insignificant difference in the gross yields of phosphate and protein under the monthly and two-monthly systems of cutting (c.f. Table XII).

GENERAL CONCLUSIONS AND SUMMARY.

The investigation which has been dealt with in this paper is a continuation of earlier work carried out in 1932 on species of grasses grown on separate plots and exposed to the same climatic conditions

while being subjected to the following system of cutting: A portion of each plot was cut at monthly intervals, another portion of the plot was cut at two-monthly intervals, a third portion at three-monthly intervals, and so on, up to twelve months, when a sample of twelve months' growth was taken off each plot. The grass resulting from each cutting was weighed when air-dry and sampled for analytical purposes. The constituents determined were crude protein, crude fibre, phosphorus, calcium, potassium, magnesium, sodium, and chlorine, while the determination of soluble or silica-free ash was included towards the end of the investigation.

Detailed data relating to all the cuts obtained from individual species from February, 1933, to February, 1934, are tabulated in an appendix. Average values for all the species combined have been chosen as a basis for discussion.

(1) Grasses cut at monthly intervals are highest in percentage phosphorus and crude protein and lowest in percentage crude fibre. With decreased frequency of cutting the crude fibre content rises to a maximum at maturity, while the phosphorus and crude protein contents drop markedly to minima in the old mature herbage cut prior to the commencement of new growth in the following season.

(2) The different frequencies of cutting do not appreciably influence the lime and magnesia contents of the herbage.

(3) Pure species grown on the same soil and exposed to the same climatic conditions show appreciable differences in mineral and protein content when harvested after definite intervals, e.g. one month.

(4) Fluctuations in the chemical composition of species cut at, say, monthly intervals during the growing season are indicated. These variations are attributed mainly to the stage of growth attained by the species and to the rainfall in so far as it influences the stage of growth.

(5) Rainfall is the most important factor governing the yield from monthly cuts.

(6) During dry seasons the phosphorus content of herbage cut at monthly intervals tends to be low. At the same time the percentage lime is high. The crude protein content does not appear to be adversely affected by drought.

(7) The percentage of mineral constituents and crude protein are low and crude fibre high during seasons of plentiful rains.

(8) Cutting at monthly intervals impairs the persistency of most species, *Pennisetum ciliare* and *Cynodon dactylon* being the only grasses not visibly affected by the severe treatment.

(9) The highest yield of dry matter is obtained from pasture species by cutting at two-monthly intervals during the growing season. The evidence suggests that while the yield from fewer cuts or a single harvest may not be much smaller the herbage will definitely be of lower nutritive value.

(10) The aggregate production of crude protein and phosphate is highest by cutting at two-monthly intervals.

(11) The difference in nutritive value between herbage cut at monthly and two-monthly intervals becomes insignificant during seasons of dry weather conditions.

(12) The date on which a system of cutting is initiated is found to exercise a determining influence on the productiveness of herbage plants in the course of the growing season. The production of dry matter seems to be depressed by a first cut during the period when active growth commences.

(13) The practical suggestion which is a corollary to this investigation is that an attempt should be made to prevent natural pastures from growing undisturbed during the entire season if economic utilization of such pasture is to be made. Provided the effects of periodic cutting are at all comparable with grazing by animals this object appears to be attainable by following a system of management in which the pasture is grazed down at least once every two months during the active growing season depending, of course, on the prevailing climatic conditions and the botanical composition of the pasture.

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APPENDIX.
TABLE A.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
HYPERBÆNIA HIRTA.											
February, 1933.....	.26	11.3	.58	1.68	.45	.018	.46	—	28.7	25.0	Green, short, few flowerheads.
March, 1933.....	.29	11.4	.57	1.95	.49	.016	.56	—	28.3	50.0	Green, few flowerheads.
April, 1933.....	.26	10.0	.62	1.98	.47	.018	.54	—	28.3	45.0	Green, few flowerheads.
November, 1933.....	.28	15.1	.88	1.53	.44	.034	.31	3.76	28.9	44.0	Green, short.
December, 1933.....	.20	10.6	.70	1.24	.49	.028	.31	3.02	32.3	100.0	Green, short.
January, 1934.....	.21	8.1	.52	1.38	.50	.033	.17	2.70	39.5	132.0	Green, with flowerheads.
February, 1934.....	.24	11.2	.44	1.65	.47	.024	.26	3.36	32.8	60.0	Green, short.
March, 1934.....	.23	9.2	.60	1.64	.48	Trace	—	3.03	34.8	28.0	Green, short.
THEMEDA TRIANDRA.											
February, 1933.....	.27	11.1	.79	1.14	.41	Nil	.40	—	26.3	20.0	Green, short.
March, 1933.....	.37	12.9	.81	1.35	.46	.018	.45	—	27.1	25.0	Green, short.
April, 1933.....	.33	12.2	.78	1.56	.42	.022	.51	—	27.1	25.0	Green, short.
November, 1933.....	.27	10.2	.51	1.48	.37	.062	.33	3.10	36.7	280.0	Green, few flowerheads.
December, 1933.....	.25	9.5	.62	1.17	.40	.032	.39	2.81	36.0	120.0	Green, few flowerheads.
January, 1934.....	.23	8.3	.60	1.19	.40	.038	.37	2.74	37.2	96.0	Green, short.
February, 1934.....	.40	8.6	.76	.90	.39	.031	—	3.01	37.2	20.0	Green, short.
March, 1934.....	—	—	—	—	—	—	—	—	—	—	Practically no growth.
CYMOPOGON PLURINODIS.											
February, 1933.....	.33	10.1	.52	2.24	.42	.053	.44	—	—	17.0	Green, short.
March, 1933.....	.42	12.8	.47	2.64	.40	.057	.55	—	—	20.0	Green, short.
April, 1933.....	—	—	—	—	—	—	—	—	—	—	Green, short.
November, 1933.....	.22	10.5	.50	1.84	.44	.032	.46	3.30	33.7	15.0	Green, short.
December, 1933.....	.31	14.6	.53	2.00	.49	.048	.46	3.65	34.1	330.0	Green, few flowerheads.
January, 1934.....	.29	10.8	.55	1.76	.43	.023	.52	3.18	29.6	80.0	Green, few flowerheads.
February, 1934.....	.29	11.6	.45	1.45	.40	.062	.48	3.23	31.4	52.0	Green, few flowerheads.
March, 1934.....	.28	11.8	.47	1.67	.43	Trace	—	3.25	—	9.0	Green, short.
CYNODON DACTYLON.											
February, 1933.....	.22	11.1	.60	1.22	.43	Trace	.26	—	27.6	35.0	Green, short.
March, 1933.....	.25	12.6	.68	1.52	.38	.020	.32	—	26.2	35.0	Green, with flowerheads.
April, 1933.....	.18	10.2	.58	1.00	.37	.020	.37	—	26.0	60.0	Green, short.
November, 1933.....	.28	14.1	.64	1.76	.42	.063	.28	4.06	27.7	146.0	Green, short.
December, 1933.....	.23	14.1	.58	1.91	.43	.067	.20	3.83	29.1	4.2	Green, short.
January, 1934.....	.19	8.9	.33	1.61	.31	.044	.20	3.50	33.8	352.0	Green, with flowerheads.
February, 1934.....	.32	12.6	.56	1.80	.41	.048	.25	—	—	188.0	Green, short.
March, 1934.....	—	—	—	—	—	—	—	—	—	—	Practically no growth.
AMPHILOPHIS INSCULPTA.											
February, 1933.....	.24	10.4	.60	2.50	.46	Trace	.53	—	29.8	85.0	Green, few flowerheads.
March, 1933.....	.32	12.0	.62	2.30	.48	.026	.74	—	30.1	75.0	Green, few flowerheads.
April, 1933.....	.28	12.7	.60	2.33	.47	.023	.72	—	29.8	55.0	Green, few flowerheads.
November, 1933.....	.27	13.5	.83	1.87	.71	.048	.53	3.96	36.9	60.0	Green, short.
December, 1933.....	.28	9.3	.66	2.04	.57	.037	.43	3.83	38.3	200.0	Green, few flowerheads.
January, 1934.....	.21	10.4	.63	2.09	.51	.025	.34	3.85	34.0	104.0	Green, few flowerheads.
February, 1934.....	.23	11.2	.64	1.90	.44	.023	.51	4.04	34.5	50.0	Green, few flowerheads.
March, 1934.....	.25	10.1	.58	1.87	.50	Trace	—	3.69	—	10.0	Green, short.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE A. (continued).

