No. 17160.

SUBJECT CO533/410

Geological Survey.

Assistance from Colonial Development Fund.

Previous

16182/30.

Subsequent

18046/32 (Sir A. Kitson's Appt.)

FILE C.

1. Gov. Byrne 180 ______________________ 30 March

Encloses application for assistance from C.D.F. for establishment of a Geological Survey;

Dup. to Mr. Smith for C.D.A.C.

will forward copies of Dr. Wayland's report on a geological reconnaissance of S. Kavirondo.

This application would seem to present a difficulty in that the local authorities are unable to give an estimate of the approximate date of the completion of the proposed survey. It seems most unlikely that the C.D.A.C. would ~~[illegible]~~ approve of a fixed annual grant of £2,500 for an indefinite period although sympathetic with the proposed undertaking. I suggest an informal talk with Mr. Freeston, before the application is submitted in its present form.

G.A. Jay
1/6/31.

I must apologise for delaying this. The Tanganyika papers have until recently been in circulation.

The need for a geological survey of Kenya has been [illegible]. In 1929 arising out of correspondence regarding the identical mining legislation which has recently been passed by Kenya, Uganda and Tanganyika, the Imperial Institute Advisory Committee on Mineral Resources addressed the Secretary of State on the subject, see No. 3 on [illegible] below; their recommendation is quoted in the present application. Since then the Secretary of State has continued to press the Governor to do something about a geological survey.

The object seems one eminently suitable for assistance from the C.D.F., but I entirely agree with Mr. Jay that it is impossible to ask the

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[illegible]. A. Jay
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The need for a geological survey of Kenya has been [illegible]. In 1929 arising out of correspondence regarding the identical mining legislation which has recently been passed by Kenya, Uganda and Tanganyika the Imperial Institute Advisory Committee on Mineral Resources addressed the Secretary of State on the subject, see No. 1 on 18502/29 below; their recommendation is quoted in the present application. Since then the Secretary of State has continued to press the Governor to do something about a geological survey.

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A | Committee for a contribution of £4,000 a year for an indefinite number of years. The work and staff are 6 to be "such that when the time comes for the institution of a combined service (i.e., when, if ever, Closer Union comes about), the work will not be wasted and the staff could be absorbed into the combined service". I would suggest that the Committee be asked to recommend the following:-

A grant of say £4,000 in the financial year 1931-32 (it is unlikely that more than this would be spent before the 1st April 1932) to enable a systematic survey of the geology of the Colony to start straight away, and, unless a combined service is then being set up, the same contribution would have to be recommended [illegible] during the [illegible]

B. | [illegible] further grants in subsequent years if the local govt. was unable to [illegible] from its own resources to [illegible] in the [illegible]

This would enable [illegible] to engage staff [illegible] service in the first instance [illegible] prospect of [illegible] being [illegible] until the survey was completed.

[illegible] for consideration whether before [illegible] the Committee we should obtain the [illegible] Imperial Institute. I think at [illegible] we send them a copy of [illegible] reference in No.6 on [illegible] they have any comments to make [illegible]

on the application. The next meeting of the Committee is June 24th, closing day for applications June 10th.

[illegible]
25.5.31

(A) I agree. The CDAC will be unlikely to give for more than say 2 years.

(B) ~~I don't think~~ the CDAC would look at the scheme on this basis. They would want an assurance that Kenya would complete the scheme i.e. the mineral-geological survey of the territory. If they got that assurance they might give the whole cost for an initial limited period; but of course there is a [illegible] chance that they will turn the whole scheme down as administrative expenditure.

As Secy of the C.D. Survey committee, I suggest that [illegible] should see them: the way with [illegible] to get the views of the Geological Section of the Mineral Survey Committee and possibly the blessing for the scheme, before it goes forward to the CDAC.

[illegible]

Unless the C.D.A.C. were prepared to recommend a grant covering the whole cost I don't think Kenya [illegible] to find the money for the balance. The [illegible] geology scheme foundered on that rock.

[illegible signature]
5/6/31

Mr Green

Any advice or suggestions wh. you may have, would be welcome. I shd much like to see a geological survey started in Kenya at [illegible] cost – and I shd much like to see Kenya get a share of the C.D.F.

A C C Parkinson
5/6/31

Mr. Parkinson,

I am sorry that this has been delayed by pressure of work.

The Kenya Government are apparently beginning to learn something of the uses of a geological survey, though they have not yet realised that the value of minerals to a territory is, generally, in inverse order of their expensiveness. The most important of all minerals to the prosperity of any country is water; next, minerals used in agriculture, food and constructions, such as limestone, fertilisers, salt, building and road materials; then fuel, and a long way down the list, metallic ores.

The organisation proposed is curious. No head; two young geologists at equal salaries; and a topographer. There must be an experienced man to run the show, and a topographer is unnecessary in the early stages. I would advise Kenya to begin by modelling on the excellent example of Nyasaland, which has been highly successful. I would estimate

Capital	£400.
Director	1000.
Field Geologist	600-840.
[Native clerk, messenger etc.,	100.]
Passages	150.
Transport and travelling	600.
Assaying etc.	50.
Contingencies	100.
	3000

For second year delete capital and passages, but add £100 for equipment, assays, and library, making £2500. I assume that headquarters and necessary furniture will be provided.

The best man for Kenya would be Dixey of Nyasaland, whose work has pleased and impressed the local unofficials. But he certainly would not go under £1200.

As to (4) there is no date of completion.

The

[illegible handwritten marginal note] £3040

[illegible initials]

The Geological Survey of Britain has been in existence for nearly 90 years and is still going strong. Kenya is a good deal bigger. The real point of a Geological Survey, as distinct from the rather futile expeditions sometimes tried, is its permanence and the consequent steady accumulation and record of knowledge, embodied largely in maps, and available to Government and the public. I think that the use of the word "established" in paragraph 3 of the despatch and the reference to Uganda show that Sir Byrne contemplates a permanent department and, if given a start for 3 or 5 years, is prepared to undertake to carry on.

I suggest that in the first place Sir B. Blackett might be consulted. If he considers that there is any chance of the Colonial Development Advisory Committee agreeing to the application, I could get it examined by the Survey Committee, though not in time for the Colonial Development Advisory Committee meeting on 2nd September. Or the scheme could be put forward on 2nd September with a promise so to refer it before putting it into force.

[signature] 13.7.31

Mr J. Campbell

This seems to me an admirable subject for assistance from the

[illegible] /7/31

[illegible margin note] [initials] /7/31

C.D.F. [illegible] part of the cost is going to take the line 5 that the Col. Govt. must put up 50% or at any rate a substantial part of the cost, then we can finish with the thing at once & tell Kenya that as they have no money to spare, they cannot have any C.D.F. assistance. (To him that hath shall be given ....)

The Kenya Govt. will provide office accommodation & clerical assistance, — a very small item; but that is all.

What, I think, we should do is a free grant for 3 years to get the survey properly started, the personnel being engaged on the usual "30 months" agreement: for the first year, say, £5000, as Mr Green suggests, & for each of the next 2 years, say, £2500.

Will you be able

Is sound [to ask] Sir Basil Blackett, as Mr. Green suggests, please?

A.C.C. Parkinson 14.7.31

I am afraid there is very little chance of getting aid here. The difficulties are:-

(i) the comm: may take the view that this is normal administrative expenditure. It would be difficult to contest that opinion. A geological dept: is in fact part of the normal administrative equipment of any well-run Government.

(ii) the liability continues indefinitely; and it may be--probably will be--that the value of much of the work done in, say, three years will depend on that work being carried to its logical conclusion. The Comm: will certainly not accept a continuing liability; and it will probably insist--from the point of view mentioned above--on guarantees being given that the work will in fact be continued after the initial period (if it agrees to provide the funds for the initial period) as an essential condition of giving aid at all.

It is difficult to see how any satisfactory guarantees could be given as to this, as things now stand in Kenya.

(iii) I think the Comm: are disposed to be reasonably liberal, in present circumstances, as regards ~~xxxxxx~~ contributions from the Govt:. See para: 16 of their latest report as to their general policy in such matters. But it will be appreciated that the impossibility of getting the local Govt: to aid in the establishment of a Geo: Survey Dept: at present will have an effect on the Comm's decision.

4. In the light of these considerations, it seems to me that this proposal is almost certain to be rejected. As there is a formal application, I think it must--under our standing instructions--be forwarded to the Comm:. There would then be no need to consult Sir Basil Blackett unofficially. If it is still desired that that should be done, this consultation usually takes place through Mr: Preston.

[illegible handwritten marginal note]

5. One never knows what will happen, of course; and I would send on the application, amended as suggested. I think Mr: Green's criticism is sound and valid. At the meeting, we would have to say that, if initial assistance were given, Kenya would carry on, if that were [illegible] financially possible. I don't think we can in fact say more; and I feel pretty sure that that will not be enough. I'd put the initial period at three years, as suggested.

That is, I'm afraid, the best we can do; and I am practically certain it will not lead to the acceptance of this proposal.

The 13th: July 1931.

[signature] 15/7/31

Sir C. Bottomley

But if we put forward the scheme (as amended), we [illegible] say that in the [illegible] of an [illegible] favouring it, we [illegible] refer it to the [illegible] appropriate technical body (see Mr Green's minute) for examination before it is actually embarked upon?

A C C Parkinson 15.7.31

Yes. I take it that the Govr's scheme must go to the Committee but we can say that we prefer Mr Green's & so lead up to the reference to the Geological Section of the Imperial Geology Cttee

We need not apologise. I would say that the want of a Geological Survey in Kenya has been obvious for some time, & that now that the Govr has recommended its establishment we hope that the C.D.A.C. will realise that the help in spite of the bad times which prevent the Colony from giving any substantial funds of the expense in the initial stages.

[illegible] 18.7.31

Mr Parkinson

I attach 2 d/ft memoranda - one covering the applicn - one financial.

G Eastwood 24.7.31

1a & 1b

C.D.A.C. 823 — 9 Aug. 31

DESTROYED UNDER STATUTE

9/9/31

3 CDAC. 4 September

Consider provision of Geological Survey to be a commonplace of administration in Kenya and are unable to recommend any assistance from fund.

This was not wholly unexpected.

1. Write to the Gov. informing him (enclosing (5) - less the financial memorandum) saying that his application was duly submitted to the Cttee but that [the CDF regrets to state that] the Committee felt themselves unable to recommend the grant of any assistance from the CDF. Go on to say that the reasons which influenced the Cttee in their decision were ... just of paras 2 & 3 of (5)

G Eastwood 9/9

Dft. cancel

[illegible] 9/9 altered

C.O.S.O.

8

5 To C.D.A.C. (w/c 4) by hand. 23 SEP 1931

Dep. Governor —— 571 —— 28 September, 1931
Enquires whether it is now possible to give a decision in regard to No 1. Mr Wayland's Report has now been printed & copies will be transmitted.

Partly – this has crossed 4

[signature] 23.X.31

7 Ag Col. Secy. (Enclosures) —— 18/12/31
Fwd 12 copies of Report by Mr E.J. Wayland "Report on a Geological Reconnaissance of Southern Kavirondo".

10 copies to Library

This is too technical for me but the general conclusion is that the area is worthy of considerable further study, & that it contains gold – which we already knew – & tin, which I at any rate did not know. ? send 6 copies to I.I. with comps.

p.32

[signature] 12.1.32

It may be presumed that distribution to the learned societies has been effected from Nairobi

[signature] 12/1

TO

nothing much more than a note-book. There is enough to show that the geology is interesting and not unfavourable from an economic point of view. I do not know who paid for this traverse, but it is not worth much for Kenya. Mr Wayland, quite rightly, puts in the whole of his observations, but a Survey would have summarised them in 5 pages, instead of 56.

J. Fred. W. Gregory [?]
2. 2. 32

Put S[?]

J. W. Allen[?]
3/2
at once[?]

COLONY AND PROTECTORATE OF KENYA

REPORT

ON A

Geological Reconnaissance

OF

Southern Kavirondo

BY

E. J. WAYLAND, A.R.C.Sc., M.I.M.M., F.G.S.

Director, Geological Survey, Uganda.

WITH APPENDICES ON THE PETROLOGY AND ASSAYING

BY

A. W. GROVES, Ph.D., M.Sc., D.I.C.

Assistant Chemist and Petrologist, Geological Survey, Uganda

Price [illegible]

NAIROBI:
PRINTED BY THE GOVERNMENT PRINTER
[illegible]

Report on a Geological Reconnaissance of Southern Kavirondo.

This Report is made up as follows:—

1. GENERAL.
2. NOTES ON INVESTIGATIONS.
3. RECOMMENDATIONS.

APPENDIX 1.—LIST OF SPECIMENS COLLECTED.

APPENDIX 2.—FIRE ASSAY RESULTS.

APPENDIX 3.—PETROLOGY.

1.—GENERAL.

The production of the following report has been long delayed. This is due to the desire to render it reasonably complete, but difficulty in doing so rapidly has been introduced by pressure of work, and shortage of staff.

A number of determinative tests, seventeen fire assays, and about 120 petrological investigations have been undertaken in this office, and Dr. Groves, who is mainly responsible for this work, has applied the means of mineral separation by the employment of heavy liquids—a process with which his name is now closely associated—to some samples of the Kisii Sandstone and quartzite, which I collected, with the highly interesting result that they are found to carry a little tin.

The work in Southern Kavirondo has proved the area to be an extremely interesting and important one geologically, and one in which conditions conducive to mineralization have obtained more than once. How far mineralization of economic significance has taken place is another matter, and one as yet not fully determined.

Igneous injection and volcanic extrusion have occurred repeatedly in this area. First in Archæan (Crystalline Complex) time, then in post-Archæan pre-Karagwe-Ankolean times, Karagwe-Aukolean times, Bukoba (i.e. Kisii Sandstone) times, probably in Karroo days, perhaps in Cretaceous times, and certainly in several of the Tertiary epochs. Associated with the larger, older and more acid intrusions, are offshoots.

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It is not proposed to go into the details of the geology in this report. It will be sufficient to say the following provisional sequence was established :—

Sedimentary Deposits.	Igneous
9. Recent. Present-day beaches and river alluvium, etc.	Simbi Crater.
8. ? Pleistocene. High-level terrace gravels, ancient beaches, red earth, etc., and the soft sandstones lying between Kendu and Homa (supposed by Oswald to be Pliocene [1]).	Volcanics of these periods are in all probability represented but they cannot be sorted out without detailed work.
7. Pliocene. The lacustrine sediments at Karungu?	
6. Miocene. The well-known fossiliferous beds at Karungu described by Oswald [2] and those of Rusinga Island and of the opposite mainland discovered by Wayland.	Nephelinite lavas and tuffs of Rusinga.
	Volcanics of late Cretaceous to Oligocene times may well be represented, but they cannot be sorted out without detailed work.
5. Karroo (Permo-carboniferous ?). It is not altogether impossible that Karroo beds may occur, but none was seen.	Dolerite sill associated with the Kisii Sandstone.
4. Bukoba Series. The Kisii Sandstone and associated phyllitic shales.	Altered amygdaloids and devitrified rhyolites, etc., apparently inter-bedded with the Kisii Sandstone. G2 granites, etc.
3. Karagwe-Ankolean. Kilaje phyllites and conglomerates.	
2. ? Pre-Karagwe-Ankolean-Post Complex. The Gori conglomerate.	Wire Hill felsites, etc.
1. Crystalline Complex.	G1 granites and amphibolites, etc.

[1] Q.J.G.S., Vol. LXX. [2] loc. cit.

The area is one which has suffered considerable disturbance, and faulting is common. One of the most important tectonic lines in the country is oriented approximately NW.–SE. It is along this direction that a mineralized shatter-zone occurs in the south-west of the Colony and crosses over into Tanganyika Territory. Here the newer granite has intruded a porphyry belt, and the earth movements, probably associated with the intrusion, have shattered and crushed the country in a remarkable way. One of the results of this diastrophism is the metamorphosis of a granite-porphyry, through a sheared granite-porphyry (locally known as "suet-rock") to schist. In this shear-zone gold reefs occur. Another important group of sheared porphyries occurs in the Wire Hill area, and appears to have been mistaken by a previous observer for an altered sedimentary series (slates), and was given the name of the Wire Hill beds, (J. S. Coates, 1909, referred to by Oswald, loc. cit.). These rocks are dealt with in an appendix to this report.

The gold areas of South-west Kavirondo are highly interesting. The property of the Kenya Gold Mining Syndicate (*see* sketch plan No. 1), though not completely opened up, appears to be a valuable one, but I do not pretend to be able to quote figures from the company's assay plans. The mine is well equipped for further development. It was my good fortune to arrive just as the first mass of sponge gold (weighing about 9 lb.) was produced. The reef being worked is known as *Blackhall's*, but ore from another reef known as the *M.K. Reef*, also the property of the Kenya Gold Mining Syndicate, is dealt with on this mine. The *M.K. Reef* was being worked opencast when I saw it, while the mine is down to the 200-feet level on *Blackhall's Reef*.

A little scheelite (calcium tungstate) was noticed in the *M.K. Reef*. Siderite is also present in small quantities.

Not far from *Blackhall's Reef*, the Kisumu Prospecting Syndicate are recovering gold from the rubble on the plateau near a granite (G2) outcrop. This rubble is most unlikely-looking stuff, but I gather that it yields well.

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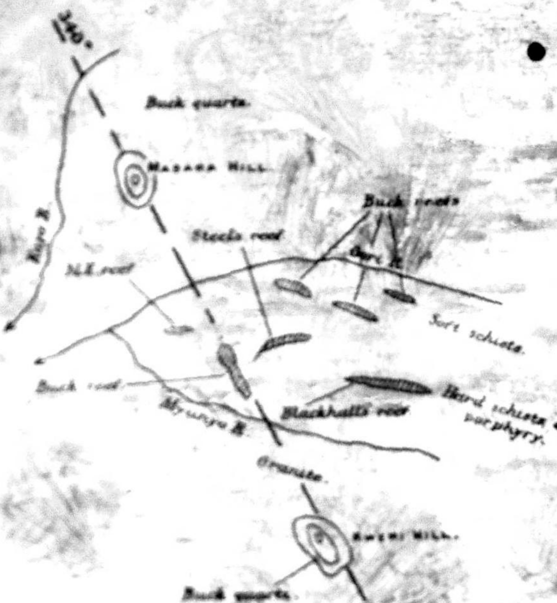


[illegible]

[illegible]

[illegible]

In what follows, details of the journeys undertaken will be found. These, although in note-book form, should enable anyone going over the ground to find all the outcrops referred to.

2.—NOTES ON SOME GEOLOGICAL INVESTIGATIONS IN THE SOUTHERN PARTS OF THE NYANZA PROVINCE OF KENYA COLONY.

I. Object.—To obtain a general idea of the geology of the country to the south of Kisumu and north of the Kenya–Tanganyika Territory, with a view to determining whether any part of the area is worthy of a detailed survey on account of its economic possibilities.

II. Procedure.—The procedure adopted was to camp at certain spots and radiate from these by car, or on foot, making preliminary geological traverses, collecting specimens, and information of geological interest.

