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Govt. and settlers will  
be willing to continue  
co-operation of Orr  
will visit Kenya in  
route to Australia to  
see local work  
and rearrange experimental  
tests in any necessary  
particular. He arrives  
Mombasa Feb-16<sup>th</sup> and  
leaves March 9<sup>th</sup>

Secy

X 15052/28  
Kenya

Letter 26/1/28  
Circular 26/1/28

- Mr. E. H. Hurdell
- Sir C. Bracken
- Sir J. G. G. G. G.
- Sir G. Grindle
- Sir G. Davis
- Sir S. Wilson
- Mr. Ormsby-Gore
- Lord Loche
- Mr. Amery



34 30 Jan 1928

DRAFT

(10175/27)

Kenya  
Cust  
Gov. Glegg

Report  
10.6.1928  
19/1/28

Please for  
handing 30th Jan

With ref to my last  
letter of the end of March  
1927, I have to  
transmit to you copies  
of a further report by  
the Sub-Committee of  
the Advt. Ctee of Civil  
Research on the Mineral  
Content of Natural  
Pastures, together with  
a copy of a letter from  
~~which has been sent~~  
by the Ctee. to the  
Empire Marketing  
Board, in which it

is proposed that the financial assistance from the Empire Marketing Fund should be made available for a further period in order to allow of the continuance of the work in Kenya.

2. In view of the very promising results obtained from the work already

done, I have no doubt

that the Govt. of Kenya <sup>in the Colony who are</sup> and others concerned will be willing to continue to give facilities for the further investigations proposed.

By the time that you receive this

Mr.  
Mr.  
Mr.  
Mr. T. A. Murray  
Sir O. Shackleton  
Sir J. S. Sandhu  
Sir G.  
Sir O. Davis  
Sir S. Wilson  
Mr. Ormsby Gore  
Lord Lonsdale  
Mr. Amery

DRAFT

This despatch or copy will be in the Colony with a view to inspecting the local work and in arranging the experimental plots in any necessary particulars, in accordance with the programme approved by the Sub-Committee.

(For the Secretary of State)  
(Signed) W. ORMSBY GORE

2  
D4  
26th January 1928.

Dear Jeffries,

We should have no objection to copies of the Pastures Report (C.R. (C)25) and our letter there on to the Empire Marketing Board being sent confidentially to Kenya. I accordingly enclose herewith three copies of each to enable you to send the despatch you have in mind.

Yours sincerely,

*A. F. Hemming*

C. J. Jeffries, Esq.

3  
copies of each to Sec. Conf. 30 JAN 1928

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any further communication  
on this subject should be  
addressed to:-

ENCLOSURE

COMMITTEE OF CIVIL RESEARCH  
2 Whitehall Gardens,  
London, S.W.1.

19th January 1928.

The Secretary,  
Committee of Civil Research,  
2 Whitehall Gardens, S.W.1.

and the following number quoted:

C.A./C.112

Sir,

I am directed by the Earl of Balfour to request you to lay before the Empire Marketing Board the enclosed copy of the Third Report of the Sub-committee on the chemical content of natural pastures.

2. The summary of the results of the field investigations contained in the Sub-committee's Report shows clearly that deficiencies of minerals in the pastures of Lanva actually exist, and that the supplementary feeding of minerals to animals grazing the pastures has a definitely beneficial effect in preventing Tekumitis and in increasing the rate of growth of lambs and the weight of the fleece.

3. Further, it is clear that the greatest care has been taken to keep the expenditure at the lowest figure compatible with the proper conduct of the experiment. The Director of the research, in Lord Balfour's opinion, is to be congratulated on having secured such promising results with an expenditure of less than half the sum put at his disposal for these investigations.

4. Lord Balfour concurs in the proposal of the sub-committee that the investigation should be continued beyond the period of two years for which it has been authorised, provided that the total expenditure incurred does not exceed the grant approved by the Empire Marketing Board, viz., £10,000 in all, and he trusts that the Empire Marketing Board will be willing to make the necessary arrangements to enable this to be done. His Lordship hopes that in that event the Board will also approve the recommendations of the sub-committee.

(c) that as regards the expenditure of the remaining balance of the grant from the Empire Marketing Board, discretion should be given to R. O. C. the Director of the research

(d) to set in the detailed method by which the investigation should be continued, provided that the experiments undertaken are in conformity with the general scheme recommended in our second report (p. 3. (d)) and approved by the Committee of Civil Research; and that the fullest possible advantage is taken of facilities offered by expert authorities in Scotland and this country;



(ii) to arrange with the Board of Agriculture for Scotland for the appointment of temporary staff within the limits of the funds available at rates of pay not exceeding the normal appropriate scales;

(iii) to arrange with the Board of Agriculture for Scotland, in consultation with the Colonial Office for the grant of increments of salary to the temporary staff at present employed on the field investigations in Kenya on the completion of one year's probationary service from the date of joining, the increments to be fixed with due regard to the prevailing rates of pay for Government servants in Kenya;

(d) That as arrangements have been made for Mr. Orr to visit Australia early in 1928, he should take the opportunity of personally inspecting the field work in Kenya and of re-arranging the experimental tests in any necessary particular;

.....