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
Pennisetum Ciliare.											
February, 1933.....	.31	13.2	.52	2.81	.88	.088	.87	—	31.0	100.0	Green, few flowerheads.
March, 1933.....	.38	14.8	.50	3.25	.86	.075	1.04	—	29.7	135.0	Green, with flowerheads.
April, 1933.....	.32	14.6	.51	2.72	.86	.039	.20	—	28.4	85.0	Green, with flowerheads.
October, 1933.....	.36	13.1	.50	3.24	.77	.055	.23	6.86	24.0	215.0	Green, few flowerheads.
December, 1933.....	.39	13.4	.44	3.76	.77	.041	.23	6.00	22.8	216.0	Green, few flowerheads.
January, 1934.....	.34	13.1	.44	3.92	.69	.034	.22	5.14	33.0	350.0	Green, with flowerheads.
February, 1934.....	.37	20.0	.39	2.87	.76	.040	.50	5.45	29.2	135.0	Green, short.
March, 1934.....	.38	15.1	.41	3.05	.85	.022	—	5.41	33.3	220.0	Green, with flowerheads.
Urochloa Puelulans.											
February, 1933.....	—	—	—	—	.97	.79	.98	—	—	—	Practically no growth.
March, 1933.....	.50	17.7	.85	3.98	—	—	—	—	18.3	45.0	Green, short.
April, 1933.....	.54	23.0	1.00	2.65	1.05	2.02	.61	8.22	28.6	50.0	Green, short.
November, 1933.....	.38	16.9	.83	2.61	.86	1.38	.65	6.22	25.5	83.0	Green, few flowerheads.
December, 1933.....	.38	16.9	.72	2.51	.60	.53	.54	6.12	31.4	100.0	Green, with flowerheads.
January, 1934.....	.46	11.0	.82	2.70	.61	.57	.57	6.12	29.0	77.0	Green, few flowerheads.
February, 1934.....	.44	11.8	.89	2.77	.70	.60	—	6.07	28.0	26.0	Green, short.
Setaria Gerrardii.											
February, 1933.....	.31	12.4	.77	2.97	.76	.028	.65	—	29.4	25.0	Green, short.
March, 1933.....	.37	15.3	.75	3.54	.86	.035	.72	—	28.0	45.0	Green, with flowerheads.
April, 1933.....	.32	13.7	.73	2.92	.70	.038	.70	—	26.6	45.0	Green, few flowerheads.
November, 1933.....	.30	16.3	.70	3.09	.57	.046	.39	4.89	29.8	39.0	Green, with flowerheads.
December, 1933.....	.31	12.6	.50	2.64	.65	.058	.37	4.20	37.7	58.0	Green, with flowerheads.
January, 1934.....	.30	11.0	.55	2.22	.60	.021	.37	3.82	36.1	58.0	Green, with flowerheads.
February, 1934.....	.42	13.6	.63	2.50	.76	.051	.43	4.64	35.4	56.0	Green, few flowerheads.
March, 1934.....	.35	12.8	.50	2.24	.73	Trace	—	4.44	33.6	76.0	Green, with flowerheads.
Panicum Maximum.											
February, 1933.....	—	—	—	—	—	—	—	—	—	—	Practically no growth.
March, 1933.....	.38	18.1	.95	2.42	1.31	.96	.76	—	24.5	35.0	Green, with flowerheads.
April, 1933.....	.36	23.1	1.20	2.18	1.23	1.24	—	6.70	23.8	50.0	Green, short.
November, 1933.....	.28	8.2	.59	2.70	.70	1.09	.90	5.78	32.0	321.0	Green, few flowerheads.
December, 1933.....	.25	9.2	.53	2.30	.57	.79	.87	5.04	30.9	160.0	Green, with flowerheads.
January, 1934.....	.42	13.5	.53	2.73	.68	.59	1.03	5.94	—	46.0	Green, short.
February, 1934.....	.34	12.0	.80	1.85	.80	.32	—	5.31	—	8.0	Green, short.
Eragrostis Superba.											
February, 1933.....	.31	11.3	.71	1.66	.60	.026	.37	—	28.0	90.0	Green, few flowerheads.
March, 1933.....	.35	13.3	.79	2.13	.70	.036	.54	—	—	125.0	Green, with flowerheads.
April, 1933.....	.30	12.3	.79	1.91	.65	.036	.46	—	25.3	85.0	Green, short.
November, 1933.....	.32	12.6	.72	1.95	.53	.052	.21	4.43	30.9	120.0	Green, few flowerheads.
December, 1933.....	.28	10.2	.71	1.87	.44	.040	.08	3.94	37.8	178.0	Green, with flowerheads.
January, 1934.....	.27	7.1	.54	1.73	.38	.037	.08	3.27	38.5	190.0	Green, with flowerheads.
February, 1934.....	.59	12.5	.51	2.10	.93	.030	.19	4.56	31.9	140.0	Green, with flowerheads.
March, 1934.....	.37	13.0	.58	1.88	.47	Trace	—	4.06	31.2	104.0	Green, few flowerheads.

TABLE B.
Two-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
HYPARRHENIA HIRTA.											
March, 1933.....	.29	10.1	.55	2.09	.45	.017	.59	—	31.7	270.0	Green, with flowerheads.
May, 1933.....	.20	8.3	.76	1.66	.53	.015	.69	3.66	45.4	110.0	Mixed, mainly green, with flowerheads.
November, 1933.....	.35	15.2	.90	1.70	.45	.038	.46	3.78	33.2	130.0	Green, short.
January, 1934.....	.14	5.1	.34	1.31	.30	.029	.17	2.12	48.9	910.0	Green, with flowerheads.
THEMEDA TRIANDRA.											
March, 1933.....	.30	11.0	.75	1.59	.44	.023	.56	—	28.4	95.0	Green, few flowerheads.
May, 1933.....	.20	8.3	.83	1.12	.51	.009	.53	3.09	25.4	35.0	Mixed, mainly green, short.
November, 1933.....	.29	11.3	.70	1.59	.39	.035	.36	3.29	35.6	100.0	Green, short.
January, 1934.....	.15	6.2	.44	1.22	.31	.044	.33	2.37	39.3	390.0	Green, with flowerheads.
CYMBOPOGON PTERINOIDES.											
March, 1933.....	.36	11.0	.50	2.51	.38	Trace	.55	—	25.0	80.0	Green, few flowerheads.
May, 1933.....	.26	8.7	.58	2.29	.46	.025	.59	4.03	25.0	25.0	Mixed, short.
November, 1933.....	.35	16.5	.70	1.96	.48	.041	.32	3.68	27.0	15.0	Green, short.
January, 1934.....	.19	7.5	.34	1.49	.28	.047	.21	2.63	35.8	122.0	Green, with flowerheads.
CYNODON DACTYLON.											
March, 1933.....	.24	12.9	.67	1.57	.45	.024	.48	—	26.2	50.0	Green, with flowerheads.
May, 1933.....	.15	9.0	.67	.60	.43	.017	.19	2.96	29.3	60.0	Mixed, mainly green, short.
November, 1933.....	.31	14.4	.59	1.87	.38	.081	.32	3.91	29.1	120.0	Green, short.
January, 1934.....	.18	9.4	.36	1.36	.35	.084	.24	3.11	31.4	400.0	Green, with flowerheads.
AMPHILOPHIS INSCUPTA.											
March, 1933.....	.24	9.3	.64	2.13	.46	.019	.83	—	32.0	330.0	Green, with flowerheads.
May, 1933.....	.18	8.4	.80	1.47	.57	.037	.82	4.50	28.6	145.0	Mixed, mainly green, seeds falling out.
November, 1933.....	.32	13.7	.86	1.93	.74	.036	.68	4.74	32.4	120.0	Green, short.
January, 1934.....	.22	7.2	.39	1.77	.38	.041	.22	3.23	40.6	500.0	Green, with flowerheads.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE B. (continued).

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
March, 1933.....	.30	13.0	.42	3.62	.91	.084	1.19	—	31.3	410.0	Green, with flowerheads.
May, 1933.....	.23	12.3	.65	1.80	1.04	.018	.97	4.87	25.9	100.0	Mixed, mainly green, short.
November, 1933.....	.35	15.2	.43	3.85	.06	.11	.64	6.78	32.4	480.0	Green, few flowerheads.
January, 1934.....	.30	10.3	.37	2.31	.81	.030	.56	4.39	35.2	880.0	Green, with flowerheads.
					PENNETUM CILIARE.						
March, 1933.....	.49	15.9	.78	3.11	.83	.91	1.20	—	21.3	75.0	Green, short.
May, 1933.....	.42	13.0	.74	2.44	.78	.65	.75	5.55	21.3	70.0	Mixed, short. ^a
November, 1933.....	.45	20.6	1.10	2.81	1.26	1.67	.80	7.96	23.6	76.0	Green, short.
January, 1934.....	.23	7.3	.51	2.22	.35	.59	.79	4.78	35.2	430.0	Green, with flowerheads.
					UROCHLOA PULLULANS.						
March, 1933.....	.33	13.7	.81	3.52	.89	Trace	1.02	—	27.7	60.0	Green, with flowerheads.
May, 1933.....	.39	15.9	.72	3.08	.81	.045	.47	5.12	32.8	50.0	Practically no growth.
November, 1933.....	.16	9.7	.31	1.82	.57	.028	.56	3.46	36.3	328.0	Green, short.
January, 1934.....											Green, with flowerheads.
					SETARIA GERRARDII.						
March, 1933.....	.37	17.2	.85	2.70	1.26	.88	1.00	—	23.3	140.0	Green, with flowerheads.
May, 1933.....	.26	15.1	1.08	1.32	1.53	.82	.77	5.63	23.0	60.0	Mixed, mainly green, short.
November, 1933.....	.30	23.9	1.11	2.49	1.12	1.35	.56	7.43	23.1	140.0	Green, short.
January, 1934.....	.15	8.8	.51	1.43	.62	1.26	.64	4.34	36.5	460.0	Green, with flowerheads.
					PANICUM MAXIMUM.						
March, 1933.....	.29	11.4	.84	2.28	.74	.050	.71	—	26.8	172.0	Green, with flowerheads.
May, 1933.....	.24	8.9	.85	1.40	.67	.013	.55	4.14	23.6	85.0	Mixed, mainly green, short.
November, 1933.....	.27	12.1	.75	2.14	.59	.043	.22	4.29	33.3	246.0	Green, few flowerheads.
January, 1934.....	.18	5.4	.46	1.37	.37	.036	.08	2.30	39.5	450.0	Green, with flowerheads.
					ERAGROSTIS SUPREBA.						