III. Notes.—The following are unexpanded journey notes with reference to the country travelled over :—

(1) *Busia to Kisumu.*

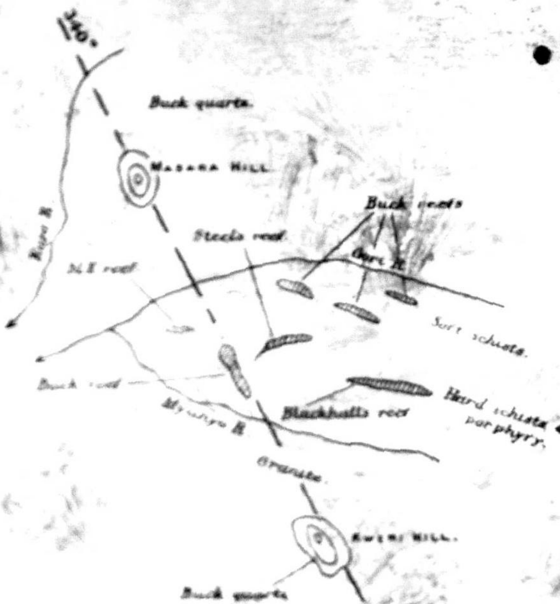
9th January, 1930. Distance, 82 miles. The country to start with is very open with but little bush.

The figures in brackets show approximate mileages from starting points, and figures in italics show the speedometer readings registered by my car from the start ; these are about 3 per cent too low.

6355.0 (0) Busia.—Immediately one leaves Busia (in Uganda) and enters Kenya, the good road gives place to a bad one. The journey is over flat country, sloping very gradually towards Lake Victoria. It is diversified by wide shallow vales, each of which is occupied by a very small stream. The surface of the flat, below the soil, is formed by a blanket of lateritic ironstone which masks the solid rocks beneath. This flat represents the lowest of three peneplains, all of which are extensively developed in different parts of Uganda.

6358.2 (3.2).—Up to this point the road has been running over the flat ; it now grades down into a vale.

6359.2 (4.2).—Here is a rest camp. On the flat lying to the east of the vale high-level gravels exist.



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6366.5 (11.5).—Descending again into another vale.

6367.5 (12.5).—Namambi River flowing south. On left bank there is a ginnery on the left of the road and a *duka* on the right of it.

[illegible] (12.9).—The second of two small streams passed since the Namambi (all the streams flow directly or indirectly into Lake Victoria).

[illegible] (14.[illegible]).—The soil, which has been essentially red and earthy hitherto, now becomes sandy. It is here indicative of the presence of granitic rocks beneath the surface.

[illegible] (15.[illegible]).—Telegraph line crosses the road along the crest of a long rise. Granite tors are seen right and left. [illegible] vale lies immediately ahead.

[illegible] (16.[illegible]).—Soil neither wholly lateritic nor wholly granitic. It soon becomes lateritic, however. Here the road to Mumias ([illegible] miles) is joined from the north by one from Malakisi (thirty-two miles).

[illegible] (17.[illegible]).—[illegible] way down the side of another vale, and [illegible] yards west of the stream, the country rock is [illegible] exposed in banks by the road. It consists of ex-[illegible] schists or gneisses, apparently the same rock as [illegible] the sedimentary (late Cretaceous or early [illegible]) of [illegible] (E. P. Uganda). Associated with [illegible] is a somewhat metamor-[illegible] quartz [illegible] (specimen 1006), and what appears to be a [illegible] sediment (specimen 1007). The schists are [illegible] by veins of blue-grey quartz with a [illegible] appearance, and there were some rather inviting [illegible]. This vale might with advantage be [illegible] by [illegible] pits or shallow boreholes, should a [illegible] opportunity arise. The dip of the schists is very [illegible] through [illegible] very steep southerly.

[illegible] (19.[illegible]).—Not far from Mile 62 is a bridge across the [illegible] River, and some sections are displayed in its [illegible]. Phyllites are seen dipping very steeply at S. 10°-20° E. (specimen [illegible]). They are intruded by a very fine-grained [illegible] (specimen [illegible]). [illegible] with little or no [illegible] at the [illegible] of these and the solid rock [illegible] of economic interest.

[illegible] (20.[illegible]).—[illegible] crosses the road which is [illegible] bad.

6380.8. (25.8).—Quartz dykes occur here. They are probably of no economic importance.

6381.5 (26.5).—Here the road to Mumias (nine miles) is joined by that from Sio (forty-two miles).

Between 6381.5 and the next observation, the soil becomes granitic (sandy).

6384.3 (29.3).—Here the road to Mumias (three miles) is joined by one from Bugoma (fourteen miles), Malakisi (twenty-nine miles) and Kitale (eighty-five miles). A few granite outcrops are passed before this road junction is reached and the soil continues to be sandy.

6387.0. (32.0).—Begin to go down into the Nzoia Valley.

6388.4. (33.4).—Nzoia Bridge. Granitic outcrops.

6390.7. (35.7).—Mumias.—The road makes a T junction with those from Yala (twenty miles) and Kisumu (forty-six miles), on the right; and from Kakamega (twenty-four miles) and Kapsabet, on the left.

One small stream crossed between this observation and the last.

6393.1 (38.1).—Lusumu River.

One small stream crossed between this observation and the last.

6395.4. (40.4).—Granite hill west of road.

6396.0. (41.0).—Granite outcrops east of road.

6397.3. (42.3).—Road crosses doleritic dyke in rotted granite country.

6399.1. (44.1).—Cross roads. Yala (nine miles), Lodana (fourteen miles) and Kisumu (thirty-seven miles) lie ahead; Butere (three miles) and Wali (ten miles) to the right, while Bukama (seven miles) and Kakamega (thirty miles) lie to the left.

The country, which has been very open bush and grass plain, is becoming more forested.

6400.6 (45.6).—A ravine (in well-forested country) in deep red soil, probably derived from dolerite. Bauxite may perhaps occur in this vicinity.

6401.7. (46.7).—Stream running in an unexpected direction in a well-forested gully. In the soil, which is rather light-coloured and buffish, except in the immediate vicinity

6366.5 (11.5).—Descending again into another vale.

6367.5 (12.5).—Namambi River flowing south. On left bank there is a ginnery on the left of the road and a *duka* on the right of it.

6367.9 (12.9).—The second of two small streams passed since the Namambi (all the streams flow directly or indirectly into Lake Victoria).

6369.4 (14.4).—The soil, which has been essentially red and [illegible] lateritic, now becomes sandy. It is here indicative of the presence of granitic rocks beneath the surface.

6370.6 (15.6).—Telegraph line crosses the road along the crest of a long rise. Granite tors are seen right and left. Another vale lies immediately ahead.

6371.9 (16.9).—Soil neither wholly lateritic nor wholly granitic. It soon becomes lateritic, however. Here the road to Mumias [illegible] is joined from the north by one from [illegible] (thirty-two miles).

[illegible] (17.9).—Some way down the side of another vale, and a hundred yards west of the stream, the country rock is [illegible] exposed in banks by the road. It consists of [illegible] schists or gneisses, apparently the same rock as [illegible] the sedimentary (late Cretaceous or early [illegible] of [illegible] Uganda). Associated with [illegible] is a somewhat metamorphosed [illegible] (specimen 1006), and what appears [illegible] sediment (specimen 1007). The schists are [illegible] by veins of blue-grey quartz with a [illegible] appearance, and there were some rather inviting [illegible]. This vale might with advantage be [illegible] by prospecting pits or shallow boreholes, should a [illegible]. The dip on the schists is very [illegible] very steep southerly.

[illegible] Mile 62 is a bridge across the [illegible] River, and some sections are displayed in its banks. Phyllites are seen dipping very steeply at S. 10°-20° E. (specimen [illegible]). These are intruded by a very fine-grained [illegible]. [illegible] with little or no [illegible] the solid rock [illegible] of weathered [illegible].

[illegible] (38.0) [illegible] the road which [illegible].

6380.8. (25.8).—Quartz dykes occur here. They are probably of no economic importance.

6381.5 (26.5).—Here the road to Mumias (nine miles) is joined by that from Sio (forty-two miles).

Between 6381.5 and the next observation, the soil becomes granitic (sandy).

6384.3 (29.3).—Here the road to Mumias (three miles) is joined by one from Bugoma (fourteen miles), Malakisi (twenty-nine miles) and Kitale (eighty-five miles). A few granite outcrops are passed before this road junction is reached and the soil continues to be sandy.

6387.0. (32.0).—Begin to go down into the Nzoia Valley.

6388.4. (33.4).—Nzoia Bridge. Granitic outcrops.

6390.7. (35.7).—Mumias.—The road makes a T junction with those from Yala (twenty miles) and Kisumu (forty-six miles), on the right; and from Kakamega (twenty-four miles) and Kapsabet, on the left.

One small stream crossed between this observation and the last.

6393.1 (38.1).—Lusumu River.

One small stream crossed between this observation and the last.

6395.4. (40.4).—Granite hill west of road.

6396.0. (41.0).—Granite outcrops east of road.

6397.3. (42.3).—Road crosses doleritic dyke in rotted granite country.

6399.1. (44.1).—Cross roads. Yala (nine miles), Lodama (fourteen miles) and Kisumu (thirty-seven miles) lie ahead; Butere (three miles) and Waki (ten miles) to the right, while Bukama (seven miles) and Kakamega (thirty miles) lie to the left.

The country, which has been very open bush and grass plain, is becoming more forested.

6400.6. (45.6).—A ravine (in well-forested country) in deep red soil, probably derived from dolerite. Bauxite may perhaps occur in this vicinity.

6401.7. (46.7).—Stream running in an unexpected direction in a well-forested gully. In the soil, which is rather light-coloured and buffish, except in the immediate vicinity

About 100 feet higher than the camp, on the side of the scarp there are other boulder beds and gravels. All these gravels are implementiferous, and the surface soils contain tools belonging to several different industries (cultures). It is hoped that time to deal with these may eventually be found.

The high-level gravels were panned, but gave no results of economic interest.

(3) *Sondu to Kericho (28 miles approximately).*

January 31, 1939.

6484.7. (0).—Police Camp.

6485.9. (1.2).—One hundred feet above the police camp there are boulder beds, and an outcrop of quartz-porphyry (specimen 1010).

6486.8. (2.1).—Much altered lavas with basaltic texture, displaying spheroidal weathering (not true boulders), passing into quartz-ironstone (specimens 1011 and 1011a).

6487.4. (2.7).—Outcrops of much altered and silicified andesite (?) (specimen 1012). This is succeeded by a similar but well-jointed stony lava (specimen 1013). This persists to the top of the scrap, after which no solid outcrops were seen. At Kericho some lavas were being used as road metal, but the quarry was not seen.

(4) *Sondu Police Camp to Rai River.*

6540.4. (0).—Police Camp.

6541.7. (1.3).—Road junctions left from Kerus and Nyakach Mission. Proceed along this. The track is extremely bad. By car to Mission, and then to the edge of the escarpment. Then by foot along the path that goes down to Sangu and ascend the Rai River, which rises to the east of Andingo. The section displayed is interesting. In its lower reaches the river cuts through alluvial deposits of a high-level plain; but affords, higher up-stream, some fine sections of amphibolite-schists (specimen 1014) with acid intrusives (specimens 1015 and 1015a) completely mylonised. These are generally gneissose and run for the most part between the parting planes of the schist, but in some places they cut across the bedding of the latter. There are also quartz stringers that usually cut the bedding. There is some contortion along the

About 100 feet higher than the camp, on the side of the scarp there are other boulder beds and gravels. All these gravels are implementiferous, and the surface soils contain tools belonging to several different industries (cultures). It is hoped that time to deal with these may eventually be found.

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January 31, 1930.

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(4) *Sondu Police Camp to Rai River*

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Locally there seem to be [illegible] the rocks are highly jointed, the chief systems being:—

(a) Dipping along 330 deg. at 60°.

(b) Dipping along 240 deg. very steep to vertical.

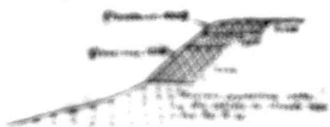
(c) Plunging downwards at right angles to the dip of the [illegible] dip joints.

(d) [illegible]

Higher up-stream the [illegible] are [illegible] by a very [illegible] which runs WNW.–ESE., and [illegible] the amphibolite-schists. [illegible]

[illegible]

[illegible]



[illegible]

The approximate NW.–SE. [illegible] of the ancient rocks [illegible] of the lower scarp.

(5) *Sonda to Kasi*

4580.3. (0).—Sonda.—Crossing the Sonda River shortly after leaving Sonda, one sees good exposures of high-level gravels and some [illegible] at less decomposed granitic rocks, resembling the granitic intrusives of the Sai River.

4662. (1.6).—Track from Lundwa border junctions left.

4665.8. (1.6).—Cross small stream. Stony lavas (probably devitrified rhyolite) passing into quartz-breccia (specimens 1502 and 1503).

5164.1. (4.8).—An ancient lava, now mostly altered to epidote-quartz rock (specimen 1504).

6074.8. (11.6).—Several small streams have been passed. Here in another, with a low [illegible] outcrop (specimen 1505).

6077.8 (10.6).—Track from Gyagi junctions right.

Sample 1506, a rock resembling in the main the Ventersdorp amygdaloid of South Africa. It is found, however, to be very much altered, and to consist largely of chalcedony, chlorite and epidote.

6080.6 (10.7).—Track junctions left.

6082.8. (10.8).—[illegible] exposes altered dolerite (sample 1507).

6085.4. (10.9).—Road junction. Papyrus-choked stream, the first of the kind seen since leaving Kasonda.

6088.1. (10.9).—Light-grey rock of somewhat andesitic appearance, actually an amphibolian-trachyte, possibly the same as one of Mr. Combe's porphyries from North Karamoja (vide Annual Report Geological Survey Uganda, 1927 and 1928).

6091.6. (10.9).—[illegible] right, Kasi left. [illegible] specimens 1509 and 1510 were collected. These are [illegible] trachyte.

6095.9. (11.0).—Bridge over Ragwe River. Beyond the bridge the [illegible] Road junctions right.

6102.0. (16.8).—A.D.C.'s house Kasi.

The country passed over is undulating, but the high ground tends to be much of the same level in a NNE.–SSW. zone, but declines steadily eastwards; to the east, however, the country is higher and more irregular.

[illegible]

strike of the amphibolite-schists which is NNW.–SSE., to WNW.–ESE., the dip being north-easterly at about 40° (in some places more).

Locally more acid bands separate the more basic layers of the schist. The rocks are highly jointed, the chief systems being:—

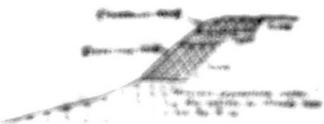
(a) Dipping along the strike at 40°.

(b) Dipping along the strike, very steep to vertical.

(c) Plunging downwards at right angles to the dip of the major dip joints.

(d) Others less regular.

[illegible]



[illegible]

[illegible]

(b) Sonda to Kasi.

6068.5. (0). Sonda.—Crossing the Sonda River shortly after leaving camp, one sees good exposures of high-level granite and some more or less decomposed granitic rocks, resembling the granitic intrusives of the [illegible] River.

6062. (1.6).—Track from Lutalwa border junctions left.

6062.4. (2.0).—Cross small stream. Stony lavas (probably devitrified deposits) passing into quartz-[illegible] (specimens [illegible] and [illegible]).

[illegible] (4.2).—[illegible] lava, now mostly altered to epidote-quartz rock (specimen [illegible]).

6074.8. (11.6).—Several small streams have been passed. Here is another, with a [illegible] outcrop (specimen [illegible]).

6077.2 (15.0).—Track from [illegible] junctions right.

Sample [illegible], a rock resembling in the mass the Ventersdorp amygdaloid of South Africa. It is found, however, to be very much altered, and to consist largely of chalcedony, chlorite and epidote.

6080.3 (15.7).—Track junctions left.

[illegible] altered dolerite (sample [illegible]).

6083.8. (18.8).—Road junction. [illegible] stream, the first of the kind seen since leaving [illegible].

[illegible] (20.3).—Light-grey rock of somewhat andesitic appearance, actually an [illegible] trachyte, possibly the same as one of Mr. Combe's porphyries, from North Kavirondo (vide Annual Report Geological Survey, Uganda, 1927 and 1928).

[illegible] junction of [illegible] right, Kasi left. [illegible] Specimens [illegible] and [illegible] were collected. These are [illegible] trachyte.

[illegible] (22.3).—Bridge over [illegible] River. Beyond the bridge the [illegible] Road junctions right.

[illegible] (24.5).—[illegible] a house Kasi.

The country passed over is undulating, but the high ground tends to be much of the same level in a NNE.–SSW. zone, but declines steadily lakewards; to the east, however, the country is higher and more irregular.

The gentle sloping plain is [illegible], and so are the hills to the east, till one gets about half way to Kisii, when the Kisii quartzites and sandstones are seen capping the escarpment. Exposures along the road are irregular and patchy. Kisii itself is situated on basalt or dolerite; presumably a sill which, according to *Felix Oswald* (Q.J.G.S. Vol. 70), underlies the mass of sandstone (specimen 1044, fine-grained basalt).

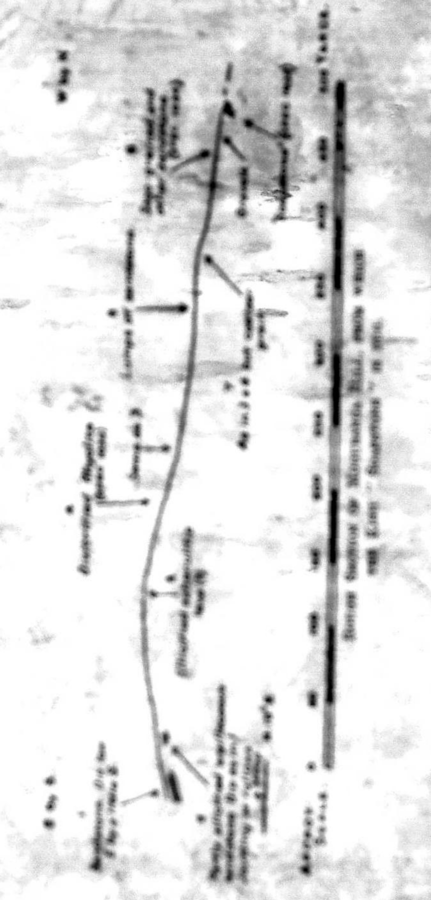
(6) *Kisii to the "Soapstone" Site on Nyagichenche Hill.*

Approximate position: E. 34° 39′ 0″; S. 0° 43′ 30″.

Proceeded by car to the nearest point on the road to this hill. Then went over the hill, and afterwards returned back to Kisii by car.

The hill is found to consist largely of somewhat altered [illegible] sediments of the Kisii group, which I have no doubt are of the same age as the Bukoba sandstones and quartzites. Like the Bukoba, Mityana and [illegible] beds, the Kisii deposits vary between [illegible] and in some places [illegible]; and [illegible] Bukoba Sandstone they are [illegible] by a [illegible] intrusion. The lower slopes of Nyagichenche hill [illegible] of quartzite [illegible] resting on a [illegible] sill. Near the top of the hill [illegible] separates that part of the hill containing the "soapstone" from the rest of the hill. [illegible] They are formed of local stone. The name of the spot from which the soapstone is dug is, I was told, [illegible], and the stone itself is called [illegible]. [illegible]

[illegible]



The gentle sloping plain is essentially bare, and so are the hills to the east, till one gets about half way to Kisii, where the Kisii quartzites and sandstones are seen capping the escarpment. Exposures along the road are irregular and patchy. Kisii itself is situated on basalt or dolerite; presumably a sill which, according to Felix Oswald (Q.J.G.S. Vol. 70), underlies the mass of sandstone (specimen, 1064, fine-grained basalt).

