

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

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### **THIRD REPORT.**

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By

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#### **INTRODUCTION AND PLAN OF WORK.**

IN the first publication (du Toit *et al.*, 1932) of the above series the plan of investigation was fully described, the objects, methods employed and technique were given in detail. The results of the first three surveys were recorded and discussed. A later publication (du Toit *et al.*, 1933) reported on the results obtained in the plot experiments which formed a sub-division of the original experimental plan. The analyses of six more surveys, i.e. until April, 1933, have now been completed and are reported on in this article.

Briefly, the surveys meant collecting samples of pasture at regular intervals from a number of areas all over the Union and analysing these for crude protein, crude fibre, soluble extract, soluble ash, phosphorus, calcium, magnesium, sodium, potassium and chlorine. Samples of soil and blood were collected simultaneously from the same area or from animals grazing in that area, the former analysed for inorganic constituents and nitrogen and the latter for phosphorus. In the first publication mentioned above the tables of results included values for both soil and pasture constituents and for blood phosphorus. The view was expressed, however, that soil analysis does not provide a very satisfactory method of studying the feeding value of pastures as obviously pasture on poor soil may yield excellent values if the samples for analysis are taken at an early stage of growth of the pasture. Hence, soil analyses, which entailed a considerable amount of labour have been omitted from further work and the number of areas from which pasture samples have been collected increased accordingly.

The diagnosis of phosphorus deficiency in pasture by determining the inorganic phosphorus content of the blood of animals grazing such pasture is simple and accurate, but the surveys described in this series of articles were intended to be a study of the feeding value of South African pastures and not merely a study of their phosphorus content. Besides, from the large number of figures for blood phosphorus it has already become evident that low phosphorus in the blood, and therefore in the pasture, is the rule rather than the exception, so that pasture analysis, which is essential for a study of the greater problem of the feeding value of the pastures and which incidentally includes the determination of phosphorus in the pasture, already covers the field of phosphorus deficiency. Blood analysis has therefore served the purpose of establishing in a remarkably short period the fact that practically all South African pastures are deficient in phosphorus at certain seasons of the year. Blood analysis for phosphorus is now being used for studying the phosphorus deficiency problem in herds or on farms where immediate information on this problem is required, and has been excluded from the greater surveys, where it would naturally involve the bleeding of many hundreds of stock over extended periods, a procedure which after several repetitions is generally met with a certain amount of opposition on the part of the farmers. Another obstacle in the way of drawing the blood and preparing it for despatch to the laboratory for analysis is that a large number of areas have to be included in the surveys in order to obtain representative figures and the staff is not available to do the blood work in such a large number of areas simultaneously. On the other hand, Government Stock Inspectors are stationed practically all over the Union, and these men collect monthly samples of pasture on certain farms in their areas as part of their official duties. The organization for obtaining the pasture samples is therefore very simple and efficient. The number of areas from which pasture samples are collected has been greatly increased recently by employing the stock inspectors for this work rather than the field veterinary officers, whose numbers are limited. However, all the surveys reported on in this paper have been collected on the old basis described in the first article with one or two minor modifications as indicated below.

Soil analyses, as already explained, have been eliminated. The samples of vegetation are no longer sorted into species on arrival and these identified, but they are freed from sand, reduced if necessary, milled and analysed. The obvious disadvantage of this procedure is that figures are obtained which are not truly representative of the pasture actually eaten but of all the pasture in a particular area.

The above disadvantage has been overcome in all the recent work, about which later particulars will appear in due course, by actually following grazing animals in the veld and collecting samples of pasture while observing the animals' method of grazing, selecting of grasses, etc. In other words, the sample collected is as nearly as possible identical with the pasture eaten by the animals which were being followed.

For the surveys reported on in this article samples of pasture were received at all stages of growth so that there was no advantage in comparing the analysis of a particular species of grass from a

certain area with the values obtained for the same species from another area. The results are in any case not comparable, for, apart from other climatic and soil influences, the difference in stage of growth of the two samples of the same species from different areas could readily account for the difference in composition. The separate analysis of individual species of vegetation was therefore omitted from the scheme. The description of the samples was continued as before and the analyses carried out as described in the last publication (1934).

The method for determining soluble ash is given by Louw (1934). The other constituents were determined according to the methods given in the earlier publications.

Briefly, then, the investigation included the collection of pasture samples simultaneously from a number of areas at three-monthly intervals and the period to be reported on this publication ranged from January, 1932, until April, 1933. The samples were described on reaching the central laboratory at Onderstepoort, dried and milled. The following determinations were then made and calculated on absolute dry basis: Soluble ash (omitted from the present series), crude protein, crude fibre, phosphorus, calcium, magnesium, potassium, sodium, chlorine and nitrogen free extractives plus ether soluble extract. The omission of one or two important determinations from the present series such as soluble ash was governed by available assistance and as large numbers of samples were arriving it was necessary to remain up to date with the work in order to keep the organization of collecting, forwarding, registering and preparing the samples for analysis active and efficient even at the sacrifice of determinations which could have been included with advantage. However, such inadvertent omissions in the earlier work have been rectified, the organization of both field and laboratory staff perfected as the officers, especially in the field, became better acquainted with the work with the result that at present an organization has developed for the collection of several hundreds of samples monthly by stock inspectors stationed in as many areas in the Union, for the despatch of these samples to Onderstepoort, where the registration, preparation for analyses and actual determinations are carried out efficiently and in such a way that the farmers and officers in the areas concerned are informed from time to time of the results of the investigation and the fruits of their labour and co-operation.

## RESULTS.

Table I gives the monthly rainfall in the areas of collection for the period November, 1931, April, 1933.

The values given in Table I, not being registered actually at the sites of the collection of the pasture samples, should be taken to be approximate and not absolute. The rainfall table will be discussed in conjunction with the values obtained on analysis of the pasture samples which are given in Table II.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE I.  
Rainfall in Inches.