TABLE C.
Three-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of outfs.
April, 1933.....	.21	8.7	.67	1.88	.48	.015	.61	—	28.0	250.0	Mixed, mainly green, few flowerheads.
January, 1934.....	.09	3.7	.26	1.00	.20	.013	.14	1.64	50.8	1720.0	Green, with flowerheads.
April, 1933.....	.19	7.6	.70	1.17	.40	Nil	.40	—	29.6	255.0	Mixed, mainly green, few flowerheads.
January, 1934.....	.11	8.3	.46	.89	.34	.024	.15	2.26	38.8	1270.0	Green, with flowerheads.
April, 1933.....	.29	9.9	.61	1.94	.41	.018	.51	—	24.3	110.0	Mixed, mainly green, few flowerheads.
January, 1934.....	.15	5.8	.34	1.08	.33	.037	.19	2.00	40.0	510.0	Green, with flowerheads.
April, 1933.....	.18	11.1	.73	1.15	.46	Trace	.40	—	26.2	130.0	Green, short.
January, 1934.....	.13	7.0	.34	1.11	.36	.057	.19	2.62	35.5	650.0	Green, with seeds.
April, 1933.....	.21	9.1	.70	1.68	.48	.019	.62	—	27.7	250.0	Mixed, mainly green, few flowerheads.
January, 1934.....	.18	6.0	.39	1.56	.34	.035	.21	2.83	40.6	920.0	Green, with flowerheads.
April, 1933.....	.21	9.7	.56	2.10	.83	.029	.85	—	31.0	395.0	Mixed, mainly green, seeds falling out.
January, 1934.....	.18	8.5	.35	1.45	.76	.025	.41	3.49	39.4	1,360.0	Green, seeds falling out.
April, 1933.....	—	—	—	—	—	—	—	—	—	—	Mixed, seeds falling out.
January, 1934.....	.16	5.9	.54	1.84	.47	.47	.73	3.87	36.5	1,780.0	Green, seeds falling out.
April, 1933.....	—	—	—	—	—	—	—	—	—	—	Mixed, mainly green, seeds falling out.
January, 1934.....	.15	7.0	.37	1.70	.55	.025	.48	3.32	41.7	434.0	Green, with flowerheads.
April, 1933.....	—	—	—	—	—	—	—	—	—	—	Mixed, mainly green, seeds falling out.
January, 1934.....	.11	5.4	.42	1.10	.55	.80	.62	3.44	37.7	1240.0	Green, seeds falling out.
April, 1933.....	.21	8.7	.67	1.50	.48	.035	.44	—	25.0	135.0	Mixed, mainly green, seeds falling out.
January, 1934.....	.15	4.3	.42	1.25	.31	.016	.09	2.69	43.5	830.0	Green, seeds falling out.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE 1).
Four-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
May, 1933.....	.20	8.3	.73	1.60	.19	.017	.54	3.55	31.3	150.0	Mixed, with flowerheads.
January, 1934.....	.07	3.4	.22	1.45	.18	.013	.18	2.12	43.6	1430.0	Green, with flowerheads.
May, 1933.....	.11	5.2	.72	.72	.85	.010	.22	2.41	29.1	220.0	Mixed, few flowerheads.
January, 1934.....	.095	4.8	.46	.75	.86	.022	.24	1.74	40.8	1090.0	Green, with flowerheads.
May, 1933.....	.26	11.4	.54	1.63	.38	.020	.44	3.51	27.1	130.0	Mixed, few flowerheads.
January, 1934.....	.16	5.6	.38	1.19	.24	.017	.26	2.11	41.4	500.0	Green, with flowerheads.
May, 1933.....	.15	8.4	.54	.70	.39	.017	.33	2.60	28.7	140.0	Mixed, mainly green, few flowerheads.
January, 1934.....	.13	6.5	.39	1.08	.36	.067	.16	2.95	33.5	1000.0	Green, with seeds.
May, 1933.....	.19	8.4	.75	1.52	.52	.016	.67	4.00	29.0	165.9	Mixed, seeds falling out.
January, 1934.....	.20	5.4	.47	1.51	.32	.026	.25	2.89	41.5	820.0	Green, with flowerheads.
May, 1933.....	.16	8.3	.66	1.50	.79	.018	.64	3.72	31.0	320.0	Mixed, mainly green, seeds falling out.
January, 1934.....	.19	7.1	.35	1.56	.71	.039	.37	3.68	35.3	1210.0	Green, seeds falling out.
May, 1933.....	.42	14.6	.98	3.21	.84	.26	.79	6.59	19.4	145.0	Mixed, short, seeds falling out.
January, 1934.....	.17	7.0	.52	2.65	.48	.32	.89	4.72	35.2	1100.0	Green, seeds falling out.
May, 1933.....	.18	8.9	1.18	2.28	.94	.016	.61	5.52	25.5	50.0	Mixed, mainly brown, seeds falling out.
January, 1934.....	.17	7.8	.48	1.94	.58	.019	.44	3.83	38.7	450.0	Green, with flowerheads.
May, 1933.....	.18	12.5	1.02	1.21	1.23	.75	.64	4.97	24.4	105.0	Mixed, seeds falling out.
January, 1934.....	.10	6.6	.49	1.24	.60	.85	.57	3.51	37.2	810.0	Green, seeds falling out.
May, 1933.....	.20	9.0	.79	1.36	.53	.008	.40	4.14	28.5	150.0	Mixed, short, seeds falling out.
January, 1934.....	.11	4.0	.35	1.08	.26	.019	.08	2.26	46.3	800.0	Green, seeds falling out.