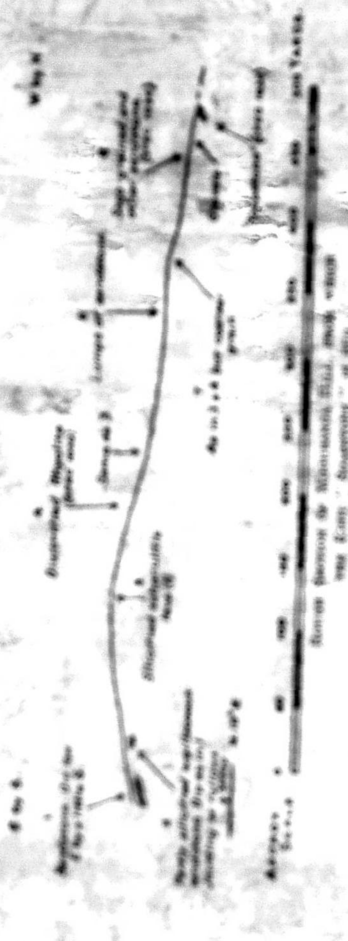
(6) Kisii to the "Soapstone" Site on [illegible] Hill

Approximate position: E. [illegible]; S. [illegible].

Proceeded by car to the nearest point on the road to this hill. Then went over the hill, and afterwards returned back to Kisii by car.

The hill is found to consist largely of somewhat altered siliceous sediments of the Kisii group, which I have no doubt are of the same age as the Bukoba sandstones and quartzites. [illegible]

[illegible]



The *Ogosi* is carved by natives into pots and pipe bowls, etc. It was used for the first purpose in prehistoric times, as shown by some of Mr. Leakey's discoveries, and by a "digging-stone" of this material found near Lugazi, in Uganda. The present industry is, however, very young. Specimens collected from the hill are as follows:—

Quartzite, 1031; amygdaloid, 1032; "soapstone," 1033; sago sandstone, 1034; devitrified rhyolite, 1035; glassy lava with spherulitic structure, 1036.

Return Traverse to Kisii.

6609.4. (0).—Start.

6610.0. (.6).—Stream crossing road to left.

6610.3. (.9).—Amphibolite (specimen 1037) in lumps by roadside. Before reaching this spot, fragments of sandstone were seen in the road.

6611.1. (1.7).—Amphibolite.

6612.0. (2.6).—After crossing a stream a road from [illegible] junctions left.

6612.3. (2.9).—Dolerite.

6612.7. (3.3).—Bauxite (?) (sample 1038). Due to its composition of dolerite or other basic rock.

6613.1. (3.7).—Dolerite.

6613.8. (4.4).—Stream crossing road to left.

6614.7. (5.3).—Bauxite (?). Several dolerite outcrops have been passed, usually near small streams.

6617.0. (7.6).—Stream crossing road to left.

6617.8. (8.4).—Fine-grained epidiorite (specimen 1039). It would appear that up to date the road has been running for the most part along a dolerite sill.

6619.1. (9.7).—Junction of Kisii–Rangwe–Homa Bay and Karungu–Suna roads.

6619.5. (10.1).—Red aplogranite outcrops (specimen 1040).

6620.3. (10.9).—Red aplogranite.

6621.1. (11.7).—Pink granite, somewhat resembling the famous Peterhead rock.

6621.3. (11.9).—Epidiorite (derived from a diorite dolerite) (specimen 1042).

6621.5. (12.1).—Dull-looking, partly decomposed granitic rock (specimen 1043). This is a [illegible].

6621.6. (12.2).—Granitic rocks as above.

6623.1. (13.7).—Highly decomposed fine-grained dolerite or basalt.

6623.9. (14.5).—Junction of [illegible] Homa Bay, [illegible] and Kisii roads.

6625.1. (15.7).—[illegible] Kisii. Kisii is built on a rock similar to that [illegible] (specimen 1044).

(b) Kisii to [illegible].

[illegible] (0).—A.D.C.'s house, Kisii.

[illegible] (2.1).—Road from Suna [illegible] left. The rocks [illegible] those of the basic Kisii sill.

[illegible] (4.0).—Road [illegible] junctions right. (Specimens [illegible] and [illegible] collected from [illegible].)

[illegible]

[illegible] outcrops of coarse dolerite (specimen [illegible]).

[illegible] Fine-grained basalt [illegible].

[illegible]

[illegible] Road crosses stream running left. [illegible] decomposed granitic rock [illegible].

[illegible] Lumps of [illegible] conglomerate [illegible] (specimen [illegible]). [illegible] a borrow pit.

[illegible] Road crosses stream running left. [illegible] conglomerates were crossed. These [illegible] Annual Report, [illegible] para. [illegible].

[illegible] Phyllites, probably [illegible], dip about [illegible] strike N. [illegible] E. (specimen [illegible]). I propose to call these the [illegible] phyllites [illegible]

The *Ogoni* is carved by natives into pots and pipe bowls, etc. It was used for the first purpose in prehistoric times, as shown by some of Mr. Leakey's discoveries, and by a "digging-stone" of this material found near Lugazi, in Uganda. The present industry is, however, very young. Specimens collected from the hill are as follows:—

Quartzite, 1031; amygdaloid, 1032; "soapstone," 1033; sago sandstone, 1034; devitrified rhyolite, 1035; glassy lava with spherulitic structure, 1036.

Return Traverse to Kisii.

6609.4. (0).—Start.

6610.0. (.6).—Stream crossing road to left.

6610.3. (.9).—Amphibolite (specimen 1037) in lumps by roadside. Before reaching this spot, fragments of [illegible] were seen in the road.

6611.1. (1.7).—Amphibolite.

6612.0. (2.6).—After crossing a stream a road from [illegible] junctions left.

6612.3. (2.9).—Dolerite.

6612.7. (3.3).—Bauxite (?) (sample 1038). Due to decomposition of dolerite or other basic rock.

6613.1. (3.7).—Dolerite.

6613.8. (4.4).—Stream crossing road to left.

6614.7. (5.3).—Bauxite (?). Several dolerite outcrops have been passed, usually near small streams.

[illegible] —Stream crossing road to left.

661[illegible] [illegible] —Fine grained epidiorite (specimen 1039). It would appear that up to date the road has been running for the most part along a dolerite sill.

661[illegible] (9.7).—Junction of Kisii, [illegible] and Karungu [illegible] roads.

6619.5. (10.1).—Red sphagranite outcrops (specimen 1040).

6620.3. (10.9).—Red sphagranite.

6621.1. (11.7).—Pink granite, somewhat resembling the famous Peterhead rock.

6621.3. (11.9).—Epidiorite (derived from a coarse dolerite (specimen 1042).

6621.5. (12.1).—Dull-looking, partly decomposed granitic rock (specimen 1043). This is a mylonitised [illegible] Granite.

6621.8. (12.3).—Granitic rocks as above.

6622.1. (12.7).—Highly decomposed fine-grained dolerite or basalt.

6622.7. (14.0).—Junction of [illegible] and Kisii roads.

6623.1. [illegible] Kisii. [illegible] a rock similar to that [illegible]

(B) Kisii to Ogugu's.

6625.1. (0).—[illegible] Kisii.

6626.0. [illegible] —Road from [illegible] junctions left. The [illegible]

[illegible]

[illegible]

[illegible]

[illegible] —Fine-grained basalt [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

probable, the conglomerates are part of the same sedimentary series as the phyllites, then they are lower than the phyllites, unless displaced by faulting, and may well represent the middle of the Karagwe-Ankolean here, as similar conglomerates appear to do in North Kavirondo (*see* Mr. Combe's remarks, p. 16, *Annual Report* for 1927).

6636.1. (11.0).—Lumps of conglomerate seen beside the road; they probably represent an interbedded band.

6636.5. (11.4).—Green-grey rocks, probably altered volcanic tuffs (specimen 1052). These are similar to certain rocks discovered by Mr. Combe in North Kavirondo.

6636.7. (11.6).—Phyllites again. The bedding in some places is horizontal; but the rocks are clearly highly disturbed, and much jointed and twisted.

6636.9. (11.8).—Green-grey rocks, apparently interbedded with or intrusive into the phyllites. The exact relationship was not determinable, and it is quite possible that the green-grey rocks are pre-phyllite in age.

6637.0. (11.9).—Road crosses stream running left.

6637.4. (12.3).—Epidioritised coarse dolerite (specimen 1053).

6637.7. (12.6).—Rotted basic rock, probably derived from a lava.

6638.3. (13.2).—Road from Nzunias, Kericho and Kisumu junctions right.

6638.4. (13.3).—Fine-grained decomposed lava, of which specimen 1053 was the upper decomposed portion (specimen 1054).

6639.0. (13.9).—Good outcrops of rocks similar to 1054.

6639.8. (14.7).—Road junctions right.

6640.1. (15.0).—Stony lava: a trachy-andesite, with calcite amygdales (specimen 1055).

6640.2. (15.1).—Much platy white quartz in soil.

6640.6. (15.5).—Oyugi's camp.

(8) *From Oyugi's to Site of Old German Prospect Pits.*

6640.6. (0).—Oyugi's; go along road to *dukas*.

6640.9. (.3).—Rangwe road junctions left. Proceed along this.

6641.7. (1.1).—Coarse dolerite, like that recorded at 6629.3 (specimen 1047).

6642.6. (2.0).—Road crosses Ouneti stream running right.

6643.2. (2.6).—Change of soil; much lateritic material on slopes.

6643.5. (2.9).—Road crosses stream running right.

(Car left here on account of a broken bridge.)

400 yards.—Some dolerite and quartz, the latter with hæmatite and limonite in shatter planes.

120 yards.—Pyritiferous extremely altered dolerite (specimen 1056).

185 yards.—Pyritiferous dark-grey siliceous rock (assay sample).

35 yards.—Pyritiferous dolerite.

600 yards.—On dolerite up to now. Here one is on an altered (and iron-impregnated) rock resembling shale; it is probably, however, an extremely decomposed amphibolite-schist.

200 yards.—Silicified ferruginous shales.

100 yards.—Trench in quartz-dyke, dug by Germans in pre-war days. Some dolerite outcrops between here and last observation (assay sample of quartz taken: proved valueless).

170 yards.—Another and similar trench; assay sample taken; proved valueless.

Bearing to Homa (5,742′) 308° mag. Bearing to Wire trig. 44° mag.

All the above traverse has been over undulating country.

(9) *Oyugi's to Wire Hill.*

6646.1. (0).—Oyugi's.

6646.9. (.8).—Rotted rocks, amphibolites or phyllites? Probably the former. Dip [illegible] mag.

Rotted rocks, amphibolites or phyllites?

probable, the conglomerates are part of the same sedimentary series as the phyllites, then they are lower than the phyllites, unless displaced by faulting, and may well represent the middle of the Karagwe-Ankolean here, as similar conglomerates appear to do in North Kavirondo (*see* Mr. Combe's remarks, p. 16, *Annual Report* for 1927).

6636.1. (11.0).—Lumps of conglomerate seen beside the road; they probably represent an interbedded band.

6636.5. (11.4).—Green-grey rocks, probably altered volcanic tuffs (specimen 1052). These are similar to certain rocks discovered by Mr. Combe in North Kavirondo.

6636.7. (11.6).—Phyllites again. The bedding in some places is horizontal, but the rocks are clearly highly disturbed, and much jointed and twisted.

6636.9. (11.8).—Green-grey rocks, apparently interbedded with or intrusive into the phyllites. The exact relationship was not determinable, and it is quite possible that the green-grey rocks are pre phyllite in age.

6637.0. (11.9).—Road crosses stream running left.

6637.4. (12.3).—Epidioritised coarse dolerite (specimen 1053).

[illegible] (12.6).—Rotted basic rock, probably derived from a lava.

6638.3. (13.2).—Road from Nzumas, Kericho and Kisumu junctions right.

[illegible] (13.[illegible]).—Fine-grained decomposed lava, of which specimen [illegible] was the upper decomposed portion (specimen 1054).

[illegible] ([illegible]).—Good outcrops of rocks similar to 1054.

[illegible] (14.[illegible]).—Road junctions right.

6640.1. (15.0).—Stony lava: a trachy-andesite, with calcite amygdales (specimen 1055).

6640.2. (15.1).—Much platy white quartz in soil.

6640.6. (15.5).—Oyugi's camp.

(b) From Oyugi's to Site of Old German Prospect Pits.

6640.6. (0).—Oyugi's; go along road to dukas.

6640.9. (.3).—Rangwe road junctions left. Proceed along this.

6641.7. (1.1).—Coarse dolerite, like that recorded at 6629.3 (specimen 1047).

6642.6. (2.0).—Road crosses Omneti stream running right.

6643.2. (2.6).—Change of soil; much lateritic material on slopes.

6643.5. (2.9).—Road crosses stream running right.

(Car left here on account of [illegible] bridge.)

400 yards.—Some dolerite and quartz, the latter with hæmatite and limonite in shatter planes.

120 yards.—Pyritiferous extremely altered dolerite (specimen 1056).

185 yards.—Pyritiferous dark-grey siliceous rock (assay sample).

35 yards.—Pyritiferous dolerite.

600 yards.—On dolerite up to now. Here one is on an altered (and iron-impregnated) rock resembling shale; it is probably, however, an extremely decomposed amphibolite-schist.

200 yards.—Silicified ferruginous shale.

100 yards.—Trench in quartz-dyke, dug by Germans in pre-war days. Some dolerite outcrops between here and last observation (assay sample of quartz taken; proved valueless).

170 yards.—Another and similar trench; assay sample taken; proved valueless.

Bearing to Homa (5,[illegible]') [illegible]° mag. Bearing to Wire trig. 44° mag.

All the above traverse has been over undulating country.

(c) Oyugi's to Wire Hill.

6646.1. (0).—Oyugi's.

6646.9. (.8).—Rotted rocks, amphibolites or phyllites? Probably the former. Dip [illegible] [illegible].

Rotted rocks, amphibolites or phyllites?

6647.0. (.9).—Cellular dark-grey quartz with much pyrites, most of which is now represented by limonite (specimen 1067), probably intrusive into the phyllites. Found in large lumps. Not quite in situ.

6647.4. (1.3).—Silicified amygdaloidal lava. This is found by the roadside in lumps (specimen 1068).

6648.2. (2.1).—Same as 1068 above.

6648.6. (1.5).—Leave car, and go towards Wire Hill; path goes NE. approximately.

800 yards.—Now on a laterite platform containing lumps of rock and rounded pebbles, 50 feet above the spot where car was left. Approximate altitude, 4,700 ft.; nearly 1,000 ft. above Lake Victoria.

200 yards.—Road called Molo. Turn E. by N.

200 yards.—Another road right.

300 yards.—Going up hill towards saddle—(S) in sketch—much quartz-haematite and haematite-quartz rock in lumps lying about (specimen 1069), and some lumps of felsite and ferruginous chert-breccia.

Profile Sketch Diagram of Wire Hill.

[illegible] yards to saddle (S) the felsite is in situ. It has a pseudo-dip 30° north-easterly. There are some slickensides along the pseudo-bedding. The whole of the hill C on sketch seems to be of this felsite, but it is less sheared in the middle of this mass. On the far side, away from saddle (S), shatter planes running E.-W. and NE.-SW. are clearly seen.

Going up hill towards the trig. station, one comes almost immediately upon haematite-chert rock—(specimen 1062); the felsite apparently passes into this.

A little higher up, lumps of felsite again appear; then ironstone, [illegible] than before in plenty. Felsite lumps are present, also some silica-rock, with a tendency to banding

A little higher up, some 50 feet above the saddle, sheared felsite appears in place (sample 1063). Still higher up felsite again passes, apparently, into ironstone.

As the next comparatively flat piece of ground (local summit) is approached, a softish white rock, an extremely sheared porphyry, appears. It is well seen on the top of this rise (specimen 1064), where many *Mutatwin* trees are growing.

At point X, ferruginous felsite occurs. Higher up more ferruginous felsite, then a quartzose variety, then pyritiferous chalcedonic rock (local), probably of hydro-thermal origin (specimen 1065).

Approximately 50 ft. higher up is the trigonometrical point on felsite.

According to Coates (*see Q.J.G.S.* Vol. 70, 1914, p. 159), this hill (Wire Hill) is composed of slates, which he calls the Wire Hill beds. It would seem from samples brought back from hills D and E of sketch, by Yunusu, one of my employees, that they too consist of felsite.

(10) *Oyugi's to Kendu, etc.*

6653.4. (0).—Point reached by car on the trip to Wire Hill yesterday.

6654.0. (.6).—Some lumps of a rock resembling dolerite with inclusions (amygdales?) of calcite.

6654.3. (.9).—Many lumps and boulders of dolerite.

6654.7. (1.3).—Large lumps of felsite (used in making culvert).

6655.3. (1.9).—Altered amphibolite-schist, outcropping in small stream, dip NE. by E. steep (specimen 1066).

Beyond last observation much felsite is seen.

6655.8. (2.4).—Dolerite with slabby jointing; dip of slabs WNW., steep.

Road junction.

6657.4. (4.0).—Altered (decomposed) amphibolite-schists, similar to those recorded at 6655.3, strike NE.-SW., dip NW. steep to vertical. Much dolerite about. Soon after this one passes on to granitic soils.

6658.7. (5.3).—Granite (contaminated by amphibolite), with xenoliths of hornblende-schist. Quartz veins are present (specimen 1067).

6647.0. (.9).—Cellular dark-grey quartz with much pyrites, most of which is now represented by limonite (specimen [illegible]), probably intrusive into the phyllites. Found in large lumps. Not quite in situ.

6647.4. (1.3).—Silicified amygdaloidal lava. This is found by the roadside in lumps (specimen 1058).

6648.2. (2.1).—Same as 1058 above.

6648.6. (2.5).—Leave car, and go towards Wire Hill; path goes NE. approximately.

[illegible] yards.—Now on a laterite platform containing lumps of rock and rounded pebbles, 50 feet above the spot where car was left. Approximate altitude, 4,700 ft.; nearly 1,000 ft. above Lake Victoria.

[illegible] yards.—Kraal called Molo. Turn E. by N.

[illegible] yards.—Another kraal right.

[illegible] yards.—Going up hill towards saddle (B) in sketch—much quartz-hematite and hematite-quartz rock in lumps lying about (specimen 1060), and some lumps of felsite and ferruginous chert-breccia.

[illegible] Diagram of Wire Hill.

[illegible] yards.—[illegible] saddle (B) the felsite is in situ. It has a [illegible] 30° north-easterly. There are some slickensides along the pseudo-bedding. The whole of the hill [illegible] seems to be of this felsite, but it is [illegible] in the middle of this mass. On the far [illegible] saddle (B) shatter planes, striking [illegible] and NE. [illegible] are clearly seen.

[illegible] up hill towards the trig station, one comes [illegible] upon hematite-chert rock—(specimen 1062). The felsite apparently passes into [illegible]

A little higher up, lumps of felsite again appear, then [illegible] than before in plenty. Felsite lumps [illegible] with a tendency to banding.

A little higher up, some 50 feet above the saddle, sheared felsite appears in place (sample 1063). Still higher up felsite again passes, apparently, into ironstone.

As the next comparatively flat piece of ground (local summit) is approached, a softish white rock, an extremely sheared porphyry, appears. It is well seen on the top of this rise (specimen 1064), where many *Mutatwin* trees are growing.

At point X, ferruginous felsite occurs. Higher up more ferruginous felsite, then a quartzose variety, then pyritiferous chalcedonic rock (local), probably of hydro-thermal origin (specimen 1065).

Approximately 50 ft. higher up is the trigonometrical point on felsite.