(1) That in view of the valuable results obtained by the search of the literature of nutrition, the services of the workers employed should be retained and that, subject to the direction of Mr. Orr, they should be employed on searching and editing the literature of cognate scientific subjects.

5. Arrangements will be made by this Department to communicate copies of the shorter paper summarising the principal points disclosed by the search of the literature of nutrition to the Dominion Office for transmission to the Dominion Governments, to the India Office for transmission to the Government of India, to the Colonial Office for transmission to the Governments of the Colonies and Dependencies to which the original questionnaire (C.R. (C) 6) was sent, and to the Foreign Office for transmission to the Government of the Sudan. The paper embodying the results of the search of the literature of nutrition, of which the shorter paper referred to above is a summary, will be communicated confidentially by the Director of the Research to the heads of Institutes working on nutritional problems in Canada, Australia, South Africa and New Zealand.

6. I am to add that Lord Balfour concurs in the view expressed by the Sub-Committee that the question whether the results of the investigation should be published and, if so, where and in what form, should be deferred for later consideration.

I am, Sir,  
Your obedient servant,

(Sd/-) THOMAS JONES.

Secretary,  
Committee of Civil Research.



CONFIDENTIAL.

Copy No. 88

C.R. (C) 25.

## COMMITTEE OF CIVIL RESEARCH.

### Sub-Committee on the Mineral Content of Natural Pastures.

#### THIRD REPORT.

##### I.—INTRODUCTORY.

1. AT their meeting held on the 3rd July, 1925 (C.R. 2nd Meeting, Conclusion 2), the Committee of Civil Research appointed the following Sub-Committee to consider and report on the Mineral Content of Natural Pastures:—

Major Walter Elliot, M.C., M.P., Parliamentary Under-Secretary of State for Scotland (*Chairman*).

Sir A. D. Hall, K.C.B., F.R.S., Chief Scientific Adviser, Ministry of Agriculture and Fisheries.

Sir Robert Greig, M.C., Chairman of the Board of Agriculture for Scotland.

Sir L. J. Kershaw, K.C.S.I., C.I.E., Assistant Under-Secretary of State, India Office.

Mr. Maurice Headlam, C.B., Assistant Secretary, Treasury.\*

Mr. C. J. Jeffries, Colonial Office.

Sir Walter M. Fletcher, K.B.E., F.R.S., Secretary, Medical Research Council.

Sir Thomas Middleton, K.B.E., C.B., Commissioner, Development Commission.

Professor T. B. Wood, C.B.E., Professor of Agriculture in the University of Cambridge.

Mr. A. F. Hemming, C.B.E., Assistant Secretary to the Committee of Civil Research, *Secretary to the Sub-Committee*.

2. On the 23rd September, 1925, we presented a first Interim Report (C.R. (C) 6) covering a Memorandum giving the substance of the scientific results at present achieved, and containing a short *questionnaire* to indicate the lines on which further information was desired. We recommended that copies of the Memorandum should be communicated to the India Office, the Dominions Office, the Colonial Office and the Foreign Office, for communication to the Government of India, the Dominion and Colonial Governments and the Government of the Sudan, who should be asked to forward observations and replies to the questions submitted. We further reported that, as a result of our representations, arrangements were being made for Dr. J. B. Orr, of the Rowett Research Institute, to visit South Africa and Kenya in order to confer on the spot with the local authorities.

3. At their meeting held on the 12th October, 1925 (C.R. 9th Meeting, Conclusion 4), the Committee of Civil Research approved this Report, copies of which were forwarded in accordance with our recommendations to the Departments named for transmission to the Government of India, the Dominion and Colonial Governments and the Government of the Sudan.

4. In March 1926 we considered the replies received to the *questionnaire*, and also the report by Dr. J. B. Orr on his return from his visit to South Africa and Kenya. The information contained in these communications showed that the subject

\* See Paragraph 8.

was one of great economic importance. It also indicated that co-ordinated research effort, if well directed, was likely, within a relatively short time to yield further information of practical value to the Animal Husbandry Industry of the Empire.