TABLE E.
Six-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	NH ₄ O.	(Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
July, 1933.....	.17	8.4	.86	.83	.60	.015	.37	3.24	25.4	58.0	Brown, short.
January, 1934.....	.15	8.4	.35	1.30	.29	.022	.09	2.22	43.8	590.0	Green, with flowerheads.
July, 1933.....	.10	5.0	.74	.70	.45	.012	.27	2.23	31.1	85.0	Brown, short.
January, 1934.....	.11	5.0	.49	.85	.35	.026	.14	2.01	38.4	910.0	Green, with flowerheads.
July, 1933.....	.18	5.5	.40	1.04	.27	0.10	.27	1.94	31.3	335.0	Brown, seeds falling out.
January, 1934.....	.14	5.3	.23	1.07	.28	0.16	.27	1.92	40.4	1030.0	Green, with flowerheads.
July, 1933.....	.12	6.7	.70	.56	.36	.015	.16	3.05	29.2	70.0	Brown, short.
January, 1934.....	.12	6.1	.37	1.15	.28	.038	.13	2.73	35.6	1200.0	Green, with seeds.
July, 1933.....	.18	8.0	.82	1.08	.50	.015	.57	3.44	31.5	85.0	Brown, short.
January, 1934.....	.15	4.5	.46	1.35	.35	.026	.34	2.60	45.5	460.0	Green, with flowerheads.
July, 1933.....	.14	7.7	.80	1.32	.70	.025	.47	3.81	29.9	120.0	Brown, short, few seeds.
January, 1934.....	.20	6.8	.30	1.35	.70	.042	.42	3.47	37.6	970.0	Green, seeds falling out.
July, 1933.....	.37	11.9	.96	1.46	.78	.19	.60	5.08	23.6	100.0	Brown, short, few seeds.
January, 1934.....	.19	8.1	.44	2.96	.51	.42	1.04	5.31	35.4	1280.0	Green, seeds falling out.
July, 1933.....	.18	9.0	1.32	1.32	.91	.020	.32	4.33	27.6	40.0	Brown, short, few seeds.
January, 1934.....	.19	7.8	.53	1.36	.53	.020	.33	2.97	41.8	130.0	Green, with flowerheads.
July, 1933.....	.18	11.3	.95	1.20	.98	.54	.71	4.38	28.6	107.0	Brown, short, few seeds.
January, 1934.....	.11	7.5	.46	1.33	.59	.63	.68	3.54	35.5	710.0	Green, seeds falling out.
July, 1933.....	.16	7.3	.77	1.09	.50	.011	.36	3.33	29.6	110.0	Brown, short, seeds fallen out.
January, 1934.....	.11	4.7	.36	1.15	.29	.022	.09	2.41	44.0	800.0	Green, seeds falling out.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE I.
Eight-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
May, 1933.....	.10	4.1	.36	1.10	.27	.015	.27	2.13	33.6	895.0	Mixed, mainly brown, seeds falling out.
January, 1934.....	.13	5.1	.24	1.47	.24	.024	.15	2.18	48.0	1680.0	Green, with flowerheads.
May, 1933.....	.11	3.2	.59	.78	.28	.009	.24	2.26	31.0	805.0	Mixed, mainly brown, seeds falling out.
January, 1934.....	.12	3.9	.48	.89	.26	.035	.09	1.75	41.0	2070.0	Green, with flowerheads.
May, 1933.....	.11	4.3	.39	.63	.23	.013	.18	2.04	34.3	870.0	Mixed, mainly brown, seeds falling out.
January, 1934.....	.15	4.4	.23	.99	.26	.015	.16	1.74	46.9	1280.0	Green, with flowerheads.
May, 1933.....	.13	6.2	.59	.66	.39	.018	.21	2.67	30.7	535.0	Mixed, mainly brown, seeds falling out.
January, 1934.....	.14	6.1	.34	1.17	.29	.049	.16	2.64	39.7	1420.0	Green, with seeds.
May, 1933.....	.13	4.9	.54	.89	.36	.019	.36	3.12	33.2	730.0	Mixed, mainly brown, seeds fallen out.
January, 1934.....	.17	6.3	.48	1.12	.39	.027	.34	2.75	44.0	880.0	Green, seeds falling out.
May, 1933.....	.19	5.5	.43	1.50	.49	.017	.39	3.00	29.2	985.0	Mixed, seeds falling out.
January, 1934.....	.26	6.2	.27	1.70	.66	.031	.50	3.61	39.0	1750.0	Green, seeds falling out.
May, 1933.....	.25	7.9	.84	1.74	.60	.16	.57	4.24	27.5	845.0	Mixed, mainly brown, seeds falling out.
January, 1934.....	.28	6.8	.56	2.47	.48	.26	.84	4.50	35.2	1350.0	Green, seeds falling out.
May, 1933.....	.11	6.0	.94	.87	.55	.012	.22	3.31	32.1	305.0	Brown, seeds falling out.
January, 1934.....	.21	9.4	.45	1.68	.53	.037	.36	3.28	40.9	104.0	Green, seeds falling out.
May, 1933.....	.16	8.2	.85	1.60	.95	.22	.52	4.73	28.1	845.0	Mixed, mainly brown, seeds falling out.
January, 1934.....	.15	7.5	.51	1.48	.90	.20	.74	3.91	38.1	1400.0	Green, seeds falling out.
May, 1933.....	.097	4.4	.55	.75	.32	.010	.15	2.40	32.2	635.0	Mixed, mainly brown, seeds fallen out.
January, 1934.....	.12	4.5	.41	1.01	.20	.026	.09	2.27	45.8	610.0	Green, seeds falling out.

TABLE G.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
CHRYSOPOGON MONTANA.											
March, 1933.....	.50	15.3	.57	2.10	.50	.050	.80	—	28.2	35.0	Green, short.
April, 1933.....	.46	14.5	.54	2.30	.47	.026	.69	—	28.1	50.0	Green, short.
May, 1933.....	.45	16.0	.52	2.03	.54	.034	.50	3.55	30.9	25.0	Green, short.
August, 1933.....	.37	13.4	.58	1.68	.55	.031	.44	3.37	27.0	25.0	Green, short.
September, 1933.....	.40	14.4	.62	1.80	.56	.036	.44	3.56	27.8	23.0	Green, short.
October, 1933.....	.29	13.7	.67	1.41	.49	.070	.45	3.46	—	65.0	Green, short.
November, 1933.....	.37	14.4	.60	2.13	.47	.040	.42	3.81	31.5	100.0	Green, with flowerheads.
December, 1933.....	.37	14.4	.54	2.35	.49	.044	.47	4.07	35.5	100.0	Green, short.
January, 1934.....	.36	11.9	.60	1.91	.47	.043	.44	3.84	32.5	72.0	Green, few flowerheads.
February, 1934.....	.41	14.0	.51	2.03	.36	.030	.42	4.20	30.9	25.0	Green, short.
March, 1934.....	.42	13.7	.62	1.87	.42	.028	—	3.86	32.9	38.0	Green, few flowerheads.
ERAGROSTIS BRIZOIDES.											
March, 1933.....	.31	12.7	.54	1.88	.39	.028	.60	—	30.2	145.0	Green, few flowerheads.
April, 1933.....	.28	11.0	.51	1.71	.36	.027	.59	—	28.2	95.0	Green, few flowerheads.
May, 1933.....	—	10.9	.46	1.20	.31	.041	.33	2.78	28.2	20.0	Green, short.
November, 1933.....	.25	11.3	.50	1.64	.38	.041	.33	2.95	38.6	120.0	Green, with flowerheads.
December, 1933.....	.30	15.9	.56	1.61	.37	.034	.30	3.07	32.7	25.0	Green, short.
January, 1934.....	.23	11.2	.48	1.67	.29	.055	.25	2.88	34.4	78.0	Green, with flowerheads.
February, 1934.....	.31	12.5	.57	1.55	.37	.030	.25	3.14	31.8	85.0	Green, few flowerheads.
March, 1934.....	.25	10.5	.33	1.32	.32	Trace	—	2.68	33.5	26.0	Green, short, few flowerheads.
ANTHEPORA PUBESCENS.											
March, 1933.....	.39	15.4	.75	2.20	1.13	.021	1.15	—	31.8	155.0	Green, short.
April, 1933.....	.37	11.0	.65	1.82	.99	.019	1.05	—	34.5	195.0	Green, with flowerheads.
October, 1933.....	.34	13.6	.64	1.71	.91	.037	.78	5.11	32.0	63.0	Green, few flowerheads.
November, 1933.....	.36	12.8	.55	2.61	1.31	.055	.76	5.60	34.4	240.0	—
December, 1933.....	.30	11.4	.53	2.28	1.08	.050	.73	4.64	36.7	190.0	Green, few flowerheads.
January, 1934.....	.28	11.5	.37	2.46	.90	.061	.69	4.81	35.0	340.0	Green, with flowerheads.
February, 1934.....	.39	11.8	.61	2.12	.86	.045	.66	5.88	32.9	75.0	Green, short.
March, 1934.....	.37	8.7	.60	2.48	.80	.016	—	5.21	34.0	103.0	Green, short, few flowerheads.
ERAGROSTIS SP.											
March, 1933.....	.43	14.2	.51	2.53	.37	Trace	1.01	—	31.6	150.0	Green, with flowerheads.
April, 1933.....	.41	11.3	.47	2.03	.31	Trace	.74	—	31.1	195.0	Green, with flowerheads.
August, 1933.....	.41	16.0	.70	1.79	.49	.036	.80	3.40	25.4	82.0	Green, short.
September, 1933.....	.39	14.6	.68	1.62	.52	.037	.57	8.65	28.7	100.0	Green, short.
October, 1933.....	.33	13.4	.66	1.84	.37	.034	.51	8.50	29.4	73.0	Green, few flowerheads.
November, 1933.....	.27	12.4	.98	1.77	.30	.039	.33	8.59	37.0	580.0	Green, with flowerheads.
December, 1933.....	.32	14.1	.90	1.74	.39	.036	.32	8.76	32.8	428.0	Green, few flowerheads.
January, 1934.....	.21	9.8	.27	1.73	.32	.036	.45	2.76	40.0	380.0	Green, with flowerheads.
February, 1934.....	.26	11.2	.45	1.74	.32	.034	.45	3.53	40.3	258.0	Green, with flowerheads.
March, 1934.....	.36	12.6	.51	1.67	.32	Trace	—	3.35	34.0	194.0	Green, with flowerheads.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE G. (continued).