Farm and District.	Nov. 1931.	Dec. 1931.	Jan. 1932.	Feb. 1932.	Mar. 1932.	April 1932.	May 1932.	June 1932.	July 1932.	Aug. 1932.	Sept. 1932.	Oct. 1932.	Nov. 1932.	Dec. 1932.	Jan. 1933.	Feb. 1933.	Mar. 1933.	April 1933.
Derby No. 56, Piet Retief.	6.33	4.69	4.50	7.09	5.69	1.01	2.85	0.84	nil	nil	1.34	2.72	3.87	7.68	2.08	—	—	—
Wildbeestfontein, Pietersburg.	2.58	3.80	3.35	1.48	3.38	2.25	0.75	nil	nil	nil	nil	0.75	2.75	2.65	8.07	—	—	—
Minosa Park, Potchefstroom.	4.52	3.64	7.35	5.46	3.28	1.03	nil	nil	nil	nil	1.08	3.01	4.09	4.20	—	—	—	—
Stainton, Xopo.	2.37	4.16	7.35	4.79	5.48	nil	3.25	1.20	0.50	nil	1.39	3.61	4.91	5.36	3.11	2.56	4.39	1.35
Bergendal, Vryheid.	1.35	2.50	2.24	6.01	4.00	0.32	3.26	nil	nil	nil	0.13	0.96	3.37	6.00	1.58	3.06	0.64	0.96
Loch Sloy, Estcourt.	—	—	4.93	6.18	3.31	2.11	2.30	0.16	nil	nil	1.65	0.83	4.65	5.19	1.57	Not	forwarded.	—
Zulu Native Training Institute, Nongoma.	2.90	2.21	1.79	2.73	3.13	4.75	4.25	0.39	nil	nil	1.06	1.72	3.18	4.97	4.01	2.55	3.65	—
Moss Side, Dundee.	2.17	2.87	3.67	4.99	5.41	0.22	2.39	0.28	nil	nil	0.96	0.93	2.79	4.99	—	—	—	—
Mariamul, Phatonee.	4.38	3.01	0.10	5.10	4.20	1.00	3.42	nil	0.12	0.03	1.14	4.80	4.04	4.85	2.05	2.37	2.74	1.03
Commissie Drift, Richmond.	3.60	5.28	4.66	4.41	4.96	0.75	1.95	0.78	0.34	0.16	1.89	3.27	3.94	5.81	2.39	2.92	4.05	1.33
Lors 45/48, Entumeni, Eshowe.	3.53	5.91	5.45	17.25	7.03	7.11	6.50	0.78	0.10	1.89	1.60	5.06	4.24	8.46	7.09	6.50	3.51	—
Voorkeur, Univof.	—	—	4.39	11.57	6.08	0.62	3.01	0.24	0.08	nil	1.73	2.94	4.91	6.01	5.86	3.77	—	—
Melbourne, Port Shepstone.	1.37	2.86	6.30	5.09	2.44	0.29	0.86	0.60	0.67	0.85	3.99	4.59	6.99	6.37	2.30	—	—	—
Rockvale, Kingwilliamstown.	2.37	4.18	2.60	5.97	2.10	nil	1.97	1.12	1.65	0.35	2.29	2.48	6.34	2.76	—	—	—	—
Koppieskraal, Mt. Currie.	2.44	3.52	2.69	6.02	3.44	0.18	1.72	1.07	1.09	0.09	2.20	2.46	6.80	3.02	1.75	1.40	4.59	—
Xura Tank Area, Lusitanski.	3.37	4.57	2.24	8.71	3.09	0.16	3.40	1.43	2.05	0.27	1.34	3.76	11.94	5.74	0.72	—	—	—
Cradock Place, Port Elizabeth.	—	—	4.32	2.13	6.37	0.12	1.27	1.12	4.59	1.50	13.43	4.40	4.25	5.49	2.61	3.34	2.10	2.18
Prineston, Bedford.	0.73	0.12	1.87	1.02	1.03	nil	2.11	0.47	1.95	nil	3.22	2.47	3.88	—	—	Not given.	—	—
Lombardpost, Bathurst.	0.69	6.15	4.35	2.20	1.26	0.05	1.40	0.69	1.99	0.68	8.39	3.05	3.72	1.14	0.50	0.93	0.93	—
Woodvale, Albany.	0.92	1.56	2.95	1.53	0.46	0.24	1.19	0.13	0.78	nil	3.89	2.35	0.94	0.08	0.83	0.36	1.49	1.19
Allandale, Middelburg, Cape.	0.61	3.35	0.43	2.53	0.73	nil	0.35	nil	nil	nil	1.73	0.45	—	—	1.00	1.00	1.00	2.50
Bishops Glen, Bloemfontein.	5.08	0.76	2.43	3.38	2.86	0.73	0.23	0.08	nil	nil	—	—	—	—	0.86	1.12	1.79	2.20
Naseby Thorns, Kroonstad.	6.85	1.32	1.20	5.01	3.10	0.21	nil	nil	nil	nil	—	—	0.76	—	1.41	—	—	—
The Outlook, Bethlehem.	1.92	1.17	1.76	4.06	2.12	0.17	0.97	0.26	1.33	0.10	0.29	0.23	0.93	1.60	1.33	2.10	4.67	—
Minosa Farm, Umata.	1.37	3.61	3.08	3.83	3.06	0.18	0.26	—	—	—	3.76	3.29	5.64	3.78	2.68	1.91	1.05	1.94
Roodepoort, Middelburg, Tvl.	2.52	3.29	2.87	3.24	3.24	0.28	0.62	nil	nil	0.45	0.49	1.60	2.93	3.51	2.68	—	—	—
Hartbeestfontein No. 51, Krugersdorp.	2.47	2.68	3.41	3.03	3.80	nil	nil	nil	nil	0.02	0.34	nil	4.12	5.20	3.75	1.28	6.02	0.99
Brooklyn, Barberton.	—	—	1.24	6.41	1.16	1.63	—	—	—	—	0.04	—	—	—	5.13	—	—	—
Gov. Ranching Stn., Zoutpansberg.	2.94	1.45	2.56	4.21	5.77	1.47	1.14	nil	nil	0.65	0.94	1.10	0.93	5.02	5.03	—	—	—
Kaaplaats, Marico.	2.76	2.68	3.41	3.03	3.80	1.63	1.14	nil	nil	1.26	1.26	0.34	—	—	—	—	—	—
Gemsbokpan, Matieling.	2.64	0.60	0.53	1.79	1.67	2.38	—	—	—	—	0.92	—	—	—	—	—	—	—
Ollivansvlei, Marico.	2.96	3.44	4.94	2.25	3.13	1.55	0.11	nil	nil	nil	nil	0.54	—	—	—	—	—	—
Melrose Farm, Zwartkops.	2.45	3.80	1.16	3.25	3.36	1.80	0.86	nil	0.15	1.80	0.89	1.20	1.20	0.52	—	—	—	—
Mt. Hupels, Queensdown.	1.23	4.30	1.06	3.17	0.15	0.35	0.20	0.14	nil	0.15	1.80	1.62	—	—	—	—	—	—
Lefcoitein, Ermelo.	6.23	2.03	—	—	—	0.09	1.07	—	—	—	2.28	1.62	—	—	—	—	—	—
Melrose Farm, De Aar.	—	—	3.00	2.45	1.98	—	—	—	—	—	records appear to have been kept	—	—	—	3.99	5.19	2.28	1.57
Rustfontein, De Aar.	2.82	2.58	10.90	4.91	2.71	0.70	2.46	0.20	given, nil	1.50	nil	nil	—	—	—	—	—	—
Hozelem, Klip River, Natal.	2.68	0.78	5.60	3.38	0.87	0.33	0.11	nil	—	—	0.68	0.68	1.12	1.64	1.28	1.97	3.10	0.62
Churchill, Kuruman.	—	—	1.89	3.99	0.85	0.03	0.92	nil	1.05	0.50	5.51	1.80	6.61	1.94	0.92	1.91	0.40	3.39
The Gaol, Butterworth.	2.24	3.69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE II.  
*Surveys IV, V, VI, VII, VIII and IX were carried out during January, 1932, April, 1932, July, 1932, October, 1932, January, 1933, and April, 1933.*