5. On the 14th April, 1926, we submitted a Second Report to the Committee of Civil Research setting out the facts which had been brought out by the enquiry and outlining the investigations which we recommended should be undertaken immediately. Our principal recommendations in that Report may be summarised as follows:

- (a) That practical investigations should be carried out in the most suitable Colony or Dependency with a view to ascertaining whether the nature of the mineral deficiencies can be determined and the diseases due to them prevented.
- (b) That the most suitable site for this investigation was Kenya.
- (c) That a minimum of four bio-chemists should be engaged for this work in Great Britain and two field workers in Kenya.
- (d) That a special worker should be employed to carry out a search of the scientific literature and to arrange the information in an easily accessible form.
- (e) That a financial programme of from £5,000 to £10,000 should be approved to carry out the work recommended in paragraphs (a) and (b), above, on the understanding that an effort should be made to secure a financial contribution towards the cost of this work from the Government of Kenya.
- (f) That the Committee of Civil Research should recommend the Secretary of State for Dominion Affairs to lay before the Empire Marketing Board (then in process of being formed) for their favourable consideration, a proposal that a grant of £10,000 should be made from the Empire Marketing Board to cover the cost of the investigations recommended in (a) to (c) above; and that in the meanwhile the Treasury should be asked to authorise an immediate advance of £1,500 by the Board of Agriculture for Scotland to the Rowett Research Institute, on the understanding that it should be recovered as an Appropriation-in-Aid from any contribution subsequently received from the Empire Marketing Board.
- (g) That the Committee of Civil Research should appoint a Sub-Committee to consider the medical questions in regard to native dietetics disclosed in Dr Orr's Report.
- (h) That copies of Dr Orr's Report on his visit to East Africa, with a précis of the replies to the *questionnaire*, should be communicated to the Government of India, the Dominion and Colonial Governments and the Government of the Sudan, for the information of their technical officers.

6. This Report was approved by the Committee of Civil Research at the meeting held on the 28th April, 1926 (C.R./10th Meeting, Conclusion 3). Steps were at once taken to carry out the various measures recommended. Dr Orr, the Director of the Rowett Research Institute, Aberdeen, was appointed Director of the investigation and a member of our Sub-Committee. Staff for the fieldwork in Kenya was selected and given a three-months' course of special training at Aberdeen preparatory to proceeding to Kenya. Two specially qualified workers were engaged to undertake the search of the scientific literature. A grant of £10,000, spread over two years, was authorised from the Empire Marketing Fund when the Empire Marketing Board was constituted. Copies of Dr Orr's Report on his visit to Kenya and a précis of the replies received to the original *questionnaire* were forwarded to the Dominions Office, Colonial Office, India Office and Foreign Office for transmission respectively to the Dominion and Colonial Governments, the Government of India and the Government of the Sudan.

7. The Research party, consisting of four workers, left this country for Kenya on the 25th August, 1926, accompanied by Mr. Arthur Crichton, Head of the Animal Husbandry Department, Rowett Research Institute, who was able to superintend the start of the work in Kenya. Constant relations were maintained by the Research party with the Rowett Research Institute, to which reports were regularly submitted and samples of pastures were forwarded for analysis.

8. In May 1927, Mr. M. Headlam, C.B., who represented the Treasury on our Sub-Committee was appointed Comptroller-General, National Debt Office, and his place was taken by Mr. A. P. Waterfield, C.B.

9. By November 1927, the investigation had sufficiently progressed to enable Dr. Orr to submit to us an Interim Report showing the results so far obtained in Kenya, together with results of control tests with sheep undertaken concurrently in Scotland. These results appeared to us so promising that, at a meeting held on the 22nd November, 1927, we decided to submit to the Committee of Civil Research the following Report on them, together with certain recommendations regarding the future conduct of the work.

## II.—GENERAL SCHEME OF WORK UNDERTAKEN.

10. The problem before the Research party in Kenya was to determine whether the pastures in certain districts were deficient in essential mineral nutrients, and if so whether these deficiencies were the cause of the malnutrition and low productivity noted in cattle and sheep in the Colony.

11. This investigation has been carried out on the following lines:—

### (a) Work in Kenya.

The work of the Research party in Kenya has consisted of two main sections, viz.:

(i) *Chemical Work*.—Samples of pastures have been collected at monthly (and in some cases shorter) intervals from four representative districts in Kenya, viz. Nakuru, Molo, Naivasha and the Athai Plains near Nairobi. These samples have been forwarded regularly to the Rowett Research Institute, where their composition has been determined by chemical analysis.

(ii) *Feeding Experiments with grazing animals*.—Feeding experiments have been carried out with various kinds of grazing animals in each of the four districts referred to above from which samples of pastures have been collected. The material fed consisted of a mixture of inorganic salts rich in the minerals believed to be deficient in the pastures. In some cases protein-rich substances were added to the mixture as the pastures were believed also to be deficient in this substance.

### (b) Work in Great Britain.

12. Concurrently with the investigations in Kenya, feeding tests on more or less similar lines were undertaken in Scotland with sheep on farms where the pastures were known to be deficient. At the same time the scientific and agricultural literature was reviewed to bring together in an easily accessible form all the information bearing on deficiency of minerals in pastures and the effect of these deficiencies on the health and productivity of herbivora.