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
PASPALUM DILATATUM.											
March, 1933.....	.46	14.0	.38	3.20	.49	.067	.69	—	33.4	295.0	Green, with flowerheads.
April, 1933.....	.44	14.0	.46	3.15	.52	.061	.69	—	30.5	250.0	Green, few flowerheads.
May, 1933.....	.44	14.5	.51	2.70	.50	.065	.73	5.09	25.0	85.0	Green, short.
August, 1933.....	.42	15.9	.62	2.40	.60	.059	.55	4.72	24.0	60.0	Green, short.
September, 1933.....	.48	16.7	.60	3.30	.63	.092	.74	6.09	25.7	130.0	Green, short.
October, 1933.....	.36	12.7	.42	2.85	.51	.055	.63	5.46	28.3	130.0	Green, short, flowerheads.
November, 1933.....	.26	10.6	.28	3.08	.38	.10	.40	4.76	38.1	460.0	Green, with flowerheads.
December, 1933.....	.34	10.7	.25	2.88	.34	.092	.44	4.85	35.0	400.0	Green, with flowerheads.
January, 1934.....	.22	9.4	.24	2.70	.39	.091	.49	4.42	37.5	570.0	Green, with flowerheads.
February, 1934.....	.33	10.3	.29	2.75	.40	.056	.43	4.90	39.0	400.0	Green, with flowerheads.
March, 1934.....	.34	11.8	.42	2.78	.43	.046	.43	5.32	32.3	280.0	Green, with flowerheads.
FRAGROSIS PLANA.											
March, 1933.....	.39	12.5	.47	1.88	.22	.027	.72	—	36.1	195.0	Green, with flowerheads.
April, 1933.....	.34	12.3	.48	1.52	.21	.052	.52	—	33.7	105.0	Green, few flowerheads.
October, 1933.....	.35	12.0	.45	1.27	.24	.15	.44	3.25	34.8	43.0	Green, short, flowerheads.
November, 1933.....	.22	11.0	.47	1.70	.24	.10	.28	3.12	36.9	515.0	Green, few flowerheads.
December, 1933.....	.34	10.7	.36	1.87	.22	.088	.41	3.13	38.5	180.0	Green, with flowerheads.
January, 1934.....	.17	8.9	.25	1.61	.19	.082	.37	2.91	40.5	340.0	Green, with flowerheads.
February, 1934.....	.26	10.5	.36	1.66	.19	.055	.49	3.26	39.4	135.0	Green, with flowerheads.
March, 1934.....	.30	11.4	.39	1.36	.18	.028	—	2.35	41.3	40.0	Green, short, few flowerheads.
CITRORIS GAYANA.											
March, 1933.....	.47	15.7	.66	2.96	.40	1.20	1.62	—	29.8	190.0	Green, with flowerheads.
April, 1933.....	.40	14.5	.77	2.22	.37	1.26	1.72	—	28.4	210.0	Green, few flowerheads.
May, 1933.....	.41	16.1	.82	1.67	.44	1.20	1.62	6.23	24.8	25.0	Green, short.
November, 1933.....	.33	16.5	.68	2.65	.36	1.62	.85	6.90	30.2	130.0	Green, short.
December, 1933.....	.34	16.1	.76	2.10	.45	1.25	.86	5.94	26.8	80.0	Green, short, flowerheads.
January, 1934.....	.20	10.4	.40	1.49	.25	.98	1.08	4.76	31.3	190.0	Green, few flowerheads.
February, 1934.....	.27	11.8	.70	1.54	.32	.95	1.09	5.27	26.1	87.0	Green, few flowerheads.
March, 1934.....	.38	12.5	.80	1.69	.32	.89	—	5.39	26.0	100.0	Green, with flowerheads.
ALLOTROPIS SEMIALATA.											
March, 1933.....	.63	14.5	.25	2.80	.33	Trace	.62	—	38.4	95.0	Green, with flowerheads.
April, 1933.....	.58	15.8	.31	2.46	.36	Trace	.57	—	37.7	50.0	Green, with flowerheads.
September, 1933.....	.68	15.7	.30	2.88	.42	.043	.63	4.53	—	10.0	Green, short.
October, 1933.....	.47	13.7	.86	2.37	.42	.081	.46	3.37	38.4	15.0	Green.
November, 1933.....	.39	17.1	.86	2.48	.42	.050	.35	3.83	37.6	75.0	Green, few flowerheads.
December, 1933.....	.44	16.2	.27	2.68	.37	.069	.41	4.12	37.8	58.0	Green, short.
January, 1934.....	.44	17.2	.29	2.48	.37	.043	.41	3.96	40.7	70.0	Green, few flowerheads.
February, 1933.....	.44	15.0	.25	2.73	.36	.082	.43	4.24	40.3	92.0	Green, short.
March, 1934.....	.50	15.3	.29	2.75	.37	.082	.43	3.96	40.8	55.0	Green, short, few flowerheads.

TABLE G. (continued).

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
March, 1933.	.46	14.3	.45	2.48	.36	-.084	.50	—	29.5	190.0	Green, short.
April, 1933.	.41	13.0	.51	2.48	.39	-.039	.50	—	26.7	135.0	Green, short.
May, 1933.	.44	14.4	.58	2.21	.43	-.038	.39	3.96	25.7	45.0	Green, short.
August, 1933.	.42	13.5	.73	1.94	.51	-.037	.45	4.13	21.7	32.0	Green, short.
September, 1933.	.40	12.0	.58	1.93	.47	-.031	.47	3.85	—	78.0	Green, with flowerheads.
October, 1933.	.27	11.4	.66	1.47	.49	-.069	.46	3.77	26.7	43.0	Green, few flowerheads.
November, 1933.	.32	13.9	.54	2.10	.38	-.059	.39	3.08	31.6	180.0	Green, with flowerheads.
December, 1933.	.30	12.2	.48	2.15	.37	-.050	.37	3.47	30.9	150.0	Green, short.
January, 1934.	.22	10.9	.53	1.78	.34	-.035	.42	3.16	32.4	170.0	Green, few flowerheads.
February, 1934.	.35	12.0	.50	2.22	.44	-.028	.40	3.96	29.9	160.0	—
March, 1934.	.35	13.2	.47	1.92	.48	-.020	—	3.50	28.4	118.0	Green, short.
					ISCHAEMUM GLAUCOSTACHYUM.						
March, 1933.	.28	9.5	.59	1.31	.42	-.016	.46	—	32.6	215.0	Green, with flowerheads.
April, 1933.	.27	10.0	.68	1.29	.47	-.014	.52	—	30.5	100.0	Green, short.
May, 1933.	—	—	—	—	—	—	—	—	—	—	Practically no growth.
November, 1933.	.21	8.8	.56	1.83	.35	-.041	.85	3.06	35.0	127.0	Green, with flowerheads.
December, 1933.	.25	10.3	.57	1.51	.35	-.038	.82	2.87	37.0	80.0	Green, few flowerheads.
January, 1934.	.17	8.0	.47	1.51	.35	-.047	.21	2.99	37.3	140.0	Green, with flowerheads.
February, 1934.	.20	7.4	.47	1.11	.38	-.012	.19	2.54	35.6	315.0	Green, with flowerheads.
March, 1934.	.26	9.4	.55	1.36	.38	-.011	—	3.18	34.7	109.0	Green, short, few flowerheads.
					POGONATHERIA FALCATA.						
March, 1933.	.45	15.9	.58	1.29	.49	-.084	.89	—	30.9	45.0	Green, with flowerheads.
April, 1933.	.34	13.6	.54	1.35	.41	-.023	.37	—	29.8	55.0	Green, few flowerheads.
May, 1933.	.31	12.1	.52	1.96	.37	-.020	.32	2.63	32.8	25.0	Green, short.
November, 1933.	.29	14.7	.61	1.79	.38	-.075	.24	3.46	32.8	46.0	Green, short.
December, 1933.	.30	13.9	.34	1.56	.35	-.050	.19	2.70	34.3	23.0	Green, short.
January, 1934.	.25	11.9	.39	1.67	.35	-.072	—	2.80	35.7	100.0	Green, few flowerheads.
February, 1934.	.31	12.5	.45	1.38	.32	-.026	—	2.93	35.0	50.0	Practically no growth.
March, 1934.	—	—	—	—	—	—	—	—	—	—	—

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE H.
Two-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
April, 1933.....	.16	6.4	.65	.92	.42	-.012	.38	—	34.4	195.0	Mixed, mainly green, few flowerheads.
December, 1933.....	.17	5.0	.50	1.30	.37	-.032	.34	2.57	42.1	263.0	Green, with flowerheads.
February, 1934.....	.17	6.0	.39	.85	.33	-.014	.46	2.14	36.9	252.0	Green, with flowerheads.
April, 1933.....	.27	10.2	.55	1.25	.38	.025	.45	—	31.7	70.0	Green, with flowerheads.
December, 1933.....	.27	11.0	.38	1.67	.33	-.054	.24	2.88	26.1	308.0	Green, with flowerheads.
February, 1934.....	.19	6.9	.29	1.09	.22	-.029	.15	2.09	46.5	490.0	Green, with flowerheads.
April, 1933.....	.36	12.9	.60	1.94	.50	.029	.69	—	27.9	175.0	Green, few flowerheads.
June, 1933.....	.33	13.1	.68	2.10	.74	-.034	.48	4.41	27.5	45.0	Mixed, short.
August, 1933.....	.36	12.9	.56	1.80	.54	-.035	.37	3.45	27.6	35.0	Green, short.
October, 1933.....	.23	11.4	.86	1.28	.66	-.021	.29	3.65	25.6	80.0	Green, short.
December, 1933.....	.28	9.4	.48	1.60	.57	-.033	.44	3.95	33.7	670.0	Green, with flowerheads.
February, 1934.....	.24	9.7	.34	1.52	.29	-.018	.50	3.37	32.1	250.0	Green, with flowerheads.
April, 1933.....	.19	8.8	.53	1.39	.25	.021	.52	—	27.7	210.0	Green, with flowerheads.
December, 1933.....	.18	6.3	.33	1.23	.24	-.026	.22	2.13	30.2	408.0	Green, with flowerheads.
February, 1934.....	.16	8.0	.31	1.20	.24	-.023	.20	2.08	40.0	605.0	Green, with flowerheads.
April, 1933.....	.21	9.3	.87	1.42	1.29	.014	1.04	—	33.4	400.0	Green, with flowerheads.
October, 1933.....	.25	11.8	.75	1.46	.66	-.037	.73	5.03	27.7	100.0	Green, few flowerheads.
December, 1933.....	.20	7.3	.46	1.50	1.03	-.082	.69	2.69	38.5	930.0	Green, seeds falling out.
February, 1934.....	.24	10.0	.51	1.68	1.09	-.025	.61	4.23	42.6	890.0	Green, with flowerheads.
April, 1933.....	.28	10.0	.52	1.78	.30	Trace	.67	—	30.0	260.0	Mixed, mainly green, seeds falling out.
August, 1933.....	.38	6.2	.64	1.63	.36	-.025	.34	3.13	26.1	30.0	Green, short.
October, 1933.....	.25	10.8	.66	1.47	.31	-.019	.58	3.42	28.9	50.0	Green, few flowerheads.
December, 1933.....	.16	8.1	.32	1.39	.27	-.032	.38	2.68	44.8	1040.0	Green, with flowerheads.
February, 1934.....	.20	6.7	.39	1.32	.22	-.015	.32	2.56	41.3	1100.0	Green, with flowerheads.