Farm and District.	Survey.	P <sub>2</sub> O <sub>5</sub>	CaO.	MgO.	K <sub>2</sub> O.	Na <sub>2</sub> O.	Cl.	Crude Protein.	Crude Fibre.	Nature of Pasture.	Average Mgn. % P.	Animals bled.
<i>Transvaal Province.</i>												
Mooiwater No. 129, Middelburg, Tvl.	IV	.12	.28	.11	.36	.01	.08	4.1	34.6	Mixed, mainly green.	5.4	Dry cows.
Roodepoort No. 8, Middelburg, Tvl.	V	.15	.31	.18	.43	.01	.19	4.5	36.1	Mixed, mainly green.	3.4	Lactating cows.
Roodepoort No. 8, Middelburg, Tvl.	VI	.08	.29	.18	.49	Trace	.10	2.3	35.0	Brown.....	3.7	Dry cows.
Blesbokvlakte No. 409, Middelburg, Tvl.	VII	.14	.38	.20	.70	Trace	.16	3.9	34.5	Mixed, mainly leaves.	2.3	Working oxen.
	VIII	.15	.31	.17	1.29	.02	.29	5.0	35.5	Mixed.....	2.8	Working oxen.
Wolverdend No. 128, Middelburg, Tvl.	IX	.11	.43	.19	.82	.01	.17	4.4	35.9	Mixed.....	2.3	Dry cows.
Hartebeestfontein No. 51, Krugersdorp	IV	.16	.24	.17	.60	.02	.14	5.1	34.1	Mixed, mainly green..	4.0	Oxen.
"	V	.12	.19	.16	.68	.01	.14	3.8	38.1	Mixed, mainly brown..	4.2	Oxen.
"	VI	.12	.34	.14	.57	Trace	.12	2.2	36.8	Brown, short.....	3.7	Oxen.
Zuurbekom No. 9, "Krugersdorp.....	VII	.16	.25	.23	.70	.01	.14	5.2	34.9	Mixed, short.....	4.0	Oxen.
"	VIII	.13	.14	.18	.62	.01	.16	5.7	38.8	Mixed, mainly green..	3.2	Oxen.
"	IX	—	—	—	—	—	—	—	—	—	—	—
Brooklyn, Barberton.....	IV	.21	.39	.20	.65	.02	.16	4.2	41.5	Mixed.....	6.5	Heifers.
"	V	—	—	—	—	—	—	—	—	—	—	—
"	VI	.19	.34	.19	.47	.02	.08	3.0	44.5	Mixed, mainly brown..	5.2	Heifers and oxen.
Castlekop, Barberton.....	VII	.47	.27	.24	2.08	.04	.43	4.3	40.4	Mixed, mainly green..	4.4	Heifers and oxen.
"	VIII	.37	.30	.22	1.60	.02	.29	2.6	43.6	Mixed.....	5.1	Dry cows and oxen.
"	IX	—	—	—	—	—	—	—	—	—	—	—
Kaaplaats, Marico.....	IV	.09	.25	.11	.27	.01	.09	3.5	36.5	Mixed.....	—	—
"	V	.08	.31	.15	.29	.01	.10	4.1	43.1	Mixed.....	—	—
"	VI	.05	.26	.15	.32	Trace	.09	2.3	41.6	Brown.....	3.1	Dry ewes.
"	VII	.08	.22	.18	.41	.01	.30	6.0	41.0	Brown.....	4.8	Dry ewes.
Rietgat No. 197, Marico.....	VIII	.23	.23	.24	1.12	.05	.30	6.0	39.6	Mixed, mainly green..	5.2	Dry ewes.
"	IX	—	—	—	—	—	—	—	—	—	—	—
Gensbokpan, Mateking.....	IV	.10	.25	.11	.73	.01	.12	3.2	34.1	Mixed.....	—	—
"	V	.13	.33	.15	.78	.01	.14	5.8	37.0	Mixed, mainly green..	—	—
"	VI	.08	.27	.15	.56	Trace	.10	3.7	38.9	Brown.....	2.4	Dry ewes.
Welgemoed Wes, Mateking.....	VII	.09	.22	.12	.41	.02	.07	3.7	37.6	Brown.....	3.0	Dry ewes and lactating cows.
"	VIII	.15	.35	.21	1.63	.02	.31	6.5	37.8	Mixed.....	3.2	Dry ewes.
"	IX	—	—	—	—	—	—	—	—	—	—	—
Olifantsvlei, Marico.....	IV	.24	.53	.24	1.60	.03	.45	5.8	34.4	Mixed.....	3.5	Cows in milk.
"	V	.20	.30	.26	1.56	.01	.32	4.7	37.2	Mixed, mainly brown..	3.8	Lactating cows.
"	VI	.14	.39	.31	.79	.02	.17	2.5	39.9	Brown.....	2.5	Lactating cows.
"	VII	.11	.33	.16	.35	.01	.03	2.0	40.3	Brown.....	4.3	Dry cows.
"	VIII	—	—	—	—	—	—	—	—	—	—	—
"	IX	—	—	—	—	—	—	—	—	—	—	—
Church Hill, Kuruman.....	IV	.18	.57	.24	1.03	.02	.27	4.8	34.8	Mixed, mainly green..	—	—
"	V	.05	.53	.11	.37	Trace	.08	2.0	37.4	Mixed, mainly brown..	—	—
"	VI	.09	.45	.22	.65	.02	.08	3.9	40.1	Mixed, mainly brown..	—	—
"	VII	.06	.40	.14	.43	.01	.10	2.1	37.0	Mixed, mainly brown..	—	—
"	VIII	.10	.81	.20	.50	.01	.14	4.3	36.6	Mixed, mainly brown..	—	—
"	IX	—	—	—	—	—	—	—	—	—	—	—

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE II (continued).