## III.—CHEMICAL ANALYSIS OF KENYA PASTURES.

13. Seventy-nine samples of pasture have been analysed. Appendix I, Table (A), shows the composition of the samples from the different centres, with, for comparison, the average composition of cultivated pastures and good uncultivated hill pasture in Great Britain.

14. The samples from Molo and Nakuru are deficient in all the essential minerals, samples from Molo being especially deficient in phosphorus. Nakuru samples are believed, from clinical observations on the cattle, to be deficient in iron, but it was impossible to collect samples under conditions which would enable iron determinations to be made with accuracy.

15. The data showing the seasonal variation are not yet available for the complete year. The most marked feature of the data so far collected is the great increase in the mineral and protein content of the pastures following rain. This is most marked in the good pastures of Naivasha, which respond to rain with greater rapidity than the poor pastures of Nakuru and Molo. After the period of growth during the rainy season the mineral and protein contents fall rapidly (see Appendix I, Tables (B) and (C)).

IV.—FEEDING TESTS IN KENYA.

16. From the outset of the investigation, it was clear that it would be a matter of considerable difficulty to carry out properly the proposed feeding tests in Kenya. This was due to the lack of facilities for exact experimental work on the farms where the tests were done, and also to the fact that the men sent out were relatively inexperienced, having received only a three months' training in experimental work with animals. At one of the centres—Athi Plains—the arrangements made proved inadequate to the strain, and there are therefore no reliable data from this centre. The data from the other centres are, however, sufficient to enable a reliable report to be prepared.

(a.) Cattle at Nakuru.

17. The object of the work at Nakuru was to determine whether the disease *Nakurutis*, which develops in animals if put to graze in this district continually for more than about six or eight months, is due to a deficiency of iron and could be prevented by the administration of iron salts.

18. Four groups each of 28 oxen were grazed in the affected area. The animals of one group were allowed to lick a salt block consisting of equal parts of sodium chloride and ferric oxide to any extent that they desired. Two of the other groups were given salt mixtures with lower concentration of iron, and the fourth group—the control—received no mineral supplements to their diet.

19. The control group developed the typical signs of malnutrition. The group allowed to lick freely the mixture of salt and iron oxide has remained in good condition without any sign of disease. The two other groups are intermediate in condition between the control group and those receiving the richest iron mixture.

20. The average increases in weight in lbs. of the four groups for the eight months during which they were under observation, are as follows:

Control group (no iron)	1.4
Low iron group	31
Medium iron group	58
High iron group	90

21. The relative appearance of the control group and the high iron group is well shown in the plates reproduced in Appendix IV.

22. *Nakurutis* was believed to be closely allied, if not identical, with Bush-sickness, and the test was based on the results of many years' research by Aston and his fellow-workers on this subject in New Zealand. The results obtained in Kenya appear, therefore, to confirm the conclusions reached by Aston.

(b.) Sheep at Nakuru.

23. Feeding tests on sheep were carried out at Molo and Naivasha. A summary of results obtained is given in Appendix II. The following table shows average gains of lambs in weight, and the average weight of the fleeces to sheep receiving (a) a mineral mixture and (b) a mineral and protein mixture, compared with those of similar animals not receiving these supplements of the natural pasture.

	Molo (7 months)		Naivasha (9 months)	
	Gain in weight (in lbs.)	Weight of fleeces (in lbs.)	Gain in weight (in lbs.)	Weight of fleeces (in lbs.)
Control group	11.5	14.97	30.7	1.95
Group fed on mineral mixture	18.2	15.74	44.2	2.31
Group fed on mineral and protein mixture	22.0	17.81	49.2	2.04

24. The effect of the addition of minerals is more marked in the Molo sheep than in the Naivasha sheep. In the latter the addition of protein had no beneficial effect. This result is in accordance with the analysis of the pastures of these two districts, which has been carried out since these two experiments were begun. In the Naivasha pastures there is no marked deficiency of either minerals or protein.

In both areas the addition of minerals was accompanied by a definite increase in the weight of fleeces. There is no available information to show whether the quality of the fleece was affected in these cases.

(c.) Dairy Cows.

25. Owing to the breakdown in the centre in the Athi Plains, already referred to, the data in regard to dairy cows is not sufficient to enable a report to be prepared.

V.—WORK IN GREAT BRITAIN.

(a.) Feeding Tests in Scotland.

26. In certain districts in Scotland the hill pastures are deficient in minerals. An investigation, on a limited scale, on the effect of these deficiencies on sheep has been running for several years. In view of the work being carried out in Kenya, it was decided in 1926 to extend the tests in Scotland so that these home tests, which could be inspected personally by senior workers, should serve as general controls for the overseas tests. Though the expenditure for this Scottish work was not met from the grant made for the work in Kenya, the results are referred to here as they form in effect, part of a single investigation.

27. The Scottish tests are not exactly comparable with those in Kenya because the material fed contained, in addition to minerals and protein, 5 per cent. of cod liver oil. Half an ounce of the material per head per day was fed to ewes from November to July. A summary of the results is given in Appendix III.