TABLE H. (continued).

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
April, 1933.....	.29	11.1	.45	2.77	.51	.051	.64	—	28.5	520.0	Green, seeds falling out.
June, 1933.....	.32	10.4	.68	2.42	.65	.054	.80	5.32	23.8	85.0	Green, short.
October, 1933.....	.27	10.5	.56	2.32	.55	.049	.45	4.74	28.6	105.0	Green, short.
December, 1933.....	.22	8.1	.26	2.58	.16	.081	.40	3.96	43.8	760.0	Green, with flowerheads.
February, 1934.....	.14	6.8	.21	2.55	.37	.041	.60	4.38	39.1	1000.0	Green, with flowerheads.
ERAGROSTIS FLAVA.											
April, 1933.....	.24	9.6	.50	1.50	.19	.035	.63	—	29.8	185.0	Mixed, mainly green, seeds falling out.
December, 1933.....	.19	8.6	.38	1.82	.19	.081	.35	3.17	39.7	1000.0	Green, with flowerheads.
February, 1934.....	.19	6.0	.34	1.48	.13	.046	.29	2.63	43.0	850.0	Green, with flowerheads.
CHLORIS GAYANA.											
April, 1933.....	.29	10.0	.73	1.44	.37	1.32	1.71	—	33.0	685.0	Green, with flowerheads.
December, 1933.....	.24	16.9	.61	1.96	.32	1.17	1.08	5.65	33.4	740.0	Green, with flowerheads.
February, 1934.....	.16	8.3	.49	1.22	.29	1.03	.99	4.45	37.5	830.0	Green, with flowerheads.
ALLOTROPIS SEMALATA.											
April, 1933.....	.56	13.6	.42	2.27	.42	Trace	.60	—	36.8	50.0	Green, with flowerheads.
October, 1933.....	.48	13.9	.45	2.59	.27	.088	.72	4.69	36.1	18.0	Green, short.
December, 1933.....	.27	10.2	.28	2.52	.20	.073	.45	3.59	40.8	220.0	Green, with flowerheads.
February, 1934.....	.37	10.8	.25	2.48	.21	.039	.41	3.70	43.6	280.0	Green, with flowerheads.
ELYONURUS ARGENTUS.											
April, 1933.....	.31	10.9	.67	1.86	.43	.027	.56	—	27.4	260.0	Green, with flowerheads.
June, 1933.....	.29	10.2	.78	1.81	.54	.018	.50	3.84	22.4	55.0	Green, short.
August, 1933.....	.43	13.0	.70	2.06	.49	.037	.39	3.82	20.7	22.0	Green, short.
October, 1933.....	.21	8.9	.56	1.81	.41	.023	.43	4.06	24.2	75.0	Green, few flowerheads.
December, 1933.....	.21	7.4	.40	1.80	.30	.041	.32	3.03	33.5	650.0	Green, with seeds.
February, 1934.....	.19	8.8	.49	1.54	.33	.036	.30	3.31	31.5	500.0	—

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE I.
Three-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
ISCHAEMUM GLAUCOSTACHYUM.											
May, 1933.....	11	5.4	.83	.66	.41	.013	.34	2.84	33.2	170.0	Mixed, with seeds.
November, 1933.....	17	9.5	.64	1.66	.36	.019	.37	2.98	36.8	123.0	Green, with flowerheads.
February, 1934.....	19	8.5	.37	.82	.23	.019	.46	2.01	38.8	369.0	Green, with seeds.
POGONARTHRIA FALGATA.											
May, 1933.....	20	9.3	.56	.85	.31	.011	.29	2.21	31.9	305.0	Mixed, mainly green, seeds falling out.
November, 1933.....	24	14.7	.67	1.69	.38	.052	.25	3.13	31.0	121.0	Green, short.
February, 1934.....	41	5.4	.20	1.00	.21	.017	.17	1.71	39.2	520.0	Green, with flowerheads.
CHRYSOPOGON MONSTANA.											
May, 1933.....	25	11.6	.87	1.18	.85	.020	.19	3.53	27.9	115.0	Green, few seeds.
August, 1933.....	36	12.5	.56	2.00	.62	.016	.36	3.89	27.3	33.0	Green, short.
November, 1933.....	28	11.8	.72	2.08	.52	.019	.51	4.14	31.2	233.0	Green, with flowerheads.
February, 1934.....	21	7.4	.50	1.12	.49	.018	.38	2.76	34.3	520.0	Green, with flowerheads.
ERAGROSTIS BRIZOIDES.											
May, 1933.....	13	7.2	.52	.95	.36	.029	.21	2.43	26.4	100.0	Mixed, few stalks, seeds falling out.
November, 1933.....	27	8.5	.43	1.63	.29	.017	.29	2.87	7.7	114.0	Green, with flowerheads.
February, 1934.....	11	7.4	.34	1.12	.22	.032	.20	2.22	36.4	360.0	Green, with flowerheads.
ANTHEPHERA PUBESCENS.											
May, 1933.....	12	6.8	1.02	1.11	1.39	.024	.77	4.05	29.0	150.0	Mixed, seeds falling out.
November, 1933.....	31	11.4	.57	2.15	1.24	.048	.63	4.93	37.0	330.0	Green, with flowerheads.
February, 1934.....	20	7.2	.45	1.36	.92	.010	.59	3.69	38.1	400.0	Green, with flowerheads.
ERAGROSTIS SP.											
May, 1933.....	26	8.1	.49	1.14	.29	.022	.55	3.81	30.0	250.0	Mixed, seeds falling out.
November, 1933.....	28	10.4	.30	2.07	.22	.014	.26	3.15	38.6	600.0	Green, with flowerheads.
February, 1934.....	16	5.4	.26	1.16	.18	.018	.23	2.18	39.2	500.0	Mixed, mainly green, seeds falling out.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE J.
Four-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
June, 1933.....	.10	4.6	.80	.58	.41	.011	.24	2.75	31.0	130.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.08	4.5	.37	.57	.28	.010	.14	1.75	40.7	717.0	Mixed, mainly green, seeds falling out.
June, 1933.....	.16	7.1	.55	.53	.25	.011	.23	1.97	31.5	115.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.15	6.0	.25	.99	.21	.017	.18	1.85	42.4	1770.0	Green, with flowerheads.
June, 1933.....	.16	7.8	.97	.89	.94	.021	.36	3.34	26.6	135.0	Mixed, mainly brown, seeds falling out.
October, 1933.....	.18	10.0	.95	1.10	.82	.020	.27	3.79	36.4	70.0	Green, short.
February, 1934.....	.17	5.8	.54	.83	.47	.021	.31	2.63	36.5	1500.0	Green, seeds falling out.
June, 1933.....	.09	6.2	.58	.78	.37	.018	.38	2.43	29.2	75.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.12	6.0	.28	.98	.24	.016	.18	1.81	39.2	845.0	Green, with flowerheads.
June, 1933.....	.10	6.0	1.01	.73	1.22	.024	.54	3.77	31.1	120.0	Mixed, mainly brown, seeds falling out.
October, 1933.....	.27	12.0	.70	2.23	.79	.029	.89	5.06	29.6	40.0	Green, short, few flowerheads.
February, 1934.....	.16	5.7	.42	1.37	.82	.015	.47	3.71	41.1	1,050.0	Mixed, mainly green, seeds falling out.

TABLE J. (continued).