Farm and District.	Survey.	P <sub>2</sub> O <sub>5</sub>	CaO.	MgO.	K <sub>2</sub> O.	Na <sub>2</sub> O.	Cl.	Crude Protein.	Crude Fibre.	Nature of Pasture.	Average Mgrs. % P.	Animals bled.
Melrose Farm, Zwartkopsberg.	IV	.34	.84	.27	1.58	-.02	.32	3.6	33.4	Mixed, seeds present.	6.7	Dry ewes.
" "	V	.15	.33	.27	.73	-.02	.16	3.8	34.1	Mixed.	3.9	Pregnant ewes.
" "	VI	.13	.40	.33	.71	-.01	.18	2.3	36.4	Mixed, mainly brown.	2.9	Dry and lactating ewes.
" "	VII	.09	.31	.21	.40	-.02	-.09	2.2	38.5	Mixed, mainly brown.	5.9	Lactating ewes.
" "	VIII	—	—	—	—	—	—	—	—	—	—	—
" "	IX	—	—	—	—	—	—	—	—	—	—	—
Gov. Ranching Stn., Zoutpansberg	IV	.43	.63	.36	1.98	-.18	.21	5.9	40.9	Mixed, mainly green.	5.4	Dry cows.
" "	V	.27	.39	.24	.94	-.05	.15	3.7	43.0	Mixed, mainly brown.	4.6	Dry cows.
" "	VI	.27	.46	.23	.66	-.13	.17	3.0	41.9	Brown.	4.1	Dry and lactating cows.
" "	VII	—	—	—	—	—	—	—	—	—	—	—
" "	VIII	—	—	—	—	—	—	—	—	—	—	—
" "	IX	—	—	—	—	—	—	—	—	—	—	—
Mooigelegen No. 685, Potgietersrust	IV	—	—	—	—	—	—	—	—	—	3.1	Lactating cows.
" "	V	—	—	—	—	—	—	—	—	—	4.3	Dry cows.
" "	VI	—	—	—	—	—	—	—	—	—	3.7	Dry cows and heifers.
" "	VII	—	—	—	—	—	—	—	—	—	2.9	Lactating cows.
" "	VIII	—	—	—	—	—	—	—	—	—	3.9	Lactating cows.
" "	IX	—	—	—	—	—	—	—	—	—	—	—
Danspan, Potgietersrust.	IV	.13	.40	.14	.76	-.05	.26	4.2	38.5	Mixed.	4.5	Dry cows.
" "	V	.11	.35	.15	.78	-.03	.28	3.2	43.7	Mixed, mainly brown.	3.1	Dry cows.
" "	VI	.09	.44	.21	.38	-.05	.12	2.2	39.0	Brown.	0.3	Dry cows.
" "	VII	.19	.39	.21	.74	-.08	.32	5.1	37.2	Mixed, mainly green.	4.1	Dry cows and heifers.
" "	VIII	.15	.23	.14	.80	-.03	.29	5.1	38.5	Mixed.	3.8	Dry cows and heifers.
" "	IX	—	—	—	—	—	—	—	—	—	—	—
Derby No. 56, Piet Reilief.	IV	.18	.33	.18	.66	-.06	.18	3.4	36.0	Mixed.	3.9	Dry cows.
" "	V	.19	.37	.19	.64	Trace	.11	2.5	38.2	Mixed, mainly brown.	5.1	Dry cows.
" "	VI	.18	.33	.12	.31	-.02	-.07	2.8	37.8	Mixed, mainly brown.	4.1	Dry cows.
" "	VII	.34	.36	.24	2.00	-.03	.32	3.8	32.5	Mixed, mainly green.	3.9	Dry cows.
" "	VIII	—	—	—	—	—	—	—	—	—	—	—
" "	IX	—	—	—	—	—	—	—	—	—	—	—
Wildebeestfontein, Pietersburg	IV	.13	.28	.12	.72	-.02	.15	5.1	35.7	Mixed, mainly green.	3.6	Dry and lactating cows.
" "	V	.12	.32	.21	1.01	-.01	.22	4.9	35.5	Mixed.	2.4	Dry and lactating cows.
" "	VI	.09	.30	.17	.48	Trace	-.09	2.7	38.3	Mixed, mainly brown.	2.3	Dry and lactating cows.
" "	VII	.10	.25	.12	.26	-.01	-.06	2.6	39.0	Mixed, mainly brown.	3.8	Dry cows.
" "	VIII	.20	.33	.22	1.43	-.02	.32	6.0	36.4	Mixed, mainly green.	3.2	Dry and lactating cows.
" "	IX	—	—	—	—	—	—	—	—	—	—	—
Mimosa Park, Potchefstroom.	IV	.17	.22	.15	.91	-.02	.20	4.4	33.8	Mixed, mainly green.	2.4	Lactating cows.
" "	V	.13	.20	.14	1.43	-.01	.11	3.3	36.4	Brown, long.	5.3	Lactating cows.
" "	VI	.22	.26	.16	.82	-.04	.20	4.4	37.9	Mixed, mainly brown.	—	—
" "	VII	.17	.25	.19	1.00	-.01	.23	6.1	31.8	Mixed, mainly green.	3.8	Oxen.
" "	VIII	.12	.29	.19	.88	-.01	.23	4.8	33.9	Brown.	4.8	Oxen and dry cows.
" "	IX	—	—	—	—	—	—	—	—	—	—	—
Lelietfontein, Ermelo.	IV	.17	.22	.15	.91	-.02	.20	4.4	33.8	Mixed, mainly green.	2.4	Lactating cows.
" "	V	.13	.20	.14	1.43	-.01	.11	3.3	36.4	Brown, long.	5.3	Lactating cows.
" "	VI	.22	.26	.16	.82	-.04	.20	4.4	37.9	Mixed, mainly brown.	—	—
" "	VII	.17	.25	.19	1.00	-.01	.23	6.1	31.8	Mixed, mainly green.	3.8	Oxen.
" "	VIII	.12	.29	.19	.88	-.01	.23	4.8	33.9	Brown.	4.8	Oxen and dry cows.
" "	IX	—	—	—	—	—	—	—	—	—	—	—

TABLE II (continued).