28. In six centres out of eight the lambs from ewes receiving a supplementary feed were heavier, on an average, at birth and at weaning than the controls, and on all the farms except one, where weights of fleeces were obtained, the average weight of the fleeces of the ewes receiving the supplementary feed was heavier than that of the controls. The results of these Scottish tests, therefore, tend to confirm those obtained in Kenya.

(b.) Search of Scientific Literature.

29. While the foregoing experiments have been in progress, it has been possible to carry out a survey of the literature bearing on deficiency of minerals in pasture and its effects on the health and productivity of grazing animals. Abstracts have been made of all available papers on this subject, and the information collected has been written up with a full bibliography.

VI.—RECOMMENDATIONS.

30. We are satisfied from the results already obtained through the investigation that deficiencies of minerals in the pastures of Kenya do actually exist and that the supplementary feeding of minerals to animals grazing the pastures has a definitely beneficial effect in preventing *Nakurutis* and in increasing the rate of growth of lambs and the weight of the fleece.

31. The experiments described in the previous Sections have now been in progress for a full year. The investigation has been carried out with the utmost economy and its cost has been materially reduced by the many services rendered without charge, by the Rowett Research Institute. The expenditure to the 30th September, 1927, from the grant received from the Empire Marketing Fund amounts to £4,889. 4s. 8d., leaving an unexpended balance of £5,110. 16s. 4d. The two years' period for which the grant was originally asked ends on the 31st March, 1928. We recommend that arrangements should be made to continue the investigation beyond that date provided that the total expenditure incurred does not exceed the unexpended balance of the grant approved by the Empire Marketing Board.

32. In the first place, we consider that the experimental tests in Kenya should be carried to a conclusion, though some rearrangement in the methods adopted is probably desirable in the light of the experience gained during the past year. We further consider that the control tests in Scotland should be extended to include chemical and, if practicable, serological tests of the blood of animals under test, to determine the influence of the mineral content of the pastures and of supplementary feeding on the composition of the blood and resistance to disease. We recommend

that this work should be centred at the Moredun Institute for Research in Animal Diseases at Edinburgh, and that the co-operation of the Director of that Institute and the Professors of Bacteriology at Glasgow and Edinburgh Universities should be invited for this part of the investigation. This development will involve the appointment of a bacteriologist. We consider also that digestibility tests should be carried out with pastures of a low mineral content. Professor Wood, F.R.S. (one of the members of our Sub-Committee), has undertaken to arrange for this work to be done at the Nutrition Institute at Cambridge University. A junior bio-chemist will be employed for this work.

33. As regards the conduct of this further stage of the investigation, it is not possible to anticipate indications of importance that later results may bring to light. It would therefore, we feel, be unwise to define a rigid programme. Accordingly, we recommend that in this matter a wide discretion should be given to Dr. Orr, the Director of the Research, in regard to the detailed methods to be adopted provided that the experiments undertaken are in conformity with the general scheme recommended in our Second Report (C.R. (C) 11). Further, we consider that the fullest advantage should be taken of the facilities offered in any particular case by expert authorities in this country. As regards any staff that it may be necessary temporarily to engage, we recommend that Dr. Orr should be empowered to arrange, with the Board of Agriculture for Scotland for the appointment of temporary staff within the limits of the funds available at rates of pay not exceeding the normal appropriate scales. At the same time, we recommend that on the completion of one year's probationary service from the date of sailing, the temporary staff employed on the field investigations in Kenya should be given an increment of salary to be fixed by Dr. Orr with the Board of Agriculture for Scotland in consultation with the Colonial Office, with due regard to the prevailing rates of pay for Government service in Kenya. We learn that arrangements have been made for Dr. Orr to visit Australia early in 1928, and we hope that it may be found possible for him to include in his programme a visit to Kenya. None of the senior staff has so far had an opportunity of inspecting the conduct of the field work in Kenya. The arrangement we suggest would afford a convenient opportunity for this to be done, and would enable Dr. Orr to rearrange the experimental tests in any particular which he might consider desirable.

34. The search of the scientific and agricultural literature on mineral deficiencies of natural pastures has been fruitful of results of great value to expert workers in this field. We recommend that the paper embodying the results of this search should be communicated confidentially to the heads of the Institutes working on nutritional problems in Canada, Australia, South Africa and New Zealand. We further recommend that a shorter paper should be prepared summarising the results disclosed by the search of the literature, and that the Committee of Civil Research should invite the Dominions Office and Colonial Office to communicate this shorter paper to the Dominions and Colonies to whom the original *questionnaire* (C.R. (C) 6) was sent, and should invite the India Office to communicate it to the Government of India and the Foreign Office to communicate it to the Government of the Sudan. The question whether the results of the investigation should be published, and if so where and in what form, should, we consider, be deferred for later consideration. In view of the valuable results obtained by the search of the literature, we recommend that the services of the workers employed should be retained, and that subject to the direction of Dr. Orr, the Director of the Investigation, they should be employed on searching and epitomising the literature of cognate scientific subjects.