Date of cutting.	F ₂ O ₃ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibr.	Total yield in grams.	Description of cuts.
June, 1933.....	.16	6.7	.47	1.24	.27	-.023	.41	2.68	33.8	205.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.13	4.7	.22	1.00	.16	-.017	.15	2.08	41.4	1440.0	Mixed, mainly green, seeds falling out.
ERAGROSTIS SP.											
June, 1933.....	.19	6.1	.56	2.15	.55	-.056	.48	4.10	28.4	510.0	Mixed, seeds falling out.
February, 1934.....	.11	5.4	.26	2.15	.41	-.049	.45	4.07	39.0	1380.0	Mixed, mainly green, seeds falling out.
PASPALUM DILATATUM.											
June, 1933.....	.14	6.2	.53	1.15	.19	-.025	.02	2.68	34.2	225.0	Mixed, seeds falling out.
February, 1934.....	.09	2.6	.29	1.26	.12	-.054	.18	2.21	40.8	2260.0	Mixed, mainly green, seeds falling out.
ERAGROSTIS PLANA.											
June, 1933.....	.13	5.5	.74	.49	.34	1.10	1.22	3.98	31.4	370.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.16	4.8	.54	—	.33	.55	.61	3.89	36.5	940.0	Green, seeds falling out.
CHLORIS GAYANA.											
June, 1933.....	.19	5.9	.67	.68	.68	-.024	.55	2.74	39.5	55.0	Mixed, mainly brown, seeds falling out.
October, 1933.....	.39	13.9	.42	2.47	.35	-.030	1.12	4.48	36.3	50.0	Green.
February, 1934.....	.16	6.9	.23	1.83	.27	-.014	.57	3.01	43.7	900.0	Green, seeds valling out.
ALLOTROPIS SEMIALATA.											
June, 1933.....	.12	2.3	.84	.80	.51	-.008	.37	3.03	28.7	260.0	Mixed, seeds falling out.
October, 1933.....	.20	8.2	.85	1.69	.33	-.027	.44	3.75	23.1	70.0	Green, few flowerheads.
February, 1934.....	.11	3.9	.33	.95	.21	-.018	.12	1.60	39.2	1300.0	—
ELYONURUS ARGENTEUS.											

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE K.
Five-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
July, 1933.....	.10	4.5	.85	.57	.40	.012	.25	2.85	30.9	160.0	Mixed, mainly brown, seeds falling out.
December, 1933.....	.15	6.5	.49	1.14	.29	.038	.32	2.61	39.6	315.0	Green, with flowerheads.
July, 1933.....	.15	7.4	.70	.60	.35	.015	.28	2.07	26.2	130.0	Mixed, seeds falling out.
December, 1933.....	.19	3.4	—	1.53	.27	.005	.28	2.90	38.0	710.0	Green, with flowerheads.
July, 1933.....	.15	6.7	.94	1.00	.85	.018	.37	3.03	26.6	175.0	Mixed, mainly brown, seeds falling out.
December, 1933.....	.21	6.9	.49	1.83	.46	.034	.42	3.19	36.9	845.0	Green, with flowerheads.
July, 1933.....	.07	5.3	.62	.72	.39	.017	.27	2.54	29.5	115.0	Brown, seeds fallen out.
December, 1933.....	.14	6.9	.36	1.19	.27	.034	.19	2.19	37.4	400.0	Green, with flowerheads.
July, 1933.....	.086	4.8	1.09	.65	1.18	.023	.50	3.93	31.9	185.0	Brown, seeds fallen out.
December, 1933.....	.14	6.8	.40	1.64	1.02	.039	.53	3.46	42.2	760.0	Green, seeds falling out.
July, 1933.....	.16	6.7	.45	1.12	.29	.025	.39	2.28	32.8	285.0	Brown, seeds falling out.
December, 1933.....	.13	6.8	.34	1.45	.23	.038	.27	2.57	41.5	710.0	Green, with flowerheads.
July, 1933.....	.11	4.4	.49	1.95	.47	.039	.44	4.08	32.2	560.0	Mixed, mainly brown, seeds falling out.
December, 1933.....	.24	8.7	.25	2.54	.35	.092	.43	4.15	42.3	930.0	Green, with flowerheads.
July, 1933.....	.076	5.6	.61	.99	.20	.044	.56	2.72	37.4	162.0	Mixed, mainly brown, seeds falling out.
December, 1933.....	.14	5.7	.36	1.53	.39	.081	.34	2.68	39.1	660.0	Green, with flowerheads.
July, 1933.....	.08	4.9	.69	.62	.38	1.25	1.30	4.43	33.3	500.0	Mixed, mainly brown, seeds falling out.
December, 1933.....	.17	10.3	.43	1.91	.26	1.00	1.16	5.28	40.0	650.0	Green, with flowerheads.
July, 1933.....	.15	5.2	.72	.72	.66	.026	.46	3.03	37.5	65.0	Brown, seeds falling out.
December, 1933.....	.29	8.8	.23	2.63	.27	.049	.40	3.57	43.4	560.0	Green, with flowerheads.
July, 1933.....	.11	4.4	1.07	.67	.67	.021	.35	3.29	27.8	240.0	Mixed, mainly brown, seeds falling out.
December, 1933.....	.16	6.3	.37	1.41	.26	.035	.31	2.71	26.9	940.0	Green, with seeds.

TABLE I.
Six-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
August, 1933.....	.095	3.5	.93	.48	.38	.013	.26	2.50	37.8	120.0	Mixed, mainly brown, seeds fallen out.
February, 1934.....	.10	4.6	.46	.59	.26	.023	.16	1.68	43.5	830.0	Mixed, mainly green, seeds falling out.
August, 1933.....	.12	6.3	.64	.68	.30	.017	.21	2.11	32.2	80.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.11	5.2	.23	.93	.22	.015	.18	1.90	41.7	1185.0	Green, with flowerheads.
August, 1933.....	.14	8.6	.84	.52	.49	.013	.11	2.23	27.1	110.0	Mixed, seeds fallen out.
February, 1934.....	.13	5.8	.43	1.01	.45	.016	.28	2.37	35.7	1400.0	Green, seeds falling out.
August, 1933.....	.09	5.2	.65	.83	.38	.021	.32	2.22	28.8	70.0	Brown, seeds fallen out.
February, 1934.....	.12	5.9	.30	.96	.25	.020	.18	2.04	38.9	725.0	Green, with flowerheads.
August, 1933.....	.08	4.4	1.01	.68	1.32	.024	.48	3.54	34.8	135.0	Mixed, mainly brown, seeds fallen out.
February, 1934.....	.13	5.1	.46	1.20	8.3	.027	.45	3.48	38.0	1060.0	Mixed, mainly green, seeds falling out.
August, 1933.....	.15	6.3	.58	.98	.29	.017	.45	2.50	33.1	192.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.10	4.5	.24	.95	.29	.015	.15	2.23	40.8	1440.0	Mixed, mainly green, seeds falling out.
August, 1933.....	.12	4.3	.63	1.83	.52	.046	.43	4.00	33.7	400.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.13	5.2	.24	2.01	.36	.038	.39	3.91	39.4	920.0	Mixed, mainly green, seeds falling out.
August, 1933.....	.087	5.4	.52	1.08	.18	.018	.58	2.75	37.8	145.0	Mixed, mainly brown, seeds falling out.
February, 1934.....	.08	3.9	.27	1.23	.10	.023	.33	2.39	41.9	1730.0	Mixed, mainly green, seeds falling out.
August, 1933.....	.12	5.3	.81	.60	.38	1.13	1.49	4.61	30.5	450.0	Mixed, mainly brown, seeds fallen out.
February, 1934.....	.16	7.1	.59	1.29	.39	.45	.72	3.93	35.9	950.0	Green, seeds falling out.
August, 1933.....	.24	5.6	.71	1.04	.65	.033	.59	2.96	36.2	100.0	Mixed, mainly brown, seeds fallen out.
February, 1934.....	.17	6.6	.21	1.73	.14	.017	.32	2.74	46.6	1140.0	Green, seeds falling out.
August, 1933.....	.13	5.3	1.03	.78	.62	.021	.31	3.17	28.0	152.0	Mixed, mainly brown, seeds fallen out.
February, 1934.....	.10	5.0	.36	.96	.23	.022	.16	2.30	34.9	1000.0	—

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE M.
7-, 8-, 9-, 10-, 11-, and 12-monthly Cuttings.