Farm and District.	Survey.	P <sub>2</sub> O <sub>5</sub> .	CaO.	MgO.	K <sub>2</sub> O.	Na <sub>2</sub> O.	Cl.	Crude Protein.	Crude Fibre.	Nature of Pasture.	Average Mgm. % I.	Animals bled.
<i>Natal Province.</i>												
Stainton, Ixopo.....	IV	.18	.21	.18	.92	.19	.30	5.8	40.9	Mixed, mainly green..	5.5	Dry cows.
" ".....	V	.19	.22	.32	1.34	.02	.46	4.3	41.0	Mixed, mainly green..	4.4	Young heifers.
" ".....	VI	.07	.27	.22	.35	.08	.17	2.3	37.8	Mixed, mainly brown.	4.1	Oxen.
" ".....	VII	.19	.17	.15	1.00	.10	.32	7.3	41.5	Green, short.....	—	—
" ".....	VIII	.15	.19	.17	1.06	.08	.42	5.0	43.6	Mixed, mainly green..	4.0	Dry cows and heifers.
" ".....	IX	.10	.23	.17	.62	.02	.18	3.6	37.9	Mixed, mainly brown..	3.1	Heifers in calf.
<i>Bergendal, Vryheid.....</i>												
" ".....	IV	.15	.38	.34	1.05	.02	.30	6.2	37.5	Green, long.....	3.3	Lactating cows.
" ".....	V	.27	.40	.25	.83	.01	.22	5.2	41.0	Mixed, short.....	4.0	Dry cows.
" ".....	VII	.13	.44	.20	.58	.01	.23	3.3	36.0	Mixed.....	3.9	Merino wethers.
" ".....	VIII	.18	.31	.18	.89	.02	.16	3.7	38.5	Mixed.....	4.4	Dry cows and oxen.
" ".....	IX	.24	.50	.26	.94	.02	.31	3.1	36.0	Mixed, mainly brown..	4.7	Cows in calf.
<i>Kimbalton, Estcourt.....</i>												
Loel Sloy, Estcourt.....	IV	.22	.30	.17	1.24	.03	.23	5.3	39.9	Mixed.....	4.3	Dry cows.
" ".....	V	.15	.40	.19	.80	.01	.17	4.4	37.6	Mixed.....	4.2	Pregnant cows.
Zulu Nat. Training Inst., Nongoma.	IV	.36	.67	.50	2.30	.96	.88	11.5	32.8	Mixed, mainly green..	—	Dry cows and oxen.
" ".....	V	.31	.42	.52	1.83	.28	.78	6.7	39.4	Mixed, mainly green..	7.9	Oxen.
" ".....	VI	.20	.32	.31	.81	.11	.45	4.2	36.2	Mixed.....	5.0	Oxen.
" ".....	VII	.19	.34	.31	.64	.09	.26	4.1	39.8	Mixed, mainly brown..	6.0	Working oxen.
Tokazi Farm, Nongoma.....	VIII	.29	.32	.28	1.03	.22	.63	5.2	39.5	Mixed.....	5.4	Oxen.
" ".....	IX	.13	.28	.13	.84	.03	.22	3.7	40.6	Mixed.....	3.2	Dry cows and oxen.
Moss Side, Dundee.....	V	.19	.23	.18	1.30	.05	.27	3.3	41.7	Mixed, mainly green..	4.1	Dry cows and oxen.
" ".....	VI	.07	.25	.15	.47	Trace	.11	1.8	44.3	Mixed, mainly brown..	2.6	Dry cows and oxen.
" ".....	VII	.17	.20	.13	1.30	.02	.21	4.1	40.1	Mixed, mainly brown..	—	Working oxen and dry cows.
Moss Side, Dundee.....	VIII	.17	.20	.13	1.30	.02	.21	4.1	40.1	Mixed, mainly brown..	4.2	Working oxen and dry cows.
" ".....	IX	.17	.20	.13	1.30	.02	.21	4.1	40.1	Mixed, mainly brown..	—	Working oxen and dry cows.
<i>Mariannhill, Pinetown.....</i>												
" ".....	IV	.17	.19	.14	.48	.05	.16	4.3	39.7	Green, seeds present..	5.5	Oxen.
" ".....	V	.11	.17	.07	.26	.04	.08	3.1	42.5	Mixed, long.....	4.8	Oxen.
" ".....	VI	.06	.20	.08	.24	.01	.08	2.2	43.6	Mixed, mainly brown..	4.1	Oxen.
" ".....	VII	.11	.15	.08	.36	.03	.07	3.8	42.0	Mixed.....	—	Working oxen.
" ".....	VIII	.18	.22	.08	.78	.05	.16	5.0	42.5	Mixed.....	4.4	Oxen.
" ".....	IX	.17	.17	.09	.69	.03	.20	5.9	42.1	Mixed.....	4.5	Oxen.

TABLE II (continued).

Farm and District.	Survey.	P <sub>2</sub> O <sub>5</sub> .	CaO.	MgO.	K <sub>2</sub> O.	Na <sub>2</sub> O.	Cl.	Crude Protein.	Crude Fibre.	Nature of Pasture.	Average Mgm. % P.	Animals bled.
Home Farm, Klip River, Natal.....	IV	.37	.52	.24	1.91	.03	.28	6.5	40.8	Mixed, mainly green..	—	—
Home Farm, Klip River, Natal.....	V	.08	.64	.24	.70	.01	.15	2.5	35.1	Brown.....	3.9	Pregnant heifers.
"	VII	.12	.48	.17	.35	.02	.07	3.8	36.4	Mixed, mainly brown..	3.1	Pregnant heifers.
"	VIII	—	—	—	—	—	—	—	—	—	2.9	Pregnant heifers.
"	IX	—	—	—	—	—	—	—	—	—	—	—
Brachum, Pietermaritzburg.....	IV	.24	.26	.15	.79	.06	.22	4.2	37.2	Mixed.....	5.0	Working oxen.
Commissie Drift, Richmond.....	V	.26	.28	.18	.84	.04	.23	3.5	42.0	Mixed.....	6.2	Oxen.
"	VI	.16	.28	.22	.50	.02	.13	4.4	39.3	Mixed, mainly brown..	6.3	Oxen.
"	VII	.31	.21	.14	1.02	.03	.21	8.1	41.3	Mixed.....	6.0	Oxen.
"	VIII	.50	1.41	.66	1.94	.72	.55	6.9	38.2	Mixed, mainly green..	5.9	Young oxen.
"	IX	.33	.22	.21	1.43	.02	.51	3.2	43.4	Mixed.....	5.3	Young oxen.
Lots 45/48, Entumeni, Eshowe.....	IV	.23	.26	.18	1.48	.37	.57	4.6	34.6	Mixed, mainly green..	7.2	Young heifers.
"	V	.18	.26	.23	1.23	.21	.49	4.4	43.9	Mixed, long.....	5.0	Heifers and dry cows.
"	VI	.15	.21	.15	.57	.11	.32	2.8	38.0	Mixed, mainly brown..	3.4	Heifers and dry cows.
"	VII	.21	.25	.15	.58	.08	.23	3.1	44.6	Mixed.....	4.3	Heifers and dry cows.
"	VIII	.19	.26	.20	1.83	.31	.74	4.4	45.6	Mixed.....	4.3	Dry cows.
"	IX	.30	.22	.13	1.01	.04	.35	3.7	45.1	Mixed, mainly green..	4.5	Dry cows.
Voorkeur, Umvoti.....	IV	.18	.39	.22	1.01	.03	.28	4.2	38.2	Mixed, mainly green..	4.1	Lactating and dry cows.
"	V	.09	.29	.13	.48	.01	.16	3.2	38.0	Mixed, mainly brown..	6.6	Dry cows.
"	VII	.23	.34	.20	1.19	.06	.38	8.1	34.7	Green, short.....	3.2	Dry cows.
"	VIII	.19	.30	.17	1.40	.03	.37	6.2	38.2	Mixed, mainly green..	4.4	Dry cows.
"	IX	.11	.24	.11	.57	.01	.18	3.9	41.0	Mixed, mainly green..	6.6	Dry cows.
Melbourne, Port Shepstone.....	IV	.11	.22	.11	.60	.11	.34	3.4	33.9	Mixed, short.....	3.7	Lactating cows.
"	V	.10	.35	.22	.66	.11	.25	3.5	36.5	Mixed.....	3.1	Lactating cows.
"	VI	.06	.25	.18	.47	.11	.25	3.0	40.1	Mixed, mainly brown..	3.7	Lactating cows.
"	VII	.10	.25	.14	.53	.12	.34	3.1	38.4	Mixed, mainly brown..	3.4	Lactating cows.
"	VIII	.10	.23	.12	.47	.06	.16	3.2	39.8	Mixed, mainly brown..	2.7	Lactating cows.
"	IX	—	—	—	—	—	—	—	—	—	—	—



TABLE II (continued).