According to Coates (*see Q.J.G.S.* Vol. 70, 1914, p. 159), this hill (Wire Hill) is composed of slates, which he calls the Wire Hill beds. It would seem from samples brought back from hills D and E of sketch, by Yunusu, one of my employees, that they too consist of felsite.

(10) *Oyugi's to Kendu, etc.*

6653.4. (.0).—Point reached by car on the trip to Wire Hill yesterday.

6654.0. (.6).—Some lumps of a rock resembling dolerite with inclusions (amygdales?) of calcite.

6654.3. (.9).—Many lumps and boulders of dolerite.

6654.7. (1.3).—Large lumps of felsite (used in making culvert).

6655.3. (1.9).—Altered amphibolite-schist, outcropping in small stream, dip NE. by E., steep (specimen 1066).

Beyond last observation much felsite is seen.

6655.8. (2.4).—Dolerite with slabby jointing; dip of slabs WNW, steep.

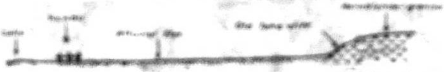
Road junction.

6657.4. (4.0).—Altered (decomposed) amphibolite-schists, similar to those recorded at 6655.3, strike NE.-SW., dip NW. steep to vertical. Much dolerite about. Soon after this one passes on to granitic soils.

6658.7. (5.3).—Granite (contaminated by amphibolite), with xenoliths of hornblende-schist. Quartz veins are present (specimen 1067).

6699.9. (5.6).—Awach River bridge. Still same rock as 1067.

6702.? (8.3).—Descend to alluvial flat.



[illegible] section near Kendu.

[illegible] about a mile beyond the cliff. Proceeding to Kendu, [illegible] [illegible] Oswald in his paper on the "Miocene [illegible]" [illegible]

[illegible]

6703.5. (9.5).—Road crosses stream running left. Ondreg [illegible] on left of road.

6703.7. (9.7).—Rotted quartz-porphyry, or granite-porphyry? (specimen 1073).

6704.1. (10.1).—Rotted red granophyre (specimen 1074).

6704.9. (10.9).—Granitic rocks here, and at intervals since the last observation.

6705.2. (11.2).—Deep red soils and rocks as at 6703.7.

6705.6. (11.6).—Granophyre (specimen 1075), associated with red granite. These exposures are near a stream.

6705.8. (11.8).—Fine-grained felsite? This is followed by red granite and then more rocks like 1075.

6706.4. (12.4).—Large lumps of jaspar-breccia with chalcedonic cement, near top of hill (specimen 1077).

6707.1. (13.1).—Rotted granitic rock.

6707.2. (13.2).—Ophitic dolerite with a pseudo-dip, N. by a little E. (specimen [illegible]).

6707.9. (13.9).—Marindi.

6708.3. (14.3).—Doleritic rock with spheroidal weathering (specimen 1079).

6709.9. (15.9).—Strongly silicified lava resembling in appearance the rock at 6690 (specimen 1080).

6710.6. (16.6).—Granite-porphyry (specimen 1081).

6710.8. (16.8).—Rotted feldspathic schistose rock.

6711.0. (17.0).—Rangwe; coarse dolerite.

6711.2. (17.2).—Cross roads; Kitare left, Oyugi's right.

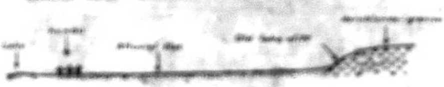
6711.5. (17.5).—D.C.'s camp.

(12) *Rangwe to Kitare and back by the "Soapstone" locality previously visited.—Journey 6.*

This trip was taken with the object of seeing whether the area around Kitare is worthy of detailed investigation or not; for according to Oswald's map it should be. A detailed traverse was not aimed at, but it was proposed to revisit the soapstone site on the return journey, and to secure from the local inhabitants some ethnological information for the British Museum.

6699.9. (5.6).—Awach River Bridge. Still same rock as 1067.

6602.5. (6.3).—Descend to alluvial flat.



[illegible] Section near Kendu.

[illegible]

6703.5. (9.5).—Road crosses stream running left. Ondreg [illegible] on left of road.

6703.7. (9.7).—Rotted quartz-porphyry, or granite-porphyry? (specimen 1073).

6704.2. (10.1).—Rotted red granophyre (specimen 1074).

6704.9. (10.9).—Granitic rocks here, and at intervals since the last observation.

6705.2. (11.2).—Deep red soils and rock[illegible] at 6703.7.

6705.6. (11.6).—Granophyre (specimen 1075), associated with red granite. These exposures are near a stream.

6705.8. (11.8).—Fine-grained felsite? This is followed by red granite and then more rocks like 1075.

6706.5. (12.5).—Large lumps of jasper-breccia with chalcedonic cement, near top of hill (specimen 1077).

6707.1. (13.1).—Rotted granitic rock.

6707.2. (13.2).—Ophitic dolerite with a pseudo-dip, N. by [illegible] (specimen [illegible]).

6707.5. (13.5).—Marsh.

6708.5. (14.5).—Doleritic rock with spheroidal weathering (specimen 1079).

6709.3. (15.3).—Strongly silicified lava resembling in appearance the rock at [illegible] (specimen 1080).

6710.4. (16.4).—Granite-porphyry (specimen 1081).

6711.0. (16.6).—Rotted felspathic schistose rock.

6711.3. (17.0).—Rangwe, coarse dolerite.

6711.4. (17.2).—Cross roads; Kitare left, Oyugi's right.

6711.5. (17.5).—D.C.'s camp.

(12) *Rangwe to Kitare and back by the "Soapstone" locality previously visited.—(Journey 6).*

This trip was taken with the object of seeing whether the area around Kitare is worthy of detailed investigation or not; for according to Oswald's map it should be. A detailed traverse was not aimed at, but it was proposed to revisit the soapstone site on the return journey, and to secure from the local inhabitants some ethnological information for the British Museum.

Most unfortunately, the rains had rendered the roads almost impassable in places, and owing to getting stuck in the mud on several occasions there was much delay, so that in the end there was no time to revisit the soapstone locality.

[illegible] —Rangwe camp.

[illegible] Kisare to the right.

[illegible] Kisare ahead and [illegible] left. (See 6727.6.)

[illegible]

[illegible] agglomerates [illegible]

[illegible] Kabwochi [illegible] Granite rocks.

[illegible]

[illegible] granite.

[illegible] River (bridge).

[illegible]

[illegible] Bridge [illegible]

[illegible] Bridge. Here we [illegible] specimen 1082.

[illegible] assay sample [illegible]

[illegible]

[illegible] Kisare [illegible]

[illegible] Road.

[illegible] sandstone.

[illegible] road. [illegible] rocks.

[illegible] River. [illegible] sandstone and quartzite.

6738.8. (27.3).—Sandstone.

6739.1. (27.6).—Quartz-reef (dyke) running apparently N.E. by E. (assay sample, no value).

6740.3. (28.8).—Road crosses stream running left. Some granitic boulders.

6740.9. (29.4).—Point where I stopped the car in road when visiting the soapstone deposit—Journey (6).

The whole of the country passed over between Kabwochi (6721.1) and 6739.1 (near Kisare) is granitic. It forms a sort of low plateau for the most part capped with lateritic ironstone. This frequently contains pebbles and artifacts.

(13) *Rangwe to Homa Bay.*

6761.7. (0).—Rangwe.

6763.8. (2.1).—Felsite.

6764.6. (2.9).—Augite-nephelinite (specimen 1084).

6765.7. (4.0).—Cross roads, that to Kochia being to the right. At the junction is Augite-nephelinite.

6766.7. (5.0).—Road crosses stream running left.

Here we pass off agglomerates and come on to rotted quartz-porphyry (?) intruding a series consisting chiefly of sheared silicified felsites (specimen 1085), gritstones, brecciated crystalline limestones (specimen 1086), and conglomerates with lava matrix, resembling an agglomerate (specimen 1087). The specimens were collected near 6767.0.

6767.2. (5.5).—Felsite again, and rocks represented by specimen 1088.

6767.5. (5.8).—Altered and sheared agglomerate (or conglomerate) (specimen 1090).

6768.2. (6.5).—Augite-bearing lava, again resembling 1084.

6769.1. (7.0).—Road crosses stream running left.

6769.3. (7.6).—Road junction. Augite-nephelinite agglomerate outcrops.

6770.9. (9.2).—Awach River (bridge). Agglomerates.

6771.7. (10.0).—Porphyritic lava—a limburgite (specimen 1091).

6772.1. (10.4).—Light-coloured completely rotted igneous rocks.

Most unfortunately, the rains had rendered the roads almost impassable in places, and owing to getting stuck in the mud on several occasions there was much delay, so that in the end there was no time to revisit the soapstone locality.

[illegible] (0).—Rangwe camp.

[illegible].—Cross roads. Kitare to the right.

[illegible].—Cross roads. Kitare ahead and Mirogo left. (See 6727.5.)

[illegible].—Doubtful conglomerate like that recorded at 6650.1. [illegible] the road is [illegible].

[illegible]

6738.8. (27.3).—Sandstone.

6739.1. (27.6).—Quartz-reef (dyke) running apparently NE. by E. (assay sample, no value).

6740.3. (28.8).—Road crosses stream running left. Some granitic boulders.

6740.9. (29.4).—Point where I stopped the car in road when visiting the soapstone deposit—Journey (6).

The whole of the country passed over between Kabwochi (6721.3) and 6739.1 (near Kitare) is granitic. It forms a sort of low plateau for the most part capped with lateritic ironstone. This frequently contains pebbles and artifacts.

(13) Rangwe to Homa Bay

6761.7. (0).—Rangwe.

6763.8. (2.1).—Felsite.

6764.6. (2.9).—Augite-nephelinite (specimen 1084).

6765.7. (4.0).—Cross roads, that to Kochia being to the right. At this junction is Augite-nephelinite.

[illegible] (5.0).—Road crosses stream running left.

Here we pass off agglomerates and come on to rotted quartz-porphyry (?) intruding a series consisting chiefly of sheared silicified felsites (specimen 1085), gritstones, brecciated crystalline limestones (specimen 1086), and conglomerates with lava matrix, resembling an agglomerate (specimen 1087). The specimens were collected near 6767.0.

6767.2. (5.5).—Felsite again, and rocks represented by specimen 1089.

6767.5. (5.8).—Altered and sheared agglomerate (or conglomerate) (specimen 1090).

6768.2. (6.5).—Augite-bearing lava, again resembling 1084.

6769.7. (7.0).—Road crosses stream running left.

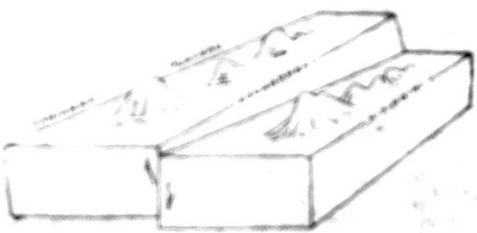
6769.3. (7.6).—Road junction. Augite-nephelinite agglomerate outcrops.

6770.9. (9.2).—Awach River (bridge). Agglomerates.

6771.7. (10.0).—Porphyritic lava—a limburgite (specimen 1091).

6772.1. (10.4).—Light-coloured completely rotted igneous rocks.

[illegible]



[illegible]

The scenery of Homa Bay (hazily outlined in the mist) must be extremely fine and rugged, and is essentially that of a drowned coast.

Rusinga Island.—The topography of this island (as seen from a distance) led me long ago to suppose that Miocene beds would be found upon it. This anticipation was fulfilled.

The highest parts of the island are, for the most part, composed of volcanic rocks. In the gaps, however, between Gumba and Lunene, and Lunene and Hiwegi, and on the peninsula beyond Hiwegi, Miocene beds are found. They rise to a height of perhaps 400 feet above the Lake; on the mainland opposite they must rise to much greater height, for there they can be seen curving up in a south-westerly direction after the manner of the Kaniamwa Plateau, some twenty miles further east. The Miocene sediments of Rusinga, which are soft beds comparable with those described from Homa Bay by Oswald, are interbedded with volcanic rocks; and these are interesting from several points of view. Volcanic rocks interbedded with dateable sediments might be very helpful for determining, by comparison, the age of other lavas far away from such an area as this; except, of course, in so far as the Rusinga volcanics may be locally peculiar. In one respect it would appear that they are somewhat peculiar, for they have absorbed a good deal of lime from pre-existing limestones, so that a most interesting lime mineral has been produced in quantity, namely a black garnet (melanite), which occurs in crystals up to 1 cm. across. So common are these crystals locally that the ground glistens and flashes with them (specimen 1098).

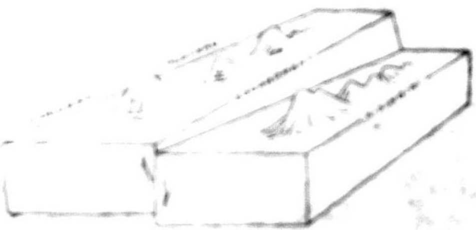
The Miocene beds provide very fine sections for study and yield important fossil remains. Among others I found the relics of the gigantic tortoise (*Testudo crassa?*), some parts of the plastron of which are one and a half inches thick.

[illegible] —Camp near Homa Bay on high ground overlooking the bay. Here there are some pebbles suggestive of the existence of high-level gravels.

[illegible] —[illegible]. [illegible] to the left.

[illegible] —Lake Victoria. Edge of water.

[illegible]



[illegible]

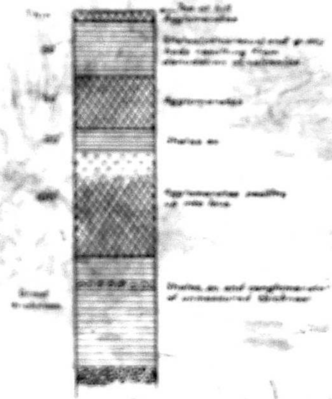
The scenery of Homa Bay (hazily outlined in the mist) must be extremely fine and rugged, and is essentially that of a drowned coast.

Rusinga Island.—The topography of this island (as seen from a distance) led me long ago to suppose that Miocene beds would be found upon it. This anticipation was fulfilled.

The highest parts of the island are, for the most part, composed of volcanic rocks. In the gaps, however, between Gumba and Lunene, and Lunene and Hiwegi, and on the peninsula beyond Hiwegi, Miocene beds are found. They rise to a height of perhaps 400 feet above the Lake; on the mainland opposite they must rise to much greater height, for there they can be seen curving up in a south-westerly direction after the manner of the Kaniamwa Plateau, some twenty miles further east. The Miocene sediments of Rusinga, which are soft beds comparable with those described from Homa Bay by Oswald, are interbedded with volcanic rocks; and these are interesting from several points of view. Volcanic rocks interbedded with dateable sediments might be very helpful for determining, by comparison, the age of other lavas far away from such an area as this; except, of course, in so far as the Rusinga volcanics may be locally peculiar. In one respect it would appear that they are somewhat peculiar, for they have absorbed a good deal of lime from pre-existing limestones, so that a most interesting lime mineral has been produced in quantity, namely a black garnet (melanite), which occurs in crystals up to 1 cm. across. So common are these crystals locally that the ground glistens and flashes with them (specimen 1098).

The Miocene beds provide very fine sections for study and yield important fossil remains. Among others I found the relics of the gigantic tortoise (*Testudo crassa?*), some parts of the plastron of which are one and a half inches thick.

The section exposed in Karwanga Hill on Rusinga Island —a hill inadequately shown on the Map to the west of Lunene and between that hill and Gwasi—is approximately as follows:—



[illegible]

war. It lies to the west of Mbeta, on the hillside, some 500-600 feet above the camp. A sample of this limestone was collected (specimen 1100). It overlies some calcareous shales that may possibly prove to be a form of cement-stone. A sample was taken for further investigation. (Magnetic bearing of quarry to Gembe Hill on mainland, 89°, and to Mbeta Camp, 104°.)

The return journey to Homa Bay was also through the mist, so nothing further was observed.

(15) *Homa Bay to Karungu.*

On account of lateness of arrival at Homa Bay, the journey to Karungu (by car) had to be undertaken without delay. It was entirely over volcanic ground (as Oswald's map shows it should be). A sample of the common rock exposed is provided by specimen 1107—a basalt.

6774.6. (0).—Start.

6779.5. (4.9).—Turning to Karungu.

This road was said to be quite impassable, so I continued ahead to Mirogi.

6782.4. (7.8).—Specimen 1107.

6788.1. (13.5).—Stone walls (right). These are said to be the remains of a fort built during the war. No doubt there was good reason for building a fort there; but it is difficult now to see what that reason could have been.

6790.1. (15.5).—Mirogi.

6790.8. (16.2).—Turning from the right.

6819.6. (45.0).—The Government Camp, Karungu. This is situated on the so-called black cotton soil. From this camp I visited the Miocene sites that were dealt with so well by Oswald. No further description of them is needed here.

Specimen 1108.—Oswald's "basalts" overlying sediments. The specimen collected proved to be nephelinite.

Specimen 1109.—Amphibolite from below basalts.

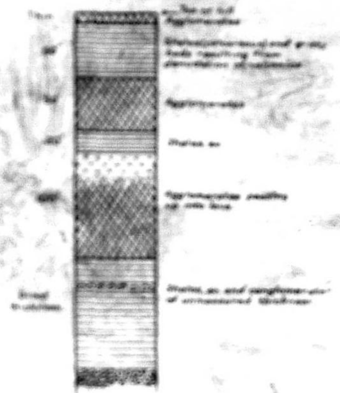
(16) *The Gold Mine Area.*

This lies to the south of the Kuja River, along an approximately NW.-SE. zone. The NW.-SE. line is an important one in the geology of East Central Africa, and is frequently one of crushing and shearing.

6827.1. (0).—Start. Ground swampy.

6835.9. (8.8).—Other side of swamp. Dead-looking semi-rotted granite. Probably a sheared G2 granite.

The section exposed in [illegible] Hill on Rusinga Island —a hill inadequately shown on the map to the west of [illegible] and between that hill and [illegible]—is approximately as follows:—



[illegible]

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6835.9. (8.8).—Other side of swamp. Dead-looking semi-rotted granite. Probably a sheared G2 granite.

1,000 yards.—Less foliated granite (specimen 1139); also exhibits crushing.

650 yards.—Non-gneissose granite with purple quartz (specimen 1140), like that on Rusinga Island (cf. specimen 1096).

400 yards.—*Diorite-porphyry* (specimen 1141), and porphyry with augite (specimen 1142).

30 yards.—Quartz floaters common. Now at or very near the base of Kweri Hill. There is much lateritic ironstone here.

60 yards.—Granite again.

30 yards.—Quartz scattered on hillside.

500 yeards.—Top of Kweri Hill. Masses of quartz (specimen 1143). On the north side of the hill a rock (floater), resembling aplite, was collected (specimen 1144). It was found to be a crushed Newer Granite.

Kweri Hill is a puzzle. I do not know whether it is a *quartz of igneous origin or a completely* metamorphosed and partly absorbed mass of quartzite. I incline to the former view.

The relationship of Kweri Hill to Masara Hill (also barren quartz, I am told), and to a large barren reef between the two, appears to be (as pointed out to me) as is shown *in sketch plan* No. 1.

The return journey to *Blackhall's Reef* was made by a native path. Where this crosses the Myunyo River the dolerite (specimen 1145), associated with amphibolite (specimen 1146), is exposed.

(17) *Return to Kisii, via Gori River.*

6847.6. (0).—Start.

6850.0 (2.4).—Hornblendic granite (not very gneissose) at Kisumu Prospecting Syndicate's camp (specimen 1147c).