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
September, 1933.....	.10	4.8	.68	.46	.28	.007	.11	2.25	33.6	120.0	Mixed, mainly brown, seeds fallen out.
October, 1933.....	.09	4.4	.68	.40	.22	.017	.08	2.14	35.5	100.0	Brown, seeds fallen out.
November, 1933.....	.12	7.3	.57	1.08	.28	.029	.13	2.40	38.4	250.0	Mixed, mainly green, with flowerheads.
December, 1933.....	.12	5.7	.59	.81	.30	.082	.17	2.29	40.0	250.0	Mixed, mainly green, with flowerheads.
January, 1934.....	.10	4.2	.38	.72	.27	.017	.09	1.75	38.5	700.0	Mixed, mainly, green seeds falling out.
February, 1934.....	.10	3.7	.45	.48	.31	.008	.06	1.80	40.6	2600.0	Mixed, mainly green, seeds falling out.
POGONANTHERIA FALCATA.											
September, 1933.....	.15	7.6	.56	.46	.29	.008	.16	1.80	33.6	148.0	Mixed, mainly brown, seeds fallen out.
October, 1933.....	.11	7.2	.38	.59	.24	.020	.20	2.05	30.4	133.0	Mixed, seeds fallen out.
November, 1933.....	.16	9.8	.57	1.53	.32	.038	.26	2.75	33.8	640.0	Mixed, mainly green, seeds falling out.
December, 1933.....	.20	7.7	.86	1.44	.25	.084	.32	2.58	40.4	800.0	Mixed, mainly green, with flowerheads.
January, 1934.....	.16	6.2	.23	1.20	.20	.080	.18	2.13	40.5	1800.0	Green, with seeds.
February, 1934.....	.17	5.9	.24	.92	.20	.016	.11	1.95	40.9	2900.0	Mixed, mainly green, seeds falling out.
CHRYSOPOGON MONTANA.											
September, 1933.....	.15	8.6	.55	.92	.44	.014	.26	2.74	30.4	240.0	Mixed (stalks blown away).
October, 1933.....	.13	8.6	.87	.75	.58	.017	.22	3.07	26.0	180.0	Mixed, mainly green, few flowerheads.
November, 1933.....	.21	8.6	.62	1.55	.38	.034	.41	3.40	32.5	650.0	Mixed, mainly green, few flowerheads.
December, 1933.....	.21	6.8	.50	1.77	.47	.040	.40	3.13	34.8	720.0	Green, with flowerheads.
January, 1934.....	.16	6.0	.39	1.16	.40	.015	.27	2.66	33.9	1700.0	Green, seeds falling out.
February, 1934.....	.17	5.7	.37	1.00	.38	.043	.32	2.40	31.0	2000.0	Mixed, mainly green, seeds falling out.
ERAGROSTIS BRIZOIDES.											
September, 1933.....	.09	5.6	.45	.32	.21	.018	.08	1.44	31.6	73.0	Brown (stalks blown away).
October, 1933.....	.06	5.1	.48	.22	.17	.027	.05	1.81	35.0	73.0	Brown (stalks blown away).
November, 1933.....	.26	10.8	.43	1.42	.25	.057	.24	3.00	36.3	146.0	Mixed, mainly green, few flowerheads.
December, 1933.....	.19	7.2	.37	1.23	.32	.035	.22	2.18	39.8	250.0	Mixed, mainly green, with flowerheads.
January, 1934.....	.14	6.2	.30	1.15	.20	.028	.16	2.08	36.6	520.0	Green, seeds falling out.
February, 1934.....	.14	6.7	.36	.97	.21	.020	.14	2.15	35.2	840.0	Green, with flowerheads.

TABLE M. (continued).

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	Cl.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
ANTHROPHORA PUBESCENS.											
September, 1933.....	.12	6.4	1.22	.78	.79	.011	.25	3.29	32.0	140.0	Mixed, mainly brown, seeds fallen out.
October, 1933.....	.09	6.1	.95	.53	.50	.021	.18	3.19	30.0	170.0	Mixed, mainly brown, seeds fallen out.
November, 1933.....	.22	8.8	.54	1.85	.97	.037	.56	4.41	36.7	620.0	Mixed, mainly green, seeds falling out.
December, 1933.....	.15	6.3	.44	1.51	.94	.045	.50	3.46	38.3	860.0	Green, seeds falling out.
January, 1934.....	.13	7.2	.35	1.48	.72	.059	.46	3.33	38.2	1360.0	Mixed, mainly green, seeds falling out.
February, 1934.....	.14	7.4	.43	1.59	.93	.030	.17	3.68	39.4	6000.0	Mixed, mainly green, seeds falling out.
ERAGROSTIS SP.											
September, 1933.....	.15	6.4	.44	.71	.25	.012	.19	1.82	31.0	185.0	Mixed, mainly brown, seeds falling out.
October, 1933.....	.11	5.3	.43	.51	.23	.015	.18	2.43	30.3	190.0	Mixed, mainly brown, seeds fallen out.
November, 1933.....	.25	9.9	.30	1.88	.23	.048	.34	2.94	40.9	1000.0	Green, with flowerheads.
December, 1933.....	.09	5.0	.36	1.10	.16	.036	.15	1.98	40.1	1260.0	Mixed, mainly green, with flowerheads.
January, 1934.....	.14	5.7	.35	1.10	.19	.018	.16	2.03	34.0	2860.0	Green, seeds falling out.
February, 1934.....	.10	4.5	.26	.94	.14	.014	.13	1.89	43.1	3200.0	Mixed, mainly green, seeds falling out.
PASPALUM DILATATUM.											
September, 1933.....	.10	4.6	.59	.99	.42	.032	.17	2.78	32.6	310.0	Mixed, mainly brown, seeds falling out.
October, 1933.....	.07	4.7	.58	.65	.32	.027	.08	2.83	35.3	507.0	Mixed, mainly brown, seeds falling out.
November, 1933.....	.22	10.7	.53	2.08	.41	.053	.26	4.58	32.7	420.0	Mixed, mainly green, few flowerheads.
December, 1933.....	.25	7.6	.36	2.59	.40	.053	.31	4.52	36.9	570.0	Green, with flowerheads.
January, 1934.....	.16	6.0	.27	2.53	.33	.060	.40	3.96	40.3	1300.0	Green, seeds falling out.
February, 1934.....	.10	4.0	.21	2.85	.28	.083	.49	4.34	43.9	2750.0	Mixed, mainly green, seeds falling out.
ERAGROSTIS PLANA.											
September, 1933.....	.12	6.0	.46	.45	.14	.008	.14	1.65	35.1	115.0	Mixed, mainly brown, seeds falling out.
October, 1933.....	.10	6.2	.37	.34	.15	.018	.08	1.61	39.4	105.0	Brown, seeds fallen out.
November, 1933.....	.19	10.0	.43	1.75	.19	.047	.26	3.05	41.3	540.0	Mixed, mainly green, few flowerheads.
December, 1933.....	.16	6.6	.36	1.65	.28	.054	.30	2.74	43.7	960.0	Mixed, mainly green, with flowerheads.
January, 1934.....	.13	4.2	.28	1.36	.10	.035	.26	2.21	43.1	2120.0	Green, with seeds.
February, 1934.....	—	—	—	—	—	—	—	—	—	2950.0	Mixed, mainly green, seeds falling out.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE M. (continued).

Date of cutting.	P ₂ O ₅ .	Crude Protein.	CaO.	K ₂ O.	MgO.	Na ₂ O.	(1.	Soluble ash.	Crude fibre.	Total yield in grams.	Description of cuts.
September, 1933.....	.11	4.5	.58	.34	.32	.78	.87	2.97	32.6	580.0	Mixed, mainly brown, seeds fallen out.
October, 1933.....	.06	4.2	.55	.25	.25	.57	.55	2.63	42.5	560.0	Brown, seeds fallen out.
November, 1933.....	.18	8.6	.59	1.48	.31	.80	.78	4.48	34.8	700.0	Mixed, mainly green, few flowerheads.
December, 1933.....	.11	5.4	.58	1.29	.27	.62	.88	4.16	39.5	580.0	Mixed, mainly green, with flowerheads.
January, 1934.....	.08	4.1	.42	1.21	.27	.58	.68	3.34	37.2	3000.0	Green, seeds falling out.
February, 1934.....	.10	4.9	.49	.92	.29	.57	.75	3.48	36.1	6700.0	Mixed, mainly green, seeds falling out.
ALLOTROPIS SEMIALATA.											
September, 1933.....	.22	6.6	.55	.65	.28	.019	.14	2.13	43.4	45.0	Mixed, seeds fallen out.
October, 1933.....	.22	8.3	.47	.99	.27	.016	.42	2.80	49.4	108.0	Mixed, mainly green.
November, 1933.....	.39	13.1	.34	2.78	.48	.063	.31	4.31	42.3	240.0	Green, few flowerheads.
December, 1933.....	.31	7.6	.20	2.22	.27	.062	.38	3.07	43.7	570.0	Green, with flowerheads.
January, 1934.....	.24	5.7	.18	2.05	.23	.026	.21	2.82	44.5	840.0	Green, with seeds.
February, 1934.....	—	8.3	.29	1.93	.27	.027	.23	3.25	46.0	860.0	Green, seeds falling out.
ELYONURUS ARGENTENS.											
September, 1933.....	.18	6.8	.69	.81	.41	.016	.14	2.49	26.2	210.0	Mixed, seeds falling out.
October, 1933.....	.18	6.1	.53	.88	.27	.016	.25	2.95	32.2	230.0	Mixed, few flowerheads.
November, 1933.....	.18	8.5	.41	1.77	.33	.053	.24	2.30	34.9	550.0	Mixed, mainly green, few flowerheads.
December, 1933.....	.23	7.3	.36	1.67	.25	.039	.23	3.20	36.7	480.0	Green, with flowerheads.
January, 1934.....	.14	6.4	.86	1.12	.26	.013	.16	2.43	36.8	520.0	Mixed, mainly green, seeds fallen out.
February, 1934.....	.13	4.9	.35	.88	.22	.019	.06	1.91	43.8	1040.0	—