Farm and District.	Survey.	P <sub>2</sub> O <sub>5</sub> .	CaO.	MgO.	K <sub>2</sub> O.	Na <sub>2</sub> O.	Cl.	Grude Protein.	Grude Fibre.	Nature of Pasture.	Average Mgm. % P.	Animals bled.
<i>Cape Province.</i>												
Woodlands, Butterworth.....	IV	.21	.27	.12	.89.	.12	.41	5.4	36.9	Mixed, mainly green.	—	—
"	V	.09	.24	.12	.47	.05	.25	3.6	38.6	Mixed, mainly brown.	—	—
"	VI	.08	.24	.14	.33	.06	.17	2.9	35.1	Mixed, mainly brown.	—	—
"	VII	.13	.25	.12	.40	.07	.14	4.7	40.2	Mixed, mainly brown.	—	—
"	VIII	.18	.26	.17	.88.	.10	.41	6.6	36.7	Mixed, mainly brown.	—	—
"	IX	.19	.37	.15	.89.	.08	.28	5.9	36.4	Mixed, mainly brown.	—	—
<i>Teko School of Agric., Butterworth</i>												
"	IV	.13	.25	.14	.77	.18	.48	4.2	37.3	Mixed, short.....	—	—
"	V	.08	.26	.13	.54	.10	.27	3.6	38.7	Brown.....	—	—
"	VII	.10	.30	.16	.30	.06	.14	3.2	39.9	Mixed, mainly brown.	—	—
"	VIII	.14	.23	.13	.82	.04	.36	4.3	38.2	Mixed, mainly brown.	—	—
"	IX	.20	.36	.16	.70	.07	.26	5.8	35.3	Mixed.....	—	—
<i>Mt. Hupeley, Queenstown.....</i>												
"	IV	.20	.33	.11	.95	.02	.19	6.0	35.3	Mixed, mainly green.	3.2	Cows in milk.
"	V	.14	.32	.13	.98	.03	.16	4.3	34.0	Mixed, mainly brown.	5.0	Young heifers.
"	VI	.09	.23	.16	.37	Trace	.06	2.4	33.9	Mixed, mainly brown.	5.2	Heifers and oxen.
"	VII	.21	.35	.20	.76	.02	.18	5.8	34.5	Mixed, mainly green.	4.9	Heifers and dry cows.
"	VIII	.15	.30	.17	.71	.01	.53	3.6	36.5	Mixed, long.....	5.7	Cows in milk (add. feed).
"	IX	—	—	—	—	—	—	—	—	—	—	—
<i>Rustfontein, De Aar.....</i>												
"	IV	.69	.57	.28	2.83	.03	.33	10.6	26.3	(Cynodon dactylon only)	5.3	Heifers, oxen and dry cows.
"	V	.38	.44	.27	.87	.02	.13	4.9	34.1	Mixed, mainly green.	4.0	Heifers, oxen and dry cows.
"	VI	.29	.57	.25	.52	Trace	.07	4.6	36.5	Mixed, mainly brown.	3.0	Heifers, oxen and dry cows.
"	VII	—	—	—	—	—	—	—	—	—	—	—
"	VIII	—	—	—	—	—	—	—	—	—	—	—
"	IX	.54	.87	.41	2.09	.04	.78	7.1	41.5	Mixed, and bushes...	—	—
<i>Rustfontein, De Aar.....</i>												
"	IV	.25	.28	.14	1.01	.08	.33	5.8	35.2	Mixed, mainly green.	3.5	Dry and lactating cows.
"	V	.16	.24	.18	.95	.08	.34	5.0	37.0	Mixed.....	3.6	Dry and lactating cows.
"	VI	.36	.36	.16	.66	.05	.15	5.0	38.7	Mixed, mainly brown.	4.2	Dry cows and heifers.
"	VII	.64	.42	.22	1.71	.29	.52	14.0	31.4	Green, short.....	4.5	Dry pregnant cows and heifers.
"	VIII	.61	.38	.21	1.90	.17	.46	8.8	33.5	Green.....	4.2	Dry cows and heifers.
"	IX	—	—	—	—	—	—	—	—	—	—	—
<i>Kopplekruaal, Mt. Currie.....</i>												
"	IV	.27	.34	.16	1.03	.04	.25	5.4	33.6	Mixed, mainly green.	5.6	Heifers, oxen and dry cows.
"	V	.22	.27	.23	.77	.03	.19	3.5	36.6	Mixed, mainly brown.	5.1	Heifers, oxen and pregnant cows.
"	VI	.14	.30	.14	.34	Trace	.08	2.2	32.9	Mixed, mainly brown.	5.0	Heifers, oxen and pregnant cows.
"	VII	.14	.37	.18	.59	.03	.15	3.3	36.7	Mixed, mainly brown.	5.0	Heifers, oxen and pregnant cows.
"	VIII	.59	.32	.30	1.09	.02	.22	3.8	38.4	Mixed.....	4.5	Working oxen and pregnant cows.
"	IX	.18	.33	.23	.66	.01	.18	3.7	36.0	Mixed.....	4.5	Working oxen and pregnant cows.

MINERAL CONTENT AND FEEDING VALUE OF NATURAL PASTURES.

TABLE II (continued).