The Syndicate are not mining; they are collecting and crushing the surface rubble (specimens 1147 and 1147a), which is largely composed of granular quartz, in which visible gold is sometimes seen. Methods of crushing and recovering are *primitive but the yield seems to* be good. An artifact was recovered from this rubble (specimen 1147b).

6860-0. (12.4).—Ferry over the Gori River.

Here some extremely ancient and much metamorphosed conglomerates, etc., are found. They may well be pre-Karagwe-Ankolean in age. The dip is south-westerly and steep. (Specimen 1148.)

1,000 yards.—Less foliated granite (specimen 1139); also exhibits crushing.

650 yards.—*Non-gneissose* granite with purple quartz (specimen 1140), like that on Rusinga Island (cf. specimen 1096).

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[illegible]

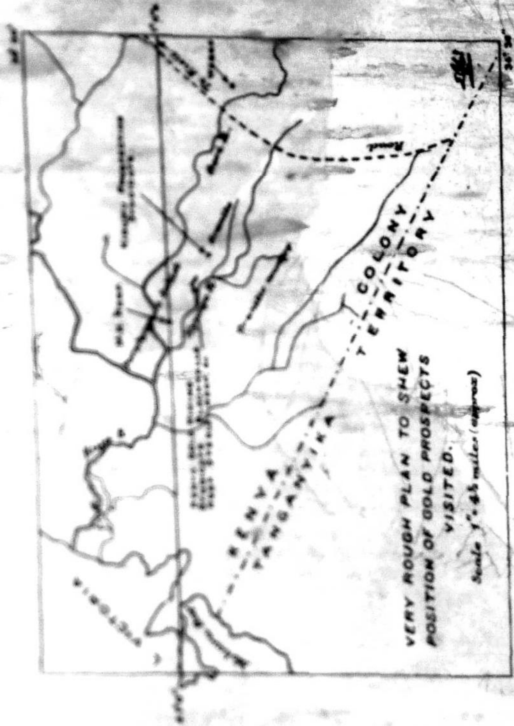
[illegible] (56.2).—Dolerite exposures of irregular form.

[illegible] (56.9).—Cross roads. Kitare to the left.

[illegible] (58.2).—Kisir village.

[illegible] (60.3).—T junction in road. Right to Kisii, left to Kericho.

[illegible] (62.0).—Kisii (A.D.C.'s house).



[illegible] —Porphyry country; much quartz lying about. Porphyry specimen [illegible] is a mica-diorite porphyry.

[illegible] —Porphyry country. High-level gravels.

[illegible] —Masses of vein-quartz lying about.

[illegible] —Porphyry exposures.

[illegible] —Ditto.

[illegible] —Exposures of a fine-grained diorite porphyry. [illegible]

[illegible]

[illegible]

[illegible]

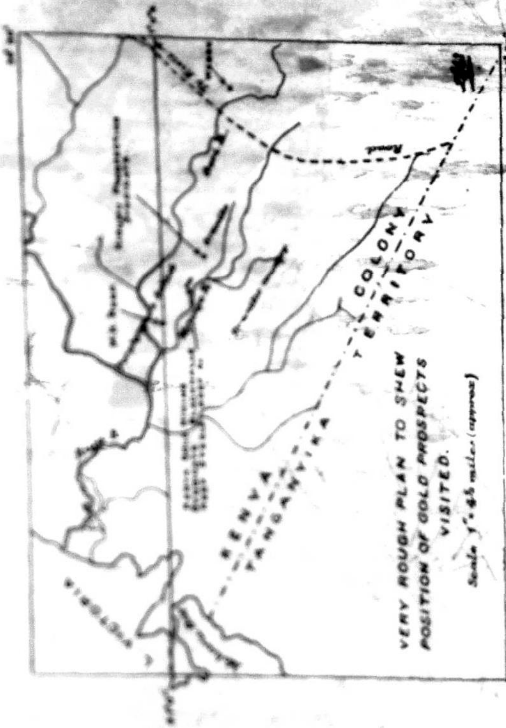
6895.4 (58.2).—Dolerite exposures of irregular form.

6896.5 (58.9).—Cross roads. Kitare to the left.

6904.5 (58.2).—Risir village.

6907.3 (60.3).—T junction in road. Right to Kisii, left to Kericho.

6909.4 (62.0).—Kisii (A.D.C.'s house).



25

F.—RECOMMENDATIONS.

Southern Kavirondo is worthy of much more detailed study than it has received, not only from the point of view of pure geology, which should provide a key to the study of [illegible], but also as a possible area for economic minerals. The mapping of the area should form part of the work of a Geological Survey of Kenya, should one be formed at any time.

With regard to gold, further prospecting, in addition to that within the known auriferous areas, should be undertaken by seeking continuations of the shatter zone, [illegible] and prospecting quartz-dykes, etc., within them, as well as sampling [illegible] and alluvial deposits.

[illegible] in the Kisii Highlands is of great interest [illegible] Appendix III. [illegible] from the Kisii Sandstone. The grains are angular and have not [illegible] [illegible]

[illegible]

[illegible]

[illegible]

E. J. WAYLAND.

APPENDIX I.

LIST OF SPECIMENS COLLECTED.

1006.—Highly siliceous rock (metamorphosed quartzite), associated with mixed gneiss, quartz-veins and dykes; 19 miles from Ikoma, by a small stream (name unknown) on the Ikoma-Musoma Road.

1007.—A metamorphosed sediment (?), associated with specimen 1006; relationship of the rocks unknown; they occur in scattered pieces on the surface.

1008.—Phyllite, traversed by stream called Mulangwa, rather more than 1½ miles nearer Musoma than specimens 1006 and 1007.

1009.—Diabasic intrusive into rocks represented by specimen 1008.

1010.—Quartz-porphyry (?), 1.4 miles beyond police camp on the [illegible] Road, and 330 ft. above the camp.

1011.—Fine-grained [illegible], with [illegible] texture, passing locally in [illegible] (specimen 1012); 4.1 miles beyond police camp and 265 ft. above it.

1012.—[illegible] (?), [illegible] 32 miles beyond police camp, and 525 ft. above it.

1013.—[illegible] (?). The [illegible] rock [illegible] that represented by specimen 1004.

1014.—Amphibolite schist; Suo River.

1015.—Completely [illegible] and [illegible] 1014. [illegible] [illegible] Suo River.

1016.—[illegible] fine-grained [illegible] of [illegible] [illegible] (?), occurring in the centre of a [illegible] vein; Suo River.

1017.—[illegible] quartz-rock, somewhat [illegible], resembling a [illegible] rock, but probably a [illegible]; Suo River.

1018.—[illegible] granite rock; Suo River.

1019.—Fine-grained [illegible], near base of [illegible] of Kisumu [illegible] near Sofu road.

[illegible]—RECOMMENDATIONS

[illegible] is worthy of much more detailed study than it has received; not only from the point of view of pure geology, which should provide a key to the study of [illegible], but also as a possible area for economic minerals. The mapping of the area should form part of the work of a Geological Survey of Kenya, should one be formed at any time.

With regard to [illegible] further prospecting, [illegible] within the known auriferous areas [illegible] by [illegible] of the [illegible], in determining [illegible] and prospecting quartz-[illegible], etc., within them, as well as sampling [illegible] and alluvial deposits.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

APPENDIX I

LIST OF SPECIMENS COLLECTED

[illegible].—[illegible] siliceous rock (metamorphosed quartzite), associated with [illegible] quartz-veins and dykes; [illegible] miles from [illegible], by a small stream [illegible] on the [illegible] Road.

[illegible].—A metamorphosed [illegible] (?), associated with specimen [illegible]; [illegible] of the rocks unknown; they occur as scattered places on the surface.

[illegible].—Phyllite, exposed by stream called [illegible], [illegible] miles nearer [illegible] than specimens [illegible] and [illegible].

[illegible].—[illegible] intrusive into [illegible] rocks, represented by specimen [illegible].

[illegible].—Quartz-porphyry (?), [illegible] miles beyond police camp on the [illegible] Road, and [illegible] ft. above the camp.

[illegible].—Fine-grained [illegible] lava, with [illegible] texture, passing locally in [illegible]. [illegible] miles beyond police camp and [illegible] ft. above it.

[illegible].—[illegible] (?) [illegible]; [illegible] miles beyond police camp, and [illegible] ft. above it.

[illegible].—[illegible] (?). The [illegible] rock [illegible] above that represented by specimen [illegible].

[illegible].—[illegible] schist; [illegible] River.

[illegible].—[illegible]; [illegible] River.

[illegible].—Brown fine-grained [illegible]; [illegible] River.

[illegible].—Banded quartz-rock, somewhat [illegible], resembling a replacement rock, but probably a [illegible]; [illegible] River.

[illegible].—[illegible] granitic rock; [illegible] River.

[illegible].—Fine-grained [illegible], near base of [illegible] of [illegible] road

1020.—Closely similar to 1019; from top of escarpment.

1021.—Closely similar to 1019; from [illegible] north of police camp at Sondu.

1022.—Devitrified glassy lava, probably a rhyolite; about 1½ miles beyond Sondu on the Kisii Road.

1023.—Intensely silicified vesicular lava, closely associated with 1022.

1024.—Epidote-quartz rock (altered lava); 1½ miles beyond (Kisii-wards of) 1023.

1025.—Grey lava with [illegible] black (trachyte?); 10½ miles beyond 1024.

1026.—Rock resembling in the mass the [illegible] amygdaloid of South Africa. Much-altered lava, the rock now consists of calcite, epidote and chlorite; 1½ miles beyond 1025.

1027.—Altered dolerite; 2½ miles beyond 1026.

1028.—Light-grey anorthoclase trachyte (possibly the same as one of Mr. Combe's Northern Kavirondo porphyries); rather more than 3 miles beyond 1027.

1029.—Dark anorthoclase-trachyte, at junction of Kisii and Kendu Roads, approximately 4 miles beyond 1028.

1030.—Rock similar to 1029; same locality as 1029.

1031.—Quartzite of the [illegible] Series, from [illegible] Hill.

1032.—Amygdaloid associated in an unknown way (possibly interbedded) with 1031.

1033.—Serpentine? from [illegible] Hill: an extremely fine-grained and somewhat altered argillaceous sediment.

1034.—[illegible] outcrop, above 1033.

1035.—Devitrified rhyolite outcrop, above 1034.

1036.—Glassy lava with spherulitic structure (?).

1037.—Amphibolite; 3½ miles from Kisii on the Kisii-[illegible] Road.

1038.—Bauxite (?). A decomposition product of dolerite; 3½ miles from Kisii, on the same road as above.

1039.—Fine-grained epidiorite; 1½ miles from Kisii.

1040.—Red aplogranite; 1.8 miles from Kisii.

1041.—Pink Newer Granite, resembling the Aberdeen rock; 4½ miles from Kisii.

1042.—Epidiorite, derived from coarse-grained dolerite; 4.2 miles from Kisii.

1043.—Mylonised Newer Granite; 1½ miles from Kisii.

1044.—Fine-grained basalt; Kisii.

1045.—Silicified dolerite; 1/2 mile beyond junction of Kendu and Kendu-Kisumu-Kisii Road.

1046.—Flinty lava (silicified basalt?); same locality as 1045.

1047.—Coarse dolerite; 1½ miles down Kendu Road, past the junction (see locality of 1045).

1048.—Basaltic material?; ½ mile beyond (Kendu side of) 1047.

1049.—Specimens of doubtful value; discarded.

1050.—Lava conglomerate; 4 miles beyond 1048.

1051.—Phyllite; 1/2 mile beyond 1050.

1052.—Green-grey rock (cf. those found by Mr. Combe in N. Kavirondo), probably an altered volcanic tuff; 1 mile beyond 1051.

1053.—Epidiorised coarse dolerite; 1 mile beyond 1052.

1054.—Stony lava, fine-grained and [illegible]; 1 mile beyond 1053.

1055.—Amygdaloidal [illegible]; [illegible] miles beyond 1054.

1056.—Pyritiferous and extensively altered dolerite; 1½ miles from Oyugi's along the Rangwe track.

1057.—Pyritiferous cellular grey siliceous rock, apparently of hydrothermal origin; [illegible] mile beyond camp at Oyugi's on the Kendu Road.

1058.—Silicified amygdaloidal lava; [illegible] mile beyond 1057.

1059.—Hornblende-schist boulder; lower slope of Wire Hill, one mile beyond 1058, 1,000 yards from the Kendu Road.

1060.—Sheared porphyry, in saddle of Wire Hill (see Profile Diagram of Wire Hill, p. 18.)

1020.—Closely similar to 1019; from top of escarpment.

1021.—Closely similar to 1019; [illegible] north of police camp at Sondu.

1022.—Devitrified glassy lava, probably a rhyolite; about 3½ miles beyond Sondu on the Kisii Road.

1023.—Intensely silicified vesicular lava, closely associated with 1022.

1024.—Epidote-quartz rock (altered lava); 1¼ miles beyond (Kisii-wards of) 1023.

1025.—Grey lava with [illegible] trachyte (?); 10¼ miles beyond 1024.

1026.—Rock resembling at the same time the Ventersdorp amygdaloid of South Africa. Much-altered lava, the rock [illegible] consists of calcite, epidote and chlorite; 4¼ miles beyond 1025.

1027.—Altered dolerite; 5¼ miles beyond 1026.

1028.—Light-grey [illegible] trachyte (possibly the same as one of Mr. Combe's Northern Kavirondo [illegible]; rather more than 3 miles beyond 1027.

1029.—[illegible], at junction of Kisii and Kendu Roads, approximately 4 miles beyond 1028.

1030.—Rock similar to 1029; same locality as 1029.

1031.—Quartzite of the [illegible] Series from [illegible] Hill.

1032.—Amygdaloid [illegible] in an [illegible] way [illegible] probably interbedded with 1031.

1033.—[illegible] from [illegible] Hill, an extremely fine-grained and somewhat altered argillaceous sediment.

1034.—[illegible], above 1033.

1035.—[illegible], above 1034.

1036.—Glassy lava with spherulitic structure (?).

1037.—Amygdaloid; [illegible] miles from Kisii on the [illegible] Road.

1038.—[illegible] A [illegible] product of dolerite; [illegible] miles from Kisii, on the same road as above.

1039.—Fine-grained [illegible]; 1½ miles from Kisii.

1040.—Red aplogranite; 1.6 miles from Kisii.

1041.—Pink Nyanza Granite, resembling the [illegible] rock; 4¾ miles from Kisii.

1042.—Epidiorite, derived from coarse-grained dolerite; 4.2 miles from Kisii.

1043.—[illegible] Nyanza Granite; 3¾ miles from Kisii.

1044.—Fine-grained basalt; Kisii.

1045.—Silicified dolerite; 1/10 mile beyond junction of Kendu and [illegible]-Kisii Road.

1046.—Platy lava (silicified basalt); same locality as 1045.

1047.—Coarse dolerite; 1½ miles down Kendu Road, past the junction (see locality of 1045).

1048.—[illegible] (?); ½ mile beyond (Kendu side of) 1047.

1049.—Specimen of doubtful nature, [illegible].

1050.—Lava conglomerate; [illegible] miles beyond 1049.

1051.—Phyllite; 1/[illegible] mile beyond 1050.

1052.—Green-grey rock (cf. those found by Mr. Combe in N. Kavirondo), probably an altered volcanic tuff; 1 mile beyond 1051.

1053.—[illegible] dolerite; [illegible] mile beyond 1052.

1054.—Stony lava, fine-grained and [illegible]; 1 mile beyond 1053.

1055.—Amygdaloidal [illegible]; [illegible] miles beyond 1054.

1056.—[illegible] and [illegible] altered dolerite; [illegible] miles from Oyugi's along the [illegible] track.

1057.—[illegible] grey siliceous rock, apparently of [illegible] origin; [illegible] mile beyond camp at Oyugi's on the Kendu Road.

1058.—(?) Silicified amygdaloidal lava; [illegible] mile beyond 1057.

1059.—[illegible]; lower slope of Wire Hill, one mile beyond 1058, 1,000 yards from the Kendu Road.

1060.—[illegible] porphyry, in saddle of Wire Hill (see Profile Diagram of Wire Hill, p. [illegible]).

Wire Hill, looking North from Oyugis.

1061.—Granite-porphyry; little south-east of 1060; less sheared.

1062.—Hæmatite-chert rock, presumably an altered felsite, a few yards higher up hill (towards trig. station), on the sheared side of the felsite.

1063.—Sheared felsite; 50 ft. above last observation.

1064.—Extremely sheared porphyry. Top of this part of the rise.

1065.—Pyritiferous chalcedonic rock, about 50 ft. below trig. station, Wire Hill.

1066.—Altered amphibole-schist (?) (resembling shale); 4½ miles down the Kendu Road from Oyugi's.

1067.—Dioritic rock, with xenoliths of hornblende-schist; nearly 3½ miles beyond 1066 is the amphibole-schist.

1068.—Red felsite pebble from Pleistocene beds of Simbi (silicified lithic and crystal tuff).

1069.—Granular crystalline limestone, near (N.E. of) Homa Mt.

1070.—Grey argillite; one mile towards hills behind D.C.'s house, Kisii (collected by D.C.); used as slate pencils and was at one time carved into pots, but the *fundi* who undertook that work is now dead.

1071.—Red aplogranite (as in specimen 1040); 7-1/10th miles from Kisii, along the Rangwe Road (exactly similar to 1040).

1072.—Granite-porphyry, jointed so as to resemble sediments; ¾ mile beyond 1071.

1073.—Rotted rock (porphyry or granite?); 2½ miles beyond 1027.

1074.—Rotted red rock (granophyre), apparently passing into red granite; nearly ½ mile beyond 1073.

1075.—Granophyre, associated with red granite (passes into material like 1074); 1½ miles beyond 1074.

1076.—Fine-grained quartz-porphyry; 1/5th mile beyond 1076.

1077.—Jasper-breccia, cemented by chalcedony; 1 mile beyond 1076.

[illegible]

Wire Hill, looking North from Oyugis.

1061.—Granite-porphyry; little south-east of 1060; less sheared.

1062.—Hæmatite-chert rock, presumably an altered felsite, a few yards higher up hill (towards trig. station), on the sheared side of the felsite.

1063.—Sheared felsite; 50 ft. above last observation.

1064.—Extremely sheared porphyry. Top of this part of the rise.

1065.—Pyritiferous chalcedonic rock, about 50 ft. below trig station, Wire Hill.

1066.—Altered amphibole-schist (?) (resembling shale; 4½ miles down the Kendu Road from Oyugis.

1067.—Dioritic rock, with xenoliths of hornblende-schist; nearly 3½ miles beyond 1066 is the amphibole-schist.

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1071.—Red aplogranite (as in specimen 1040); 7-1/10th miles from Kisii, along the Rangwe Road (exactly similar to 1040).

1072.—Granite-porphyry, jointed so as to resemble sediments; [illegible] mile beyond 1071.

1073.—Rotted rock (porphyry or granite?); 2¼ miles beyond 1027.

1074.—Rotted red rock (granophyre), apparently passing into red granite; nearly ½ mile beyond 1073.

1075.—Granophyre, associated with red granite (passes into material like 1074); 1¼ miles beyond 1074.

1076.—Fine grained quartz-porphyry; 1/5th mile beyond 1075.

1077.—Jasper-breccia, cemented by chalcedony; 1 mile beyond 1076.

[illegible]

1099.—Reconstructed volcanic tuff, with clay pellets; near the top of the Miocene, Kaswanga Hill, Rusinga.