#### VII.—SUMMARY.

36. Our conclusions and recommendations may be summarised as follows—
- (a.) That the results already obtained through the investigation show that deficiencies of minerals in the pastures of Kenya do actually exist, and that the supplementary feeding of minerals to animals grazing the pastures has a definitely beneficial effect in preventing *Nekrotic* and in increasing the rate of growth of lambs and the weight of the fleece.
  - (b.) That the investigation should be continued beyond the period of two years for which it has been authorised, provided that the total expenditure incurred does not exceed the grant approved by the Empire Marketing Board, viz., £10,000 in all.

that this work should be centred at the Moredun Institute for Research in Animal Diseases at Edinburgh, and that the co-operation of the Director of that Institute and the Professors of Bacteriology at Glasgow and Edinburgh Universities should be invited for this part of the investigation. This development will involve the appointment of a bacteriologist. We consider also that digestibility tests should be carried out with pastures of a low mineral content. Professor Wood, F.R.S. (one of the members of our Sub-Committee), has undertaken to arrange for this work to be done at the Nutrition Institute at Cambridge University. A junior bio-chemist will be required for this work.

33. As regards the conduct of this further stage of the investigation, it is not possible to anticipate indications of importance that later results may bring to light. It would therefore, we feel, be unwise to define a rigid programme. Accordingly, we recommend that in this matter a wide discretion should be given to Dr. Orr, the Director of the Research, in regard to the detailed methods to be adopted provided that the experiments undertaken are in conformity with the general scheme recommended in our Second Report (C.R. (C) 11). Further, we consider that the fullest advantage should be taken of the facilities offered in any particular case by expert authorities in this country. As regards any staff that it may be necessary temporarily to engage, we recommend that Dr. Orr should be empowered to arrange, with the Board of Agriculture for Scotland for the appointment of temporary staff within the limits of the funds available at rates of pay not exceeding the normal appropriate scales. At the same time, we recommend that on the completion of one year's probationary service from the date of sailing, the temporary staff employed on the field investigations in Kenya should be given an increment of salary to be fixed by Dr. Orr with the Board of Agriculture for Scotland in consultation with the Colonial Office, with due regard to the prevailing rates of pay for Government service in Kenya. We learn that arrangements have been made for Dr. Orr to visit Australia early in 1928, and we hope that it may be feasible for him to include in his programme a visit to Kenya. None of the senior staff has so far had an opportunity of inspecting the conduct of the field work in Kenya. The arrangement we suggest would afford a convenient opportunity for this to be done, and would enable Dr. Orr to rearrange the experimental tests in any particular which he might consider desirable.

34. The search of the scientific and agricultural literature on mineral deficiencies of natural pastures has been fruitful of results of great value to expert workers in this field. We recommend that the paper embodying the results of this search should be communicated confidentially to the heads of the Institutes working on nutritional problems in Canada, Australia, South Africa and New Zealand. We further recommend that a shorter paper should be prepared summarising the results disclosed by the search of the literature, and that the Committee of Civil Research should invite the Dominions Office and Colonial Office to communicate this shorter paper to the Dominions and Colonies to whom the original *questionnaire* (C.R. (C) 6), was sent, and should invite the India Office to communicate it to the Government of India and the Foreign Office to communicate it to the Government of the Sudan. The question whether the results of the investigation should be published, and if so, where and in what form, should, we consider, be deferred for later consideration. In view of the valuable results obtained by the search of the literature, we recommend that the services of the workers employed should be retained, and that, subject to the direction of Dr. Orr, the Director of the Investigation, they should be employed on searching and epitomising the literature of cognate scientific subjects.

#### VII. - SUMMARY.

35. Our conclusions and recommendations may be summarised as follows:—

- (a.) That the results already obtained through the investigation show that deficiencies of minerals in the pastures of Kenya do actually exist, and that the supplementary feeding of minerals to animals grazing the pastures has a definitely beneficial effect in preventing *Nakivuttia* and in increasing the rate of growth of lambs and the weight of the fleeces.
- (b.) That the investigation should be continued beyond the period of two years, for which it has been authorised, provided that the total expenditure incurred does not exceed the grant approved by the Empire Marketing Board, viz., £10,000 in all.

(c.) That as regards the expenditure of the remaining balance of the grant from the Empire Marketing Board, discretion should be given to Dr. Orr, the Director of the Research.