Farm and District.	Survey.	P <sub>2</sub> O <sub>5</sub> .	CaO.	MgO.	K <sub>2</sub> O.	Na <sub>2</sub> O.	Cl.	Crude Protein.	Trade Fibre.	Nature of Pasture.	Average Mgn. % P.	Animals bled.
Mimosa Farm, Umtata.	IV	.31	.89	.12	.73	.13	.31	4.5	36.4	Mixed	4.6	Dry cows.
	V	.19	.29	.14	.85	.05	.21	4.3	37.6	Mixed	5.0	Dry cows.
	VI	.21	.32	.12	.67	.05	.17	4.8	37.2	Mixed, mainly brown.	4.0	Dry cows.
	VII	.26	.33	.16	.07	.30	.07	6.3	37.2	Mixed, mainly brown.	3.0	Dry cows.
	VIII	.24	.25	.23	1.91	.04	.36	6.0	36.6	Mixed.	4.1	Dry cows.
IX	.23	.30	.14	1.18	.03	.38	5.4	36.8	Mixed.	4.4	Dry cows.	
Xura Tank Area, Lusikisiki.	IV	.16	.35	.27	.43	.09	.23	4.0	39.5	Mixed	5.0	Cows in calf, oxen and heifers.
	V	.25	.34	.26	.82	.16	.39	5.0	35.4	Mixed	4.8	heifers and oxen.
	VI	.24	.29	.21	.59	.18	.28	4.2	36.6	Mixed, mainly brown.	5.0	Dry cows, heifers and oxen.
	VII	.23	.31	.17	.81	.17	.33	4.7	38.8	Mixed.	4.2	Dry cows and oxen.
	IX	—	—	—	—	—	—	—	—	—	5.1	Dry cows, heifers and oxen.
Cradoek Place, Port Elizabeth.	IV	.26	.38	.35	1.86	—	—	10.3	33.6	Mixed, mainly green.	8.1	Oxen, dry cows and heifers.
	V	.26	.91	.34	1.51	1.18	1.51	10.8	33.8	Mixed, mainly green.	6.0	Oxen.
	VI	.39	.45	.20	1.73	.53	.71	10.1	33.0	Green.	5.8	Oxen and dry cows.
	VII	.36	.31	.22	1.28	1.39	1.89	5.6	38.1	Mixed.	—	—
	IX	.32	.81	.26	1.90	.47	.95	8.8	37.1	Mixed, mainly green.	—	—
Primeston, Bedford.	IV	.36	.48	.18	1.60	.41	.68	6.8	36.4	Mixed, mainly green, and bushes	7.6	Heifers and oxen.
	V	.45	.82	.68	2.19	1.39	1.80	8.2	34.9	Mixed, and bushes.	6.0	Oxen.
	VI	.30	.62	.40	1.33	.78	.47	7.0	30.6	Mixed, mainly brown, and bushes	4.6	Oxen and dry cows.
	VII	.59	.81	.62	2.90	1.84	1.50	11.5	32.0	Mixed, and bushes.	5.4	Oxen and dry cows.
	IX	.50	.60	.48	1.56	1.93	2.04	8.0	33.3	Mixed, mainly brown and bushes	4.7	Oxen.
Lombardspost, Bathurst.	IV	.20	.31	.12	.69	.12	.28	5.3	29.2	Mixed, mainly green, short	6.3	Dry cows.
	V	.23	.36	.26	1.21	.48	.56	6.7	35.0	Mixed, mainly green.	3.8	Dry cows.
	VI	.18	.36	.15	.55	.07	.16	5.0	19.9	Mixed, short.	4.5	Dry cows and heifers.
	VII	.47	.46	.17	1.72	.24	.42	11.9	27.7	Green, short.	5.0	Dry cows and heifers.
	IX	.33	.19	.33	.82	.10	.31	4.1	31.6	Mixed, short.	4.6	Dry cows.
		.33	.77	.20	1.22	.28	.46	8.5	30.2	Mixed, mainly green.	—	—

TABLE II (continued).

Farm and District.	Survey.	P <sub>2</sub> O <sub>5</sub> .	CaO.	MgO.	K <sub>2</sub> O.	Na <sub>2</sub> O.	Cl.	Crude Protein.	Crude Fibre.	Nature of Pasture.	Average Mgm. % P.	Animals bled.
Kingston, Albany.....	IV	.37	1.45	.36	1.70	.56	.47	11.5	32.3	Bushes.....	7.8	Heifers.
Woodvale, Albany.....	V	.31	2.33	.94	1.51	.60	1.11	12.0	21.6	Bushes.....	5.8	Dry cows.
"	VI	.36	2.82	1.22	2.25	1.25	.55	9.9	42.6	Mainly bushes and mixed, short	3.9	Dry cows.
"	VII	.58	1.50	.86	2.90	1.06	.59	14.8	24.8	Mainly bushes and green, short	3.7	Dry cows.
"	VIII	.31	.35	.20	1.30	.18	.72	9.0	27.4	Mixed, and bushes...	5.3	Dry cows.
"	IX	.36	1.67	1.07	2.42	.90	1.00	10.1	24.6	Mixed, mainly green and bushes.	6.2	Dry cows.
Allandale, Middelburg, C.P.....	IV	.46	.67	.23	1.66	.10	.28	6.5	29.7	Green, short and bushes	5.6	Lactating cows.
"	V	.39	.62	.25	1.66	.04	.23	8.7	36.1	Mixed, mainly green and bushes	5.1	Dry cows.
"	VI	.25	.49	.18	1.17	Trace	.08	5.3	41.0	Brown, and bushes...	5.2	Dry cows.
"	VII	.25	.49	.21	1.29	.04	.18	7.4	40.3	Mixed, and bushes...	3.5	Dry cows and heifers.
Leeuwfontein, Middelburg.....	VIII	.25	.89	.28	1.30	.03	.20	3.0	33.6	Green, and bushes...	5.3	Dry cows and heifers.
"	IX	.31	1.08	.33	1.70	.02	.34	9.7	32.7	Green, and bushes...	5.4	Dry cows and heifers.
<i>Orange Free State.</i>												
Bishops Glen, Bloemfontein.....	IV	.38	.63	.25	.98	.02	.14	4.6	32.5	Mixed, and bushes...	5.3	Dry cows.
"	V	.26	.41	.31	1.13	.03	.05	6.0	35.2	Mixed, mainly green...	4.6	Dry cows.
"	VI	.14	.26	.22	.54	Trace	.20	2.8	38.8	Brown.....	4.9	Dry cows.
"	VII	—	—	—	—	—	—	—	—	—	—	—
Bishops Glen, Bloemfontein.....	VIII	.34	.93	.33	1.86	.05	.43	7.3	39.2	Green, and bushes...	—	Dry cows.
"	IX	—	—	—	—	—	—	—	—	—	—	—
Naseby Thorus, Kroonstad.....	IV	.26	.53	.24	1.35	.02	.34	5.2	32.6	Mixed.....	6.1	Dry cows.
"	V	.29	.36	.32	1.57	.02	.42	6.6	34.4	Mixed, mainly green...	5.7	Dry cows.
"	VI	.22	.41	.29	1.09	Trace	.15	4.3	36.0	Brown, long.....	4.9	Dry cows.
"	VII	.19	.34	.19	.56	.02	.07	3.5	36.5	Brown, long.....	5.0	Dry cows.
"	VIII	—	—	—	—	—	—	—	—	—	—	—
Naseby Thorus, Kroonstad.....	IX	.20	.46	.24	.90	.01	.28	6.6	32.8	Mixed, mainly brown...	5.0	Dry cows and oxen.
The Outlook, Bethlehem.....	IV	.36	.36	.21	2.22	.03	.39	9.2	31.5	Green, short.....	5.5	Lactating cows.
"	V	.25	.34	.20	1.41	.04	.22	6.3	34.4	Mixed, mainly brown...	3.8	Dry and lactating cows.
"	VI	.09	.27	.13	.71	Trace	.11	3.0	37.4	Brown.....	—	Pregnant cows.
Sebastopol, Bethlehem.....	VII	.11	.26	.11	.40	.02	.05	3.3	36.9	Mixed.....	4.5	Lactating cows.
The Outlook, Bethlehem.....	VIII	.25	.21	.16	1.75	.07	.57	6.8	33.9	Mixed, mainly green...	—	—
"	IX	—	—	—	—	—	—	—	—	—	—	—