1100.—Limestone from old quarry site, west of camp at Mbeta, Rusinga Island.

1101.—Lumps of basic material resting on conglomerate; same locality as 1092.

1102.—Compact crystal tuff derived from nephelinite above agglomerate that succeeds thick deposits of sedimentaries; Kaswanga Hill.

1103.—Nephelinite tuff, exposed near camp at Mbeta.

1104.—Same as 1103, but cemented by calcite; same locality as 1103.

1105.—Nephelinite; near 1104.

1106.—Nephelinite interbedded with Miocene; Kaswanga Hill.

1107.—Typical rock (basalt) of country between Homa Bay and Karungu.

1108.—Nephelinite, overlying Miocene sediment, at Karungu.

1109.—Amphibolite, from below Miocene beds, Karungu.

1110.—Hornblende-granite, somewhat gneissose, passing into orthogneiss derived from pyroxene-granite; approximately ½ mile beyond Kuja River on track to gold mine from Karungu.

1111.—Sheared quartz-porphyry, nearly 4 miles beyond 1110; same track.

1112.—Foot wall; Blackhall's Reef, west face.

1113.—Hanging wall; Blackhall's Reef, west face.

1114.—Rock in fault (E.-W. approximately) Blackhall's Reef.

1115.—Reef sample, E. face, at 150 feet.

1116.—Hanging wall, near west face.

1117.—Steel's Reef (average sample).

1118.—Dolerite with pyrrhotite; 400 yards west of camp (Blackhall's Reef), running SSE. by S.

1119.—Sheared granite-porphyry ("suet rock"); ¼ mile east of camp.

1120.—Same as 1119, but further south, towards granite contact.

1121.—M.K. Reef (average sample).

1122.—Quartz rock, shattered and re-cemented, showing visible gold; M.K. Reef.

1123.—Reef with siderite, and country rock; east side, M.K. Reef.

1124.—Country rock, M.K. Reef (sheared granite-porphyry).

1125.—Small leader in country rock; Blackhall's Reef.

1126.—Highly mineralised patch of Blackhall's Reef.

1127 *to* 1132.—Transition series between granite-porphyry, sheared granite-porphyry ("suet rock"), and schist (the final stage of shearing).

1134.—Pyritic reef (Blackhall's), with "semi-suet" rock.

1135.—Completely rotted "suet rock" at surface; Blackhall's Reef.

1136.—Gneissose hornblende-granite in river below Blackhall's (at the pump).

1137.—Diorite, 500 yards beyond 1136, towards Kweri Hill; non-gneissose "syenite."

1138.—Crushed Newer Granite, 200 yards further on in the same direction. Here the foliation runs NW. by W. The exposures are becoming less foliated.

1139.—Ditto. 1,000 yards further on; rock still less gneissose.

1140.—Ditto. 650 wards further on, near gneissose granite with pink feldspar and purple quartz.

1141.—Diorite, 400 yards further on; grey granite (porphyritic) and transition to 1142.

1142.—Porphyry with augite.

1143.—Quartz; top of Kweri Hill.

1144.—Floater of crushed Newer Granite, on quartz-rocks of Kweri Hill.

1145.—Dolerite in stream below pump; a few hundred yards down-stream of 1136.

1146.—Amphibolite associated with 1145.

1147.—Granular quartz, from rubble at Kisumu Prospecting Syndicate's mine (visible gold).

1099.—Reconstructed volcanic tuff, with clay pellets; near the top of the Miocene, Kaswanga Hill, Businga.

1100.—Limestone from old quarry site, west of camp at Mbeta, Businga Island.

1101.—Lumps of basic material, resting on conglomerate; same locality as 1092.

1102.—Compact crystal tuff derived from nephelinite above agglomerate that succeeds thick deposits of sedimentaries; Kaswanga Hill.

1103.—Nephelinite tuff, exposed near camp at Mbeta.

1104.—Same as 1103, but cemented by calcite; same locality as 1103.

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1119.—Sheared granite-porphyry ("suet rock"); ¼ mile east of camp.

1120.—Same as 1119, but further south, towards granite contact.

1121.—M.K. Reef (average sample).

1122.—Quartz rock, shattered and re-cemented, showing visible gold; M.K. Reef.

1123.—Reef with siderite, and country rock; east side, M.K. Reef.

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1137.—Diorite, 500 yards beyond 1136, towards Kweri Hill; non-gneissose "syenite."

1138.—Crushed Newer Granite, 300 yards further on in the same direction. Here the foliation runs NW. by W. The exposures are becoming less foliated.

1139.—Ditto. 1,000 yards further on; rock still less gneissose.

1140.—Ditto. 650 wards further on, near gneissose granite with pink feldspar and purple quartz.

1141.—Diorite, 400 yards further on; grey granite (porphyritic) and transition to 1142.

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1146.—Amphibolite associated with 1145.

1147.—Granular quartz, from rubble at [illegible] Prospecting Syndicate's mine (visible gold).

1147a.—Breccia; same locality as 1147.

1147b.—Artifact; same locality as 1147.

1147c.—Hornblende-granite, not very gneissose; same locality as 1147.

1148.—Ancient conglomerate at Gori Ferry on the Tanganyika–Kisii Road; possibly pre-K.A.

1149.—Fine-grained mica-diorite-porphyry; 2/5ths mile beyond 1148 on the Kisii Road.

1150.—Another member of the porphyry group (a diorite porphyry), less porphyritic than 1149; 4 miles approximately beyond 1149.

1151.—Augite-mica-diorite-porphyry; ½ mile beyond 1150.

1152.—Variety of 1151? 2-1/5th miles beyond 1151.

1153.—Conglomerate with lava matrix; 2-1/10th miles beyond 1152.

1154.—Sedimentary or rotted igneous rock? 2½ miles beyond 1153.

1155.—Volcanic agglomerate; 9/10ths mile beyond 1154.

1156.—Altered dolerite; nearly 3 miles beyond 1155.

1157.—Altered dolerite; ½ mile beyond 1156.

1158.—Altered shales; 1 miles beyond 1157.

APPENDIX II.—FIRE ASSAY RESULTS.

Locality	Nature of Specimen	Dwt. per long ton of Silver	Dwt. per long ton of Gold
Nine-tenths of a mile beyond camp at Oyugis on the Kendu Road	Pyritiferous, cellular, grey, quartz-rock	4	2
Gori Ferry on Tanganyika–Kisii Road	Ancient conglomerate	4	..
One and three-fifth miles from junction of Kisii–Suna and the Kitare track, along the former towards Kisii	Quartz-reef	..	..
Five and two-third miles beyond Rangwe Camp on the Homa Road	Sheared agglomerate or conglomerate	..	..
Long hill north of Rangwe Camp	"Reef"?	3	6
Three-quarters of a mile from Kitare on the Rangwe Rd.	Quartz-reef	..	..
Three and one-third miles beyond Sondu on the Kisii Rd.	Silicified pyritiferous lava	2	..
In stream below pump at Blackhalls	Amphibolite	2	..
Four miles beyond Rangwe Camp, Homa Road	Conglomerate	..	..
Seven and one-quarter miles from Kisii down the Kendu Road	Lava conglomerate	2	..
Six and three-quarter miles from Sondu on the Kisii Rd.	Pyritiferous trachytic lava	..	..
Rai River	Banded quartz rock, somewhat pyritiferous	..	..
Three and one-third miles from Oyugis along the Rangwe track	Amphibolised dolerite with pyrites	..	..
German prospect pit No. 2 S.W. of Oyugis	Ferruginous quartz	..	..
Old prospect pit at Nya[illegible]	Quartz	..	..
One mile, 1300 yards beyond Onuok R. on Rangwe track from Oyugis	Pyritiferous cherty rock	..	..
German prospect trench No. 1 S.W. of Oyugis	Quartz	..	..

Assayed by A. W. GROVES.

1147a.—Breccia; same locality as 1147.

1147b.—Artifact; same locality as 1147.

1147c.—Hornblende-granite, not very gneissose; same locality as 1147.

1148.—Ancient conglomerate at Gori Ferry on the Tanganyika–Kisii Road; possibly pre-K.A.

1149.—Fine-grained mica-diorite-porphyry; 2/5ths mile beyond 1148 on the Kisii Road.

1150.—Another member of the porphyry group (a diorite porphyry), less porphyritic than 1149; 4 miles approximately beyond 1149.

1151.—[illegible] diorite-porphyry; ½ mile beyond 1150.

1152.—Variety of 1151? 2-1/5th miles beyond 1151.

1153.—Conglomerate with lava matrix; 2-1/10th miles beyond 1152.

1154.—Sedimentary or rotted igneous rock? 2½ miles beyond 1153.

1155.—Volcanic agglomerate; 9/10ths mile beyond 1154.

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APPENDIX II.—FIRE ASSAY RESULTS.

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Nine-tenths of a mile beyond camp at Oyugis on the Kendu Road	Pyritiferous, cellular, grey, quartz-rock	4	2
Gori Ferry on Tanganyika–Kisii Road	Ancient conglomerate	4	..
One and three-fifth miles from junction of Kisii–Suna and the Kitare track, along the former towards Kisii	Quartz-reef	..	..
Five and two-third miles beyond Rangwe Camp on the Homa Road	Sheared agglomerate or conglomerate	..	..
Long hill north of Rangwe Camp	"Reef"	..	..
Three-quarters of a mile from Kitare on the Rangwe Rd.	Quartz-reef	3	6
Three and one-third miles beyond Sondu on the Kisii Rd.	Silicified pyritiferous lava	..	..
In stream below pump at Blackballs	Amphibolite	2	..
Four miles beyond Rangwe Camp, Homa Road	Conglomerate	..	..
Seven and one-quarter miles from Kisii down the Kendu Road	Lava conglomerate	..	..
Six and three-quarter miles from Sondu on the Kisii Rd.	Pyritiferous trachytic lava	2	..
Rai River	Banded quartz rock, somewhat pyritiferous	..	..
Three and [illegible] miles from Oyugis along the Rangwe track	Amphibolised dolerite with pyrites	..	..
German prospect [illegible] N.W. of Oyugis	Ferruginous quartz	..	..
Old prospect pit at [illegible]	Quartz	..	..
One mile, 1,000 yards beyond Oniok R. on Rangwe track from Oyugis	Pyritiferous cherty rock	..	..
German prospect [illegible] S.W. of Oyugis	Quartz	..	..

Assayed by A. W. GROVES.

APPENDIX III

[illegible]

LAVAS.

[illegible]

[illegible] grouping. [illegible] vesicles were subsequently occupied by quartz, but they are all elongated parallel to the flow-trend exhibited by the crystallites.

Trachytes.—These have the usual fine-grained trachytic groundmass, but generally with relatively few phenocrysts. The latter consist of sanidine showing Carlsbad twinning, partly resorbed biotite, and sometimes a pyroxene with just a suspicion of colour of the very weakest green. Vesicles are occupied either by fibrous zeolites or by chlorite and epidote.

A further type of trachyte is characterised by the presence of anorthoclase phenocrysts. No. 1028, 26½ miles from Sondu on the [illegible] Road, is typical of several. It is a light-grey rock which under the microscope consists of abundant laths and rhombs of felspar, crowded with minute inclusions in a trachytic groundmass. Small prismoids of felspar have the included material segregated at the centre (cf. [1], p. 397). Examination under a high-power objective shows exceedingly fine twinning on microcline and albite systems, so that the prismoids are definitely anorthoclase, and one can only surmise that most, if not all, of the felspar is anorthoclase. There are also [illegible] crystals of colourless diopside.

Vesicles are occupied by a greenish-brown epidote, and at other times by chalcedony and chlorite. Accessory pyrite is visible megascopically. No alkali pyroxenes or amphiboles are developed, and the rock is an *anorthoclase-trachyte.*

Trachy-Andesites.—No. 1050, near Oyugis, is an amygdaloidal lava, with the small vesicles occupied by chlorite, while the largest, which measure two or three inches across, are filled with calcite. The phenocrysts of plagioclase, which are up to half-an-inch or more in length, contain many included particles of epidote. The groundmass consists of fine laths of plagioclase showing a tendency towards a variolitic structure. Small granules of colourless diopside occur in the groundmass.

The maximum symmetrical extinction angle of the plagioclase is 18° [illegible] but among the phenocrysts and in the groundmass there is some sanidine present. The lava is thus a trachy-andesite.

Basalts.—There are several widely different types of basalts. Some very fine-grained types are much altered and contain [illegible] quartz, epidote and chlorite as in 1011 [illegible] miles beyond the police camp on the Kericho-Sondu Road.

[1] [illegible] "The Rift Valleys and Geology of East Africa," by Prof. J. W. Gregory, p. 397 [illegible]

APPENDIX III.

THE PETROLOGY OF THE ROCKS COLLECTED BY THE DIRECTOR OF GEOLOGICAL SURVEY IN THE SOUTHERN PART OF THE NYANZA PROVINCE OF KENYA.

By Dr. A. W. Groves.

About 400 specimens were collected from 180 localities, and all of these have been sliced and examined under the microscope. Seventeen specimens were assayed for gold and silver, the results of which are given in Appendix II.

[illegible]

LAVAS.

[illegible]

radiate grouping. Elongated vesicles were subsequently occupied by quartz, but they are all elongated parallel to the flow-trend exhibited by the crystallites.

Trachytes.—These have the usual fine-grained trachytic groundmass, but generally with relatively few phenocrysts. The latter consist of sanidine showing Carlsbad twinning, partly resorbed biotite, and sometimes a pyroxene with just a suspicion of colour of the very weakest green. Vesicles are occupied either by fibrous zeolites or by chlorite and epidote.

A further type of trachyte is characterised by the presence of anorthoclase phenocrysts. No. 1025, 26½ miles from Sondu on the Kisii Road, is typical of several. It is a light-grey rock which under the microscope consists of abundant lath- and rhombs of felspar, crowded with minute inclusions in a trachytic groundmass. Small prismoids of felspar have the included material segregated at the centre (cf. [1], p. 397). Examination under a high-power objective shows exceedingly fine twinning on microcline and albite systems, so that the prismoids are definitely anorthoclase, and one can only surmise that most, if not all, of the felspar is anorthoclase. There are also euhedral crystals of colourless diopside.

Vesicles are occupied by a greenish-brown epidote, and at other times by chalcedony and chlorite. Accessory pyrite is visible megascopically. No alkali pyroxenes or amphiboles are developed, and the rock is an anorthoclase-trachyte.

Trachy-Andesites.—No. 1080, near Oyugis, is an amygdaloidal lava, with the small vesicles occupied by chlorite, while the largest, which measure two or three inches across, are filled with calcite. The phenocrysts of plagioclase, which are up to half an inch or more in length, contain many included patches of epidote. The groundmass consists of fine laths of plagioclase showing a tendency towards a variolitic structure. Small granules of colourless diopside occur in the groundmass.

The maximum symmetrical extinction angle of the plagioclase is 18° (Andesine), but among the phenocrysts and in the groundmass there is some sanidine present. The lava is thus a trachy-andesite.

Basalts.—There are several widely different types of basalts. Some very fine-grained types are much altered and contain amygdales of quartz, epidote and chlorite as in 1011; 2 miles beyond the police camp on the Kericho-Sondu Road.

[1] "The Rift Valleys and Geology of East Africa," by Prof. J. W. Gregory; p. 397 [illegible]

1064. [illegible] consists of a very fine mesh of plagioclase laths and small colourless granules of monoclinic pyroxene in a glassy base and without accessory iron-ores.

1097, which Mr. Wayland states is typical of the outflows between Homa Bay and Karungu, is a dark lava with porphyritic augite. Under the microscope it consists of numerous large phenocrysts of very pale-coloured olivine, [illegible] showing [illegible] and resorption by the magma, [illegible] a fine-grained groundmass formed of [illegible]

[illegible]

1100: Near Camp at Mbeta, Rusinga Island.—This is a similar rock to the last, but has a very deep brown melanite developed in it, while, as in other altered nephelinites the nepheline is largely decomposed to calcite and cancrinite. 1109, a nephelinite associated with the supposed Miocene of Karungu Hill, has much melanite developed and some of it [illegible].

Limburgite.—1101: 5·6 miles beyond Rangwe Camp on the Homa Road.—This is a dark lava, with conspicuous crystals of fresh olivine up to an inch in length, accompanied by slightly smaller porphyritic augite crystals.

In thin section under the microscope, the whole rock is [illegible]. The porphyritic olivines are very large and fresh, but are fewer in number than the pyroxenes. In most cases they show corrosion by the magma, resulting in a fringe of magnetite crystals. Some of the smaller olivine crystals have been almost entirely resorbed and are surrounded by a small band of magnetite grains. In other cases a dark circle of magnetite grains marks the complete resorption of an olivine by the magma. The olivine is quite colourless, optically positive, and has an estimated optic axial angle of about [illegible].

The augite is of the palest possible shades of pinkish-brown to green, but in most cases it is very nearly colourless. In between the olivines and large augites are somewhat smaller augite crystals, while the groundmass is glassy and crowded with specks of iron-ore.

There are no felspar phenocrysts, and close examination of the groundmass, which is cryptocrystalline and glassy, shows microphenocrysts of augite, but none of felspar, even under a magnification of 400 diameters. The rock is thus a typical limburgite.

Altered Lavas.—These include silicified lavas, altered [illegible] lavas, and others largely altered to epidote and calcite.

The silicified lavas such as 1015—about 3 miles beyond the police camp on the [illegible] Road—are fine-grained, but have all the [illegible] and all the felspar laths replaced by quartz. The groundmass consists of turbid cryptocrystalline decomposition products. What appear to be green olivine crystals in the hand specimen are seen to be green chlorite, and probably represent an original ferro-magnesian mineral.

1064, Kisii, consists of a very fine mesh of plagioclase laths and small colourless granules of monoclinic pyroxene in a glassy base and without accessory [illegible].

1207, which Mr. Wayland states is typical of the country between Homa Bay and Karungu, is a dark lava with porphyritic augite. Under the microscope it consists of [illegible] large phenocrysts of very pale-coloured augite, frequently showing zoning, twinning and corrosion by the magma, set in a fine-grained groundmass formed of myriads of minute pyroxene [illegible] with [illegible] felspar and [illegible] in [illegible] glassy [illegible] felspar laths and these are [illegible].

[illegible]

1200: Near Camp at Mbita, Rusinga Island.—This is a similar rock to the last, but has a very deep brown melanite developed in it, while, as in other altered nephelinites the nepheline is largely decomposed to calcite and cancrinite. 1198, a nephelinite [illegible] with the supposed Miocene of Karungu, [illegible] has much melanite developed and some of it is zoned.

Limburgite.—[illegible] miles beyond Rangwe Camp on the Homa Road.—This is a dark lava, with conspicuous crystals of fresh olivine up to an inch in length, accompanied by slightly smaller porphyritic augite crystals.

In thin section under the microscope, the whole rock is perfectly fresh. The porphyritic olivines are very large and fresh, but are fewer in number than the pyroxenes. In some cases they show corrosion by the magma, resulting in a fringe of [illegible] crystals. Some of the smaller olivine crystals have been almost entirely resorbed and are surrounded by a broad band of magnetite grains. In other cases a dark circle of magnetite grains marks the complete resorption of an olivine by the magma. The olivine is quite colourless, optically positive, and has an estimated optic axial angle of about [illegible].

The augite is of the palest possible shades of pinkish-brown or green, but in most cases it is very nearly without colour. In between the olivines and large augites are some [illegible] smaller augite crystals, while the groundmass is glassy and dusted with specks of [illegible].