- (i) to settle the detailed method by which the investigation should be continued, provided that the experiments undertaken are in conformity with the general scheme recommended in our Second Report (C.R. (C) 11) and approved by the Committee of Civil Research; and that the fullest possible advantage is taken of facilities offered by expert authorities in Scotland and this country;
- (ii) to arrange with the Board of Agriculture for Scotland for the appointment of temporary staff within the limits of the funds available at rates of pay not exceeding the normal appropriate scales;
- (iii) to arrange with the Board of Agriculture for Scotland, in consultation with the Colonial Office, for the grant of increments of salary to the temporary staff at present employed on the field investigations in Kenya on the completion of one year's probationary service from the date of sailing, the increments to be fixed with due regard to the prevailing rates of pay for Government servants in Kenya;

(d.) That as arrangements have been made for Dr. Orr to visit Australia early in 1928, he should take the opportunity of personally inspecting the field work in Kenya and of re-arranging the experimental tests in any necessary particular;

(e.) That the paper embodying the results of the search of the literature of nutrition should be communicated confidentially to the heads of Institutes working on nutritional problems in Canada, Australia, South Africa and New Zealand.

(f.) That a shorter paper should be prepared summarising the principal points disclosed by the search of the literature of nutrition, referred to in (e) above;

(g.) That the Committee of Civil Research should communicate copies of the shorter paper referred to in (f) above to the Dominions Office for transmission to the Dominion Governments, to the India Office for transmission to the Government of India, to the Colonial Office for transmission to the Governments of the Colonies and Dependencies to which the original *questionnaire* (C.R. (C) 6) was sent, and to the Foreign Office for transmission to the Government of the Sudan;

(h.) That the question whether the results of the investigation should be published, and if so, where and in what form, should be deferred for later consideration;

(i.) That in view of the valuable results obtained by the search of the literature of nutrition, the services of the workers employed should be retained and that, subject to the direction of Dr. Orr, they should be employed on searching and epitomising the literature of cognate scientific subjects.

Signed on behalf of the Sub-Committee,  
WALTER ELLIOT, Chairman.

(Signed) A. F. HEMMING,  
Secretary to the Sub-Committee.

21 Whitehall Gardens, S.W. 1.  
December 14, 1927.

APPENDIX I.

TABLE (A).—COMPOSITION OF THE DRY MATTER OF THE HERBAGE.

Contry	Naivasha	Doonholm (Ashi Plains)	Kerinet Molo.		Naivasha	British Pasture	
	Average of 14 Samples.	Average of 7 Samples.	Average of 10 Samples. Area A.	Average of 10 Samples. Area B.	Average of 21 Samples.	Average for Collocated Pasture.	Average for Hill Pasture All Dates.
Dry Matter	100	100	100	100	100	100	100
Nitrogen	2.06	1.46	0.94	0.86	1.62	2.82	2.58
Total Ash	12.58	12.36	11.54	17.03	17.72	9.75	7.18
Acid Soluble Ash	5.38	4.42	2.46	2.80	3.22	6.54	4.86
Lime (CaO)	1.60	0.64	0.45	0.48	0.40	1.00	0.88
Soda (Na <sub>2</sub> O)	0.07	0.16	0.02	0.02	0.03	0.25	0.37
Potash (K <sub>2</sub> O)	2.25	1.36	0.83	0.69	1.78	3.18	2.86
Phosphoric Acid (P <sub>2</sub> O <sub>5</sub> )	0.38	0.86	0.19	0.17	0.35	0.74	0.67
Chlorine (Cl)	0.42	0.47	0.18	0.17	0.33	0.54	0.64

TABLE (B). RAINFALL EFFECT—NAIVASHA.

Percentages expressed on Dry Matter.

Date of Collection	March 6.		March 23.	
	Before Rain.	After Rain.	Before Rain.	After Rain.
Dry Matter	100	100	100	100
Nitrogen	1.05	0.60	1.05	0.60
Total Ash	9.68	13.50	9.68	13.50
Acid Soluble Ash	2.70	8.76	2.70	8.76
Lime (CaO)	0.51	1.22	0.51	1.22
Soda (Na <sub>2</sub> O)	0.03	0.08	0.03	0.08
Potash (K <sub>2</sub> O)	0.70	4.17	0.70	4.17
Phosphoric Acid (P <sub>2</sub> O <sub>5</sub> )	0.30	1.16	0.30	1.16
Chlorine (Cl)	0.24	0.62	0.24	0.62

TABLE (C). RAINFALL AND MATURITY EFFECTS—NAKURU.

Percentages expressed on the Dry Matter.

Date of Collection	January	March 16.	April 16.	June 27.
	Before Rain.	After Rain.	After Rain.	Grass Fully Mature.
Dry Matter	100	100	100	100
Nitrogen	0.51	0.75	1.35	0.77
Total Ash	14.10	11.54	2.36	9.54
Acid Soluble Ash	2.35	3.41	6.12	3.65
Lime (CaO)	0.39	0.40	0.52	0.28
Soda (Na <sub>2</sub> O)	0.03	0.03	0.06	0.06
Potash (K <sub>2</sub> O)	0.97	1.14	3.25	1.96
Phosphoric Acid (P <sub>2</sub> O <sub>5</sub> )	0.17	0.15	0.41	0.19
Chlorine (Cl)	0.26	0.27	0.85	0.13

APPENDIX II.