The description of the pasture samples is superficial and based on the following:—

“Mixed” means that the sample can be divided into approximately equal quantities of green and brown herbage respectively. A sample labled “mixed, mainly green” contains 60-90 per cent. green herbage, while “mixed, mainly brown” indicates the presence of 60-90 per cent. brown herbage. In a “brown” sample the presence of not more than 10 per cent. of green material is allowed, while in a “green” sample the amount of brown material should not exceed 10 per cent. These terms refer to grasses only, and if bushes or shrubs are present mention of these is made accordingly. The blanks in the table indicate that for the period in question no collections were made. Outbreaks of infectious diseases occurred on several occasions, during which periods primary claim was made upon the services of the Government veterinary officers for assistance so that they could not always carry out the collections of samples regularly.

The analyses of the samples obtained from Kuruman and Mafeking given in Table II are grouped with those from centres in the Province of the Transvaal on account of the proximity of these districts to the latter province. Strictly speaking these areas lie in the Cape Province.

Generally speaking, values for blood phosphorus above about 4.5 mgm. per 100 c.c. blood are not in any way indicative of phosphorus deficiency but as many classes of stock including dry and lactating cows, oxen, heifers and sheep were bled for analysis this figure is by no means exact but could serve to show up deficiencies and sufficiencies of phosphorus at the time of bleeding. For more details in regard to the relation between the phosphate content of the pasture and that of the blood the reader is referred to the first report on this investigation (du Toit *et al.*, 1933). Another factor which is brought out by the values for blood phosphorus in the table above is the apparent lack of agreement between the phosphorus content of the pasture and that of the blood in quite a number of cases. Although earlier work has undoubtedly established a direct relation between phosphorus intake and blood phosphorus it does not follow that any one determination of the percentage phosphorus in pasture should be reflected directly in the inorganic phosphorus content of the blood and that for two reasons mainly. Firstly, the pasture collected may not represent a true sample of that eaten by stock on account of the method of collection employed for the above surveys, and secondly the percentage value of phosphorus in pasture gives no indication of the amount of pasture available of that composition, i.e. of the total intake of the animals on such pasture. Obviously, not much available pasture containing high phosphorus, as for instance at the beginning of a new season's growth will not show as high a figure for inorganic phosphorus in blood as abundant pasture of average composition. Hence information of a more exact nature in regard to the relation between blood and pasture phosphorus and also in regard to phosphorus deficiency or otherwise can be obtained if both values are studied for periods as can be done in the above table, rather than for corresponding months only. If this is done it will be noticed that the higher values for pasture

phosphorus tend to be reflected as higher values for blood phosphorus, e.g. Barberton, Zoutpansberg, Nongoma, Pietermaritzburg, Port Elizabeth, etc. However, the agreement is by no means of the nature of that obtained in controlled experiments and is being further investigated in a few areas only where true samples of the pasture eaten are collected by following animals and bleeding them afterwards for blood samples for analysis. Furthermore, the analytical values of pasture collected on the basis reported in this article are being compared with those obtained from true samples of pasture eaten gathered by following animals as already stated.

One point is nevertheless evident from a study of the values for blood phosphorus when compared with the phosphorus content of the pasture, viz., that practically no values are indicative of a phosphorus sufficiency in South African pastures throughout the year, although quite a fair number of both pasture and blood analyses suggest that during seasons of active growth and highest rainfall (mainly in summer) the pasture probably contains enough phosphorus for the requirements of non-lactating stock.

The phosphorus contents of the pasture samples corroborate the statements made in the first report of this series (1932) and may be summarized as follows: (a) The percentage phosphorus in pasture decreases as the plants mature and extremely low values are often obtained during winter in cases where only fully grown out grasses are available. These values tend to be even lower after adverse conditions of temperature, such as frost. (b) Of the climatic conditions during the growing seasons rainfall apparently determines the stage of growth of pasture and hence its phosphorus content. (c) Very abundant rains do not appear to favour a high phosphorus content of pasture, while the question of a possible leaching effect of the rains may be a possible explanation but is still a matter of conjecture, e.g. Derby 56, Piet Retief; Stainton, Ixopo; Mimosa Park, Potchefstroom, etc. (d) Pasture samples containing shrubs invariably show higher values for phosphorus than those consisting of grasses only. (e) Deplorably small amounts of phosphorus are present even during the best seasons of the year in samples from certain areas, e.g. Melbourne, Port Shepstone, Marico, Mafeking, Kuruman, etc., and in some other areas during the winter months. It is inconceivable that the phosphorus requirements of animals could be met under such adverse conditions. (f) The supplementation of pasture used for grazing by phosphates for the greater part of the year is essential if maximum production is aimed at.

The rest of the constituents given in Table II do not present such a gloomy picture as the phosphate values do. Crude protein is certainly very low at times and as stated in the first article can hardly be believed to satisfy the protein requirements of the animals at all seasons of the year. Appreciable increases in the protein content of the pasture is associated with the presence of new growth and naturally an increase in the phosphorus content. Low phosphorus and low protein, usually indicative of an advanced stage of growth of the pasture, are on the whole associated with high values for crude fibre. Lime values for some pasture samples are distinctly on the low side but the values that need be viewed with concern are those for sodium. Generally it appears that the pastures

are extraordinarily low in sodium and even with moderate milk production it is hardly conceivable that the daily pasture ration satisfies the sodium requirements of a lactating cow. As a matter of fact in a number of cases the sodium content of 25 lb. of dry pasture, of the type represented by the samples—the approximate daily intake of a 1,000 lb. cow—is less than the sodium actually secreted in two gallons of milk. The question of a possible sodium deficiency in South African pastures and the effect on animals is being investigated at the present time and will be reported on in due course.

If the samples analysed are at all representative of South African pastures the latter must be looked upon as distinctly poor, for the greater part of the year, for purposes of production in stock farming. Supplementary feeding, or, alternatively, the necessity for improvement of the pastures, be it by fertilizing or better management to increase their feeding value, is strongly indicated.

### SUMMARY.

1. The third report of the series on the mineral content and feeding value of South African natural pastures is presented.

2. Both pasture and blood analysis confirm the earlier statement that practically all South African pastures are low in phosphorus for the greater part of the year.

3. Crude protein varies more or less directly as the phosphorus content of the pasture and is extraordinarily low during certain seasons of the year.

4. Generally, the sodium content of the samples is so low that it suggests an insufficiency of sodium for producing animals on pasturage.

5. The samples analysed were representative of the herbage in the areas of collection and not necessarily of the pasture actually eaten by stock as will be the case with all samples collected subsequently and to be reported on in due course.

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