There are no felspar phenocrysts, and close examination of the groundmass, which is cryptocrystalline and glassy, shows microphenocrysts of augite, but none of felspar even using a magnification of [illegible] diameters. The rock is thus a typical limburgite.

Altered Lavas. These include silicified lavas, altered [illegible] lavas, and others largely altered to epidote and quartz.

The silicified lavas such as 1083—about 3 miles beyond the police camp on the Kisii-Kericho Road—are fine-grained, but have all the interstices and all the felspar laths replaced by quartz. The groundmass consists of turbid cryptocrystalline decomposition products. What appear to be green [illegible] crystals in the hand specimen are seen to be green chlorite, and probably represent an original ferro-magnesian mineral.

[illegible] which has clearly been broken up and invaded by siliceous solutions crystallising as quartz.

Other fine-grained silicified lavas, such as [illegible] on the Kendu Road, have pseudomorphs in quartz after porphyritic felspars.

[illegible] miles from Kisii on the [illegible] Road [illegible] although otherwise completely silicified.

The character of the foregoing silicified types [illegible] that they were probably andesites originally.

[illegible]

[illegible]

[illegible]

blende, which is a peculiar brown variety, though not barkevikite, is intricately intergrown in poikilitic manner with the aegerine-augite. There is much clove-brown sphene enclosed in the microlitic variety, as well as crystals of apatite with well-defined [illegible] of pyroxene and amphibole. Large patches of magnetite also occur.

Volcanic Agglomerate.—[illegible] (about 12 miles from Gore Ferry on the Tanganyika-Kisii Road) is a very much decomposed green-coloured volcanic agglomerate, the rounded lapilli being largely altered to calcite and chlorite.

Lava Conglomerates.—These consist of pebbles and boulders of lavas and other rocks in a matrix which is in part sedimentary, but which has been invaded and cemented by subsequent lava flows and the liquid emanations therefrom.

Specimen [illegible] ([illegible] miles from Kisii on Kendu Road) has rounded pebbles of stony lava up to about six inches in length, and occasionally these have a coating of pyrite. The pebbles grade down to the very smallest sizes, and in some specimens there is very little matrix. Slides cut from the fine-grained lava forming the matrix show it to consist of phenocrysts of plagioclase, and some of [illegible], in an andesitic groundmass. Some of the phenocrysts are slightly resorbed by the magma. Vesicles are occupied by chalcedony and chlorite, while there are also some pseudomorphs in chlorite after probable pyroxene or amphibole. The maximum symmetrical extinction angle of the plagioclase is 17°, corresponding to andesine. The lava matrix is thus andesitic. There are included in the lava matrix, as seen under the microscope, pebbles of all sizes down to the size of a pea or less. They consist of different types of andesite and some of jasper. There are also odd quartz grains of sedimentary appearance, and the lava appears to have flowed in around them. In places the groundmass consists of angular grains of quartz, chiefly of sedimentary origin, cemented by cryptocrystalline silica and chlorite probably derived from lava.

No. [illegible] (3 miles from Gore Ferry on the Tanganyika-Kisii Road) is very similar to the last, but it has some pebbles of granite and other plutonic types in addition to lava pebbles. Slides specially cut from the matrix show it to consist of angular to sub-angular grains of plagioclase, with only a few grains of quartz and occasional granules of lava. The cementing material is a mixture of the chalcedonic silica and green chlorite.

[illegible] locality as [illegible] is a rock composed of fragments of [illegible], which has clearly been broken up and invaded by siliceous solutions crystallizing as quartz.

Other fine-grained silicified lavas, such as [illegible] mile beyond camp at [illegible] on the [illegible] Road, have pseudomorphs in quartz after porphyritic felspars.

[illegible] miles from Kisii, on the [illegible] Road has an almost [illegible] pyroxene preserved in it, although otherwise completely silicified.

The characters of the foregoing silicified types all suggest that they were probably [illegible] originally.

[illegible]

[illegible]

[illegible]

blende, which is a peculiar brown variety, though not barkevikite, is intimately intergrown in poikilitic manner with the aegirine-augite. There is much clove-brown sphene enclosed in the colourless variety, as well as crystals of apatite with well-defined cores of pyroxene and amphibole. Large patches of magnetite also occur.

Volcanic Agglomerate.—[illegible] taken 12 miles from Gori Ferry on the Tanganyika–Kisii Road is a very much decomposed green-coloured volcanic agglomerate, the rounded lapilli being largely altered to calcite and chlorite.

Lava Conglomerates.—These consist of pebbles and boulders of lavas and other rocks in a matrix which is in part sedimentary, but which has been invaded and cemented by subsequent lava flows and the liquid emanations therefrom.

Specimen [illegible] miles from Kisii on [illegible] Road has rounded pebbles of many lava up to about six inches in length, and occasionally these have a coating of pyrite. The pebbles grade down to the very smallest sizes, and in some specimens there is very little matrix. Slides cut from the fine-grained lava forming the matrix show it to consist of phenocrysts of plagioclase, and some of [illegible], in an [illegible] groundmass. Some of the phenocrysts are slightly resorbed by the magma. Vesicles are occupied by chalcedony and chlorite, while there are also some pseudomorphs in chlorite after probable pyroxene or amphibole. The maximum symmetrical extinction angle of the plagioclase is [illegible], corresponding to andesine. The lava matrix is thus andesitic. There are included in the lava matrix, as seen under the microscope, pebbles of all sizes down to the size of a pin or less. They consist of different types of andesite and some of jasper. There are also odd quartz grains of sedimentary appearance, and the lava appears to have flowed in round them. In places the groundmass consists of angular grains of quartz, clearly of sedimentary origin, cemented by cryptocrystalline silica and chlorite probably derived from lava.

No. [illegible] miles from Gori Ferry on the Tanganyika–Kisii Road is very similar to the last, but it has some pebbles of granite and other plutonic types in addition to lava pebbles. Slides specially cut from the matrix show it to consist of angular to sub-angular grains of plagioclase, with only a few grains of quartz and occasional granules of lava. The cementing material is a mixture of the chalcedonic silica and green chlorite.

The origin of these last two rocks is believed to be as follows. Pebble and boulder beds were covered by lavas, which also flowed into them. Where the coarse grit between the pebbles was not actually invaded by lava, fluid emanations from the flow cemented it.

HYPABYSSAL ROCKS

Granophyre.—One occurrence is a marginal phase of red granite, about 10 to 12 miles from [illegible], along the [illegible] Road. Its felspar is decomposed and reddened. The granophyric structure is [illegible] displayed. [illegible] miles from [illegible], along the [illegible] Road appears in the hand specimen to be a granite with green and pink felspars. A thin section under the microscope shows it to be a granophyre, a peculiar feature of which is that the felspar intergrown with the quartz is plagioclase, showing fine twin lamellae, together with much [illegible].

Quartz Porphyry.—Occurs on the [illegible] stretch of the [illegible] Road, and is probably [illegible] with the [illegible]. It has few [illegible] quartz crystals but [illegible] resorption by the magma.

[illegible] Porphyry.—Specimens were collected from Mile 73 and Mile 87 from [illegible] on the [illegible] Road. They contain porphyritic [illegible] quartz and [illegible]. In the specimen from Mile 17 [illegible] there is a great deal of shearing and the introduction of some [illegible].

[illegible] Porphyry.—[illegible] from the [illegible] by the river below [illegible] is a porphyry with altered plagioclase phenocrysts, [illegible] and a little pyrite.

[illegible] Porphyry.—Three specimens, from [illegible] [illegible] and one [illegible] on the [illegible] Road, are porphyries with phenocrysts of [illegible] and [illegible] pyroxene [illegible] quartz. The groundmass [illegible] of felspar [illegible] with [illegible] crystals [illegible].

Sheared Porphyries.—[illegible] specimens of [illegible] were collected, a few from [illegible] of [illegible] Hill, but mostly from the neighbourhood of [illegible]'s Reef. In the latter locality the sheared porphyries have been [illegible] known as [illegible] rock.

The sheared porphyries of [illegible] Hill, in some cases, show under the microscope phenocrysts of [illegible] quartz, and [illegible] aggregates which represent former felspar phenocrysts,

so that their nature is evident. In other specimens, however, they are powerfully sheared siliceous rocks, with much exceedingly fine sericitic material, which has probably resulted from the destruction of former felspars.

The series of twenty specimens from the neighbourhood of [illegible]'s Reef illustrates [illegible] how powerful shearing has caused a gradual transition from porphyry to schistose and slaty rocks, which in the hand specimen resemble altered sediments rather than an igneous rock.

In [illegible] where the porphyries display their phenocrysts clearly, both in the hand specimen and thin section. Some of the specimens are [illegible] from crushing but, as might be expected, the felspar phenocrysts [illegible] and decompose comparatively rapidly while the quartz phenocrysts preserve their integrity after crushing by [illegible]. At the same time, changes take place in the [illegible] of the groundmass, and [illegible] is developed as [illegible]. Pyrite is also developed, and there may be some chlorite and [illegible] formed.

With increasing shearing, the phenocrysts of quartz and felspar become rolled out and hardly distinguishable. The rock is now a greenish-grey slate, and [illegible] of pyrite and [illegible] developed along the parting planes. In the advanced stages surfaces of the specimen parallel to the foliation have to be carefully searched before traces of the original phenocrysts of the porphyry are recognised.

Finally the rock appears to be a [illegible] of pale greenish-grey [illegible], and no traces of the former phenocrysts are visible in the hand specimen. The shearing is here very intense and the rock is a true [illegible]. A thin section of this rock ([illegible]) shows elongated [illegible] roughly aligned with the direction of foliation, which consist of pale chlorite, but probably represent remnants of former felspar phenocrysts.

[illegible] of Sheared Porphyry.—Specimen [illegible], from [illegible] Hill, is a breccia of pebbles of sheared porphyry cemented with [illegible] and quartz.

Specimen [illegible], from [illegible] miles beyond [illegible] Camp on the [illegible] Road, is similar to the last, but is cemented and thoroughly silicified with [illegible].

Dolerites, Epidiorites and Amphibolites.—There are some twenty specimens of dolerite and epidiorite in the collection.

The origin of these last two rocks is believed to be as follows: Pebble and boulder beds were covered by lavas, which also flowed into them. Where the matrix got between the pebbles was not actually covered by lava, fluid emanations from the flow converted it.

HYPABYSSAL ROCKS

Granophyre.—One occurrence is a marginal phase of red granite, about 10 to 12 miles from [illegible], along the [illegible] Road. Its felspar is decomposed and reddened, but granophyric structure is beautifully displayed. [illegible] miles from [illegible], along the [illegible] Road appears in the hand specimen to be a granite with green and pink felspars. A thin section under the microscope shows it to be a granophyre, a peculiar feature of which is that the felspar intergrown with the quartz is plagioclase, showing fine twin lamellae together with much [illegible].

Quartz-Porphyry.—[illegible] of the [illegible] Road and [illegible] with [illegible]. It has few porphyritic quartz [illegible] by the [illegible].

Granite-Porphyries.—Specimens were collected from Mile 73 and Mile 77 from [illegible] on the [illegible]. They contain porphyritic bipyramidal quartz and orthoclase. In the specimen from Mile 77 [illegible] there is a good deal of shearing and the introduction of some [illegible].

Biotite Porphyry.—[illegible] from the [illegible] near Blackhall's [illegible] of [illegible] Hill is a [illegible] with altered plagioclase phenocrysts, [illegible] and a little pyrite.

[illegible] Porphyry.—These specimens, from [illegible] and one [illegible] on the [illegible] Road, are porphyries with phenocrysts of [illegible] and [illegible] pyroxene [illegible] of quartz. The [illegible] of felspar [illegible] with [illegible].

Sheared Porphyries.—A whole series of sheared ones was collected, a few from the middle of Wau Hill, but mainly from the neighbourhood of Blackhall's Reef. In the latter locality the [illegible] porphyries have been popularly known as [illegible].

The sheared porphyries of Wau Hill, in some cases, show [illegible] the [illegible] phenocrysts of bipyramidal quartz, and [illegible] which represent former felspar phenocrysts.

as that these [illegible] is evident. In other specimens, however, they are essentially sheared siliceous rocks, with much exceedingly fine sericitic material, which has probably resulted from the destruction of former felspars.

The series of twenty specimens from the neighbourhood of Blackhall's Reef illustrates [illegible] how powerful shearing has caused a gradual transition from porphyry to schist and slaty rocks, which in the hand specimen resemble altered sediments rather than an igneous rock.

In the earliest stages the porphyries display their phenocrysts clearly, both in the hand specimen and thin section. Some of the specimens are altogether free from crushing, but, as might be expected, the felspar phenocrysts crumple and decompose comparatively rapidly while the quartz phenocrysts preserve their integrity after crushing by recrystallisation. At the same time, changes take place in the composition of the groundmass, and foliation is developed as shearing increases. Pyrite is also developed, and there may be some chlorite and sericite formed.

With increasing shearing, the phenocrysts of quartz and felspar become rolled out and hardly recognisable. The rock is now a greenish-grey slate, and the [illegible] of pyrite and iron oxide are developed along the parting planes. In the advanced stages surfaces of the specimen parallel to the foliation have to be carefully searched before traces of the sheared phenocrysts of the porphyry are recognised.

Finally the rock appears to be a sericitic schist of pale greenish-grey colour, and no traces of the former phenocrysts are visible in the hand specimen. The shearing is here very intense, and the rock is a true [illegible]. A thin section of this rock ([illegible]) shows elongated lighter-coloured patches, roughly aligned with the direction of foliation, which consist of pale chlorite, but probably represent remnants of former felspar phenocrysts.

[illegible] Breccias of Sheared Porphyry.—Specimen [illegible], [illegible], Wau Hill, is a breccia of pebbles of sheared porphyry cemented with hematite and quartz.

Specimen [illegible], from [illegible] miles beyond [illegible] Camp on the [illegible] Road, is similar to the last, but is cemented and thoroughly silicified with chalcedonic silica.

Dolerites, Epidiorites and Amphibolites.—There are some twenty specimens of dolerites and epidiorites in the collection.

The normal dolerites are usually characterised by a pyroxene which is colourless in thin section when fresh and unaltered. *In this respect they resemble the dolerite of* Uganda and N.W. Tanganyika. This pyroxene is optically positive, and has a very small optic axial angle, so that it may be classed as pigeonite. Its fairly high extinction angle indicates that it is rich in lime.

The dolerites are usually more or less ophitic and the plagioclase is the usual labradorite, and there is accessory ilmenite.

Alteration of the pyroxene changes it first to a very pale brown tint, and then to green as it becomes amphibolised. These same changes are to be found in many of the dolerites of the *Ankole District of* S.W. Uganda and Bukoba Province of Tanganyika Territory.

Several of the specimens from the neighbourhood of Kisii *are apparently extrusive dolerites, and in some of these chal*cedone solutions have attacked both the pryoxene and felspar.

The amphibolites and epidiorites derived from the dolerites have no outstanding features of petrographic interest.

PLUTONIC ROCKS.

Granites.—Most of the biotite-granite specimens when examined under the microscope show crushing to a greater or less extent. The felspars are microcline, microperthite or microcline-microperthite, and a little oligoclase, but they are usually severly granulated by *crushing*. A characteristic of the felspars is the strong delineation of the cleavages due to the *formation* along them of iron oxide, biotite and chlorite, etc. Sometimes there are remnants of crushed porphyritic felspar crystals. In all these characters they resemble the "Newer" Granites of Uganda[1]. Each slide has its counterpart among the slides made from specimens collected by Mr. A. D. Combe *from the granites of* Ankole, *and a study of their heavy mineral* assemblages confirms this. The localities from which specimens of "Newer" Granite have been collected are Rai River (3 miles from Kisii), Kweri Hill, and near Blackhall's.

1082, from Nyasoki Bridge (4-2/5ths miles from Kitare on the Rangwe Road), is a biotite-hornblende-granite different from the foregoing. The hornblende is pleochroic from an

[1]The G2 Granites of the Geological Survey of Uganda.

extremely pale green to deep olive-green, and there is suggestive evidence that some of the amphibole was originally hypersthene. The felspars are rather turbid and comprise orthoclase finely twinned oligoclase, and some zoned plagioclase. There is much accessory sphene in well-formed idiomorphic crystals pleochroic from cream to clove-brown. The quartz indicates stress conditions during the late stages of crystallisation, and this is also reflected to some extent by the felspars. The heavy mineral suite shows that this granite is to be correlated with the "Newer" Granites.

Aplogranite.—Two specimens of rather fine-grained aplogranite, with a strikingly red felspar, appear from field evidence to be related to the "Newer" Granites. In thin section something of the reddish tint of the felspars is still visible. It is probably due to finely dispersed ferric oxide. The felspar is largely oligoclase, with some microcline. There does not appear to be much orthoclase, and ferro-magnesian minerals are absent.

Diorites.—Specimen [illegible] miles from Oyugis down the Kendu Road: appears in the field to be a diorite rock invading hornblende-schist and assimilating xenoliths of it. The xenoliths vary from fragments of an inch up to large boulders.

Under the microscope the plutonic rock is seen to be a hornblende-diorite, with many zoned plagioclases, but also much secondary quartz. It appears to be a granite rendered dioritic by assimilation of hornblende-schist. As the hornblende-schist is assimilated by the granite it is first strongly silicified and then its foliation disappears as the hornblende crystals float away in the diorite. The diorite is richer in sphene near to where hornblende-schist is being assimilated, and the titanium is evidently derived from the schist.

Two specimens of normal diorite were collected from between Blackhall's and Kweri Hill.

Hornblende Gneisses.—Specimen [illegible] from a point approximately half a mile beyond the Kuja River, on the track from Karungu to the gold mine, is a hornblende-gneiss which has clearly been derived from a pyroxene-granite. The hornblende, sometimes with cores of pale pyroxene from which it is clearly derived, is set in a groundmass of severely shattered felspars and recrystallised quartz. The remnants of plagioclase show bent twin lamellae, but some are probably oligoclase and there is a little microcline. Brown sphene and pale yellow epidote occur as accessory minerals.

The normal dolerites are usually characterised by a pyroxene which is colourless in thin section when fresh and unaltered. In this respect they resemble the dolerite of Uganda and N.W. Tanganyika. This pyroxene is optically positive, and has a very small optic axial angle, so that it may be classed as pigeonite. Its fairly high extinction angle indicates that it is rich in lime.

The dolerites are usually more or less ophitic and the plagioclase is the usual labradorite, and there is accessory ilmenite.

Alteration of the pyroxene changes it first to a very pale brown tint, and then to green as it becomes amphibolised. These same changes are to be found in many of the dolerites of the Ankole District of S.W. Uganda and Bukoba Province of Tanganyika Territory.

Several of the specimens from the neighbourhood of Kisii are apparently extrusive dolerites, and in some of these chalcedonic solutions have attacked both the pryoxene and felspar.

The amphibolites and epidiorites derived from the dolerites have no outstanding features of petrographic interest.

PLUTONIC ROCKS.

Granites.—Most of the biotite-granite specimens when examined under the microscope show crushing to a greater or less extent. The felspars are microcline, microperthite or microcline-microperthite, and a little oligoclase, but they are usually severely granulated by crushing. A characteristic of the felspars is the *strong delineation of the cleavages due to the* formation along them of iron oxide, biotite and chlorite, etc. Sometimes there are remnants of crushed porphyritic felspar crystals. In all these characters they resemble the "Newer" [illegible] of Uganda[1]. Each slide has its counterpart among the slides made from specimens collected by Mr. A. D. Combe from the granites of Ankole, and a study of their heavy mineral assemblages confirms this. The localities from which specimens of "Newer" Granite have been collected are Rai River [illegible] miles from Kisii, Kweri Hill, and near Blackhall's.