FEEDING TESTS, NAIVASHA, NAKURU.

Weights in lbs.

	Group I.	Group II.	Group III.	Group IV.
	Control.	Low Iron.	Medium Iron.	High Iron.
	Nil.	Mineral Mixture with 4 per cent. Fe <sub>2</sub> O <sub>3</sub> ad lib.	Mineral Mixture with 7 per cent. Fe <sub>2</sub> O <sub>3</sub> ad lib.	Mineral Mixture with 30 per cent. Fe <sub>2</sub> O <sub>3</sub> ad lib.
<i>Grad. Oxen (9).</i>				
Average weight Nov. 16, 1926	704.7	774.3	763.8	765.3
Average weight July 4, 1927	773.0	829.1	843.4	864.4
Gain	68.3	54.8	79.6	99.1
<i>Work Oxen (15).</i>				
Average weight Nov. 16, 1926	610.19	589.1	580.7	560.9
Average weight July 4, 1927	600.71	608.8	620.5	643.2
Gain	10.8	19.7	39.8	76.3
<i>Native Oxen (4).</i>				
Average weight Nov. 16, 1926	607.3	616.4	636.8	605.8
Average weight July 4, 1927	639.5	636.8	628.3	636.5
Gain	32.2	19.4	31.5	29.7

SHEEP TEST.

	Group I.	Group II.	Group III.
	Basal.	Basal + Minerals.	Basal + Minerals + Protein.
<i>Molo (45 per group).</i>			
Average weight Feb. 16, 1927	35.0	35.2	35.1
Average weight Sept. 10, 1927	49.3	53.4	57.1
Gain	14.3	18.2	22.0
Gains expressed as per cent. of gain in Group I	100	127	154
Average Fleece weights	1.58	1.74	1.81
<i>Naivasha (46 per group).</i>			
Average weight Nov. 24, 1926	25.0	24.1	24.8
Average weight Aug. 18, 1927	64	63.8	67.0
Gain	39.7	44.2	42.2
Gain expressed as per cent. of gain in Group I	100	114	106
Average Fleece weights	1.95	2.31	2.04
Feeding	Mineral Mixture— Nil.	Mineral Mixture— ½ oz. each daily ad lib.	As II plus 2 oz. protein per sheep daily.



## APPENDIX III.

## SCOTTISH TESTS.

	Fed.	Control unfed.
<i>Weights of Lambs at Birth.*</i>		
	Lbs.	Lbs.
Blairmore, Arran	7.4	7.1
Benlester, Arran	8.7	7.7
Easiehill, Rowett Institute	9.5	8.7
Edgerston, singles	9.0	8.5
"    twins	7.8	7.2
<i>Weights of Lambs at Weaning.</i>		
Easiehill, Rowett Institute	60.4	78.2
Boghall, Edinburgh College Farm	61.0	51.4
Watcarrick, Langholm	59.2	49.1
Terrona	58.8	51.5
Drumbune, Dalry	49.8	47.4
<i>Weights of Fleeces.</i>		
Blairmore	4.8	4.2
Benlester	6.0	5.5
Edgerston, ewes	4.6	4.2
"    hogs	4.8	4.8
Watcarrick	3.7	3.8
Terrona	3.8	3.5
Drumbune	5.1	3.8

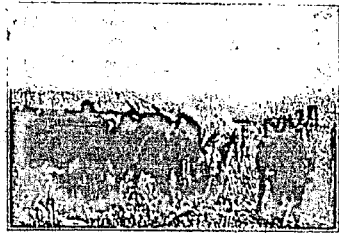
\* The belly wool in the fed lot was shed before clipping.



APPENDIX IV



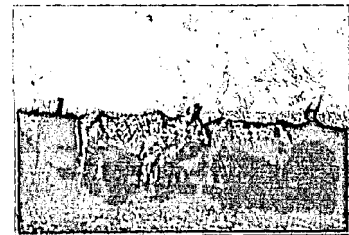
HIGH Dose GROUP



CONTROL GROUP



HIGH Dose GROUP



CONTROL GROUP

This is a confidential document

in Kenya.

Reference M/2028

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END

MR. H. T. ALLEN,  
COLONIAL OFFICE.

As you are probably aware Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen, left England last week on a scientific mission to Australia in connection with problems of animal nutrition and diseases. On his way he will call at Kenya, arriving for this purpose at Mombasa on February 16th and remaining in the Colony until the 8th March.

Before leaving, Dr. Orr asked that the Kenya Government might be informed of his visit, and, if that has not already been done, we should be glad if you would take the necessary action either by despatch or telegram.

*G. W. H. K. L. O. G.*

24th January, 1928.

*It will let us know after meeting of Research Grants Committee with whether proposal for continuation of work approved. Then we must let Sir J.*

*25/1*