[illegible] from [illegible] Bridge (4-2/5ths miles from Kitare on the [illegible] Road) is a biotite-hornblende-granite different from the foregoing. The hornblende is pleochroic from an

[1] [illegible] Granites of the Geological Survey of Uganda.

extremely pale green to deep olive-green, and there is suggestive evidence that some of the amphibole was originally hypersthene. The felspars are rather turbid and comprise orthoclase, finely twinned oligoclase, and some zoned plagioclase. There is much accessory sphene in well-formed idiomorphic crystals pleochroic from cream to clove-brown. The quartz indicates stress conditions during the late stages of crystallisation, and this is also reflected to some extent by the felspars. The heavy mineral suite shows that this granite is to be correlated with the "Newer" Granites.

Aplogranite.—Two specimens of rather fine-grained aplogranite, with a strikingly red felspar, appear from field evidence to be related to the "Newer" Granites. In thin section something of the reddish tint of the felspars is still visible. It is probably due to finely dispersed ferric oxide. The felspar is largely oligoclase, with some microcline. There does not appear to be much orthoclase, and ferro-magnesian minerals are absent.

Diorites.—Specimen [illegible] [illegible] miles from Oyugis down the Kendu Road appears in the field to be a diorite mass invading hornblende-schist and assimilating xenoliths of it. The xenoliths vary from fragments of an inch up to large boulders.

Under the microscope the plutonic rock is seen to be a hornblende-diorite with many zoned plagioclases, but also much secondary quartz. It appears to be a granite rendered dioritic by assimilation of hornblende-schist. As the hornblende-schist is assimilated by the granite it is first strongly silicified and then its foliation disappears as the hornblende crystals float away in the diorite. The diorite is richest in sphene near to where hornblende-schist is being assimilated, and the titanium is evidently derived from the schist.

Two specimens of [illegible] diorite were collected from between Blackhall's and Kweri Hill.

Hornblende Gneisses.—Specimen [illegible] from a point approximately half a mile beyond the Kuja River on the track from Karungu to the gold mine, is a hornblende-gneiss which has clearly been derived from a pyroxene-granite. The hornblende, sometimes with cores of pale pyroxene from which it is clearly derived, is set in a groundmass of [illegible] felspars and recrystallised quartz. The remnants of plagioclase show bent twin lamellae, but some are probably oligoclase and there is a little microcline. Brown sphene and pale yellow epidote occur as accessory minerals.

The foliation has been imposed by intense crushing, the original rock having been a pyroxene-granite.

The rock exposed in the river below Blackhall's (at the pump) is a hornblende-gneiss, with some visible pyrite. It [illegible] some microcline and, like Specimen 1110 above, is [illegible].

Hydrothermal Siliceous Rocks.—Several specimens from the vicinity of [illegible] and Wire Hill are siliceous rocks of [illegible], the origin of all of which is probably hydrothermal. Some are cellular and may have been pyritiferous, the spaces being now occupied by hydrated iron oxide. Thin sections show that while quartz may be present, the bulk of the silica is in the form of chalcedony. Some are cherty in appearance and others resemble jasper, though a little accessory [illegible] of epidote may be present.

A specimen No. 1134 of quartz containing visible gold, [illegible] appears under the microscope to have [illegible] and recemented by fine quartz and [illegible].

[illegible]—Specimen 1079 (13 miles from Kisii along the Rangwe Road) is a breccia, comprising red jasper and [illegible] of epidote as seen in the hand specimen. The thin section reveals small pebbles of lava in addition to jasper. This is an extremely fine grained lava—possibly a trachyte—[illegible] glassy base. In addition there are numerous [illegible] crystals, the whole conglomerate being [illegible] silica and to some extent by epidote.

SEDIMENTARY ROCKS

[illegible] 1031, Nagachemchi Hill, is a quartziferous [illegible] cement. The majority of the quartz grains [illegible] and sedimentary character, [illegible] indicating their probable [illegible]. Several rounded grains [illegible]. Specks of iron oxide give a [illegible] to the rock, but apart from this the rock is [illegible]. This specimen and the next belong to [illegible].

[illegible] Nagachemchi Hill, is a coarse sandstone, formed of [illegible] quartz grains of [illegible] mm. diameter, set in a fine-grained matrix of angular and subangular quartz grains. The whole is cemented by a little interstitial secondary silica. There is no evidence of any crushing or subsequent disturbance

and the deposit is ill-graded. A number of minute zircons, mostly well worn, are visible in the finer-grained portions of the slide. One of the quartz pebbles is derived from a severely crushed rock such as an orthogneiss, and another is entirely composed of chalcedonic silica.

Crystalline Limestone.—Specimen 1069, from NE. of Homa Mountain, is a finely-granular crystalline limestone, with occasional grains of a colourless accessory mineral which appears to be brucite.

Limestone-Breccia.—1086, 3½ miles beyond Rangwe Camp on the Homa Road, is an unusual rock, consisting of lumps of a greenish rock with lighter-coloured veins running in between the lumps. Some veins of pure calcite and chalcedony are visible, as well as small pieces of stony lava.

The lumps of green rock in thin section are seen to comprise angular grains of calcite, quartz, occasional plagioclase, and some patches of green chlorite. The calcite grains greatly predominate, and the greenish rock is actually an impure crystalline limestone which has been broken into small pieces, and invaded by quartz which has clearly crystallised under stress conditions.

The lumps of fine-grained lava are without phenocrysts, and are probably either trachytic or phonolitic.

Calcite-Siderite Rock.—A specimen from a conglomerate outcrop in a gully west of Sienga, Rusinga Island (No. 1092), is a peculiar rock displaying wavy bands. Thin sections under the microscope show the lighter bands to be calcite, while the brown bands are siderite. In between the bands there are areas where the two minerals are intergrown. The siderite is altering in places to limonite. Specimen 1100 is an impure limestone very similar to the foregoing No. 1092.

Contact Metamorphosed Limestone.—Specimen 1094, on west side of the valley between Sienga and Gumba, Rusinga Island, is a contact metamorphosed limestone, with prominent megascopic crystals of magnetite and biotite, some of the magnetite being in good octahedra.

A thin section of the more normal limestone shows it to be very similar to the calcite-siderite rock (1092) described above, though not so banded. The proportion of siderite varies considerably in different parts of the specimen, and in some slides there are octahedra of magnetite. Biotite of a bright reddish-brown shade occurs in thick crystals or "books," and

The foliation has been imposed by intense crushing, the [illegible] rock having been a pyroxene-granite.

The rock exposed in the river below Blackhall's (at the pump) is a hornblende-gneiss, with some visible pyrite. It contains some microcline and, like Specimen 1110 above, is [illegible] orthogneiss.

Hydrothermal Siliceous Rocks.—Several specimens from the vicinity of Oyugis and Wire Hill are siliceous rocks of [illegible] the origin of all of which is probably hydro-[illegible] [illegible] are cellular and may have been pyritiferous, the [illegible] being now occupied by hydrated iron oxide. Thin sections show that, while quartz may be present, the bulk of the silica is in the form of chalcedony. Some are cherty in [illegible] and others resemble jasper, though a little acces-[illegible] [illegible] epidote may be present.

[illegible] No. 1126 of quartz containing visible gold, [illegible] W.A. [illegible] appears under the microscope to have [illegible] crushed and recemented by fine quartz and [illegible]

[illegible] Specimen 1079 (13 miles from Kisii along [illegible] Road) is a breccia, comprising red jasper and [illegible] epidote as seen in the hand specimen. The thin [illegible] small pebbles of lava in addition to jasper. [illegible] fine grained lava—possibly a trachyte— [illegible] glassy base. In addition there are nu-[illegible] crystals, the whole conglomerate being [illegible] silica and to some extent by epidote.

[illegible]MENTARY ROCKS

[illegible] Hill, is a quartziferous [illegible] The majority of the quartz [illegible] and sedimentary character, [illegible] inclusions indicating their probable [illegible] Several rounded grains [illegible] Specks of iron oxide give a [illegible] but apart from this the rock is [illegible] This specimen and the next belong to [illegible]

[illegible] Hill, is a coarse sandstone, formed of [illegible] with rounded quartz grains of 2–3 mm. diameter, set in [illegible] of angular and subangular quartz grains. [illegible] by a little interstitial secondary silica. [illegible] of any crushing or subsequent disturbance

and the deposit is ill-graded. A number of minute zircons, mostly well worn, are visible in the finer-grained portions of the slide. One of the quartz pebbles is derived from a severely crushed rock such as an orthogneiss, and another is entirely composed of chalcedonic silica.

Crystalline Limestone.—Specimen 1069, from NE. of Homa Mountain, is a finely-granular crystalline limestone, with occasional grains of a colourless accessory mineral which appears to be brucite.

Limestone-Breccia.—1086, 3½ miles beyond Rangwe Camp on the Homa Road, is an unusual rock, consisting of lumps of a greenish rock with lighter-coloured veins running in between the lumps. Some veins of pure calcite and chalcedony are visible, as well as small pieces of stony lava.

The lumps of green rock in thin section are seen to comprise angular grains of calcite, quartz, occasional plagioclase, and some patches of green chlorite. The calcite grains greatly predominate, and the greenish rock is actually an impure crystalline limestone which has been broken into small pieces, and invaded by quartz which has clearly crystallised under stress conditions.

The lumps of fine-grained lava are without phenocrysts, and are probably either trachytic or phonolitic.

Calcite-Siderite Rock.—A specimen from a conglomerate outcrop in a gully west of Sienga, Rusinga Island (No. 1092), is a peculiar rock displaying wavy bands. Thin sections under the microscope show the lighter bands to be calcite, while the brown bands are siderite. In between the bands there are areas where the two minerals are intergrown. The siderite is altering in places to limonite. Specimen 1100 is an impure limestone very similar to the foregoing No. 1092.

Contact Metamorphosed Limestone.—Specimen 1094, on west side of the valley between Sienga and Gumba, Rusinga Island, is a contact metamorphosed limestone, with prominent megascopic crystals of magnetite and biotite, some of the magnetite being in good octahedra.

A thin section of the more normal limestone shows it to be very similar to the calcite-siderite rock (1092) described above, though not so banded. The proportion of siderite varies considerably in different parts of the specimen, and in some slides there are octahedra of magnetite. Biotite of a bright reddish-brown shade occurs in thick crystals or "books," and is practically dark in the position of maximum absorption. The biotite is sometimes in the centre of a patch of magnetite, and is clearly a strongly ferruginous variety.

Soapstone.—The "soapstone" of Nagichenchi Hill (specimen [illegible]) has a very smooth and almost soapy feel on its joint faces. When broken open, the rock is of a paler colour inside and is seen to be slightly banded by what appear to be more siliceous bands and streamers. Under the microscope the rock is extremely fine-grained and mottled in lighter and darker patches. The darker patches appear to be more cloudy and optically inert, while the lighter patches appear cryptocrystalline. Under the high-power it is seen to be an extremely fine aggregate of sericite, talc or kaolin, or a mixture of these. It appears to be derived from an extremely fine argillaceous rock by low grade metamorphism. The report of the Imperial Institute shows it to be a pyrophyllite.

HEAVY MINERALS OF THE KISII SANDSTONE.

Specimens 1031 and 1034 were crushed, washed and passed through bromoform. The crop of heavy minerals so obtained was small but of considerable interest inasmuch as the bulk of the material can be matched with that of the neighbouring "Newer" Granites and contains much cassiterite.

The suite of heavy minerals is as follows:—

Zircon.—Abundant. Buff to tawny zircons, generally showing zoning and of "Newer" Granite type, [illegible].

Cassiterite (Tinstone).—Very common. Colourless, or olive-green to blood-red. Very angular and some in sharp splinters.

Biotite.—Common. Fresh. Pleochroic haloes well developed suggesting derivation from granites.

Iron Ores.—Common.

Muscovite.—Scarce.

Garnet.—Scarce. Pink.

Tourmaline.—Scarce. Brown, unworn grains, clearly locally derived.

Anatase.—Rare. Blue.

Amphibole.—Rare.

Diopside.—Rare. Colourless variety.

The *cassiterite occurs in larger grains* than any of the other minerals. The grains are all angular and evidently directly derived. The pleochroism is precisely the same as that of the cassiterite of the Bukoba Sandstone of the Bukoba Province *of* Tanganyika, and *of* the cassiterite deposits associated with the G2 ("Newer") Granites of Ankole and Karagwe. The mineral is present in marked amount, and, in part of specimen 1031, which was crushed, it was the dominant heavy *mineral* next to iron-ores. *In no English sediments, so far* as the writer's experience goes, even in the Pliocene of Cornwall, does cassiterite occur in such quantity as in the Bukoba and Kisii Sandstones.

The petrography and heavy mineral assemblage of the Bukoba Sandstone is described by the writer in the forthcoming *memoir on the* "Geology of Part of S.W. Ankole and ajacent Territories." Comparison of the heavy mineral suite of the Bukoba Sandstone with that of the Kisii Sandstone shows that they are very similar indeed. The ten minerals recorded from *the Kisii Sandstone* all occur *in the* Bukoba Sandstone, and the varietal characters of each mineral are the same in both formations. In both, the zircons are of types characteristic of the local "Newer" Granites of each district, and both are *characterised by a marked amount of cassiterite* having the same pleochroism. The general lithology and petrography in thin section of these two sandstone formations is markedly similar, and, having regard also to their similar stratigraphical position, there appears to be every reason for their correlation.

The evidence of the zircons tends to show that the material *of the Kisii Sandstones is mainly derived from* the Kisii Highlands "Newer" Granites. Whether contributions have come across from the country to the west of Lake Victoria is doubtful, though on the face of the evidence available this does not appear *to* have *taken place to any very appreciable* extent. The cassiterite of the Kisii Sandstone is, if anything, rather more abundant than it is in the Bukoba Sandstone of Bukoba Province, and in view of its lack of rounding and relatively large size *it* seems probable that *this cassiterite has* been derived from some source on the eastern shores of Lake Victoria.

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C. O.

Mr. [illegible] 11/9

Mr. [illegible]

Mr. [illegible]

Sir [illegible] 12/9/31

Mr. [illegible]

Sir C. [illegible] 13.9

Sir J. Shuckburgh

Sir G. Grindle

Parly. U.S. of S.

Perm. U.S. of S.

Secretary of State.

DRAFT.

KENYA

No. 664

Gov.

(No. 1)

(Sa minutes)

CDAC 8.1.

(2 papers [illegible])

(cmd. [illegible] Kenya [illegible])

Copy to C.D.A.C.

[illegible] C.J. 22/9/31

DOWNING STREET,

23 September, 1931.

Sir,

I have, etc., to refer to your despatch No. 180 of the 17th March forwarding an application for assistance from the Colonial Development Fund for the establishment of a geological survey in Kenya, and to enclose for your information a copy of the documents submitted for consideration by the C.D.A.C. at their meeting on September 22nd.

2. In reporting upon this application, the Committee ~~[illegible]~~ did not question the need for such a service as is proposed, nor its value in furthering the [illegible] development of Kenya. ~~[illegible], however, that its desirability has been generally~~

(continued)

recognised for many years, and they regard as a matter for possible regret the fact that no active steps have been taken for its inception until the finances of the Colony have reached so low an ebb as to render it impossible without extraneous assistance] but it ~~2. It~~ appears to them ~~Committee~~ that in a territory such as Kenya ~~the provision of~~ a Geological Survey Department is necessary as a normal adjunct of the administration, ~~commonplace of administration,~~ and they feel obliged to reiterate their opinion that the function of the [illegible] is not to relieve the Colonial Government of its normal [illegible]. In these circumstances they are unable to recommend assistance from the [illegible]

3. While I regret the ~~[illegible]~~ decision at which the Committee arrived, I fear that it was inevitable. Having

(SIGNED) J. H. THOMAS.

Communications on this subject should be addressed to:
The Secretary.
Telephone: Victoria ~~8940~~ 8540.

17160/31

3

41

COLONIAL DEVELOPMENT ADVISORY COMMITTEE,
~~COLONIAL OFFICE,~~
Caxton House, ~~DOWNING STREET,~~
Tothill Street, S.W.1.

C.D.A.C./F/194.

4 September 1931.

RECEIVED 5-SEP 1931 COL. OFFICE

Sir,

I am directed by the Colonial Development Advisory Committee to request you to inform Mr. Secretary Thomas that, at their 42nd Meeting on 2nd September, they had before them a despatch from the Governor of Kenya applying for annual grants from the Fund, for an indefinite number of years, of the cost of establishing and maintaining a geological survey of the Colony (C.D.A.C. 823). The application is supported by the Secretary of State, who proposes, however, that assistance from the Fund should be limited to a period of three years.

2. The Committee do not question the need for such a service as is proposed, nor its value in furthering the economic development of Kenya. They note that, in the Governor's words its desirability has been generally recognised for many years, and they regard as a matter for possible regret the fact that no active steps have been

THE UNDER SECRETARY OF STATE,
COLONIAL OFFICE.

Communications on this subject should be addressed to—
The Secretary.
Telephone: Victoria ~~6000~~ 8540.

Colonial Development Advisory Committee,
~~Colonial Office,~~
Caxton House, ~~Downing Street,~~
Tothill Street, S.W.1.

3
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THE UNDER SECRETARY OF STATE,
COLONIAL OFFICE.

been taken for its inception, until the finances of the Colony have reached so low an ebb as to render it impossible without extraneous assistance.

3. In a territory such as Kenya the provision of a Geological Survey Department appears to the Committee to be a commonplace of administration, and they feel obliged to reiterate their opinion that the function of the Colonial Development Fund is not to relieve a Colonial Government of its normal obligations. In these circumstances, they are unable to recommend any assistance from the Fund.

4. A similar letter is being sent to the Treasury.

I am,

Sir,

Your obedient servant,

[signature]

Secretary to the Committee.

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I am,

Sir,

Your obedient servant,

Secretary to the Committee.

Draft to Eastwood 24/7 to Parkinson 1/8 ... 42

16

Colonial Office Memorandum.

1. The want of a geological survey in Kenya has been obvious for some time. In 1929 the Advisory Council on Mineral Resources of the Imperial Institute ~~made~~ recommend~~ations urging~~ that a ~~geological~~ survey should be established and that the necessary funds should be in part provided from Imperial resources. ~~These resolution is~~ quoted in full ~~on page 2 of~~ the application submitted by the Kenya Government. Apart ~~from the possibility of expensive minerals like metallic ores being discovered~~ the geological survey should provide most valuable data, first as to water supply, of which in many parts of the country there is a pronounced shortage: secondly, as to minerals used in agriculture, food and construction work, such as limestone, fertilisers, salt, building and road materials;

The financial situation in Kenya which is fully explained in the ~~enclosure~~ to this memorandum is such that it is impossible for Kenya to contemplate from her own resources any new services at the present moment, but, now that Sir Joseph Byrne, the new Governor, has recommended the establishment of this valuable work, the Secretary of State hopes that in spite of the fact that ~~no substantial part~~ of the expense in the initial stages can be borne by the Colony, the Committee will be able to recommend the grant of the necessary assistance from the Colonial Development Fund.

At the same time, while the Secretary of State strongly supports the principle of the establishment of the geological survey, ~~there are certain objections to the~~

the detailed proposals made:

(1) Organisation.

It is proposed to appoint two young Geologists at equal salaries and also a Topographer. [illegible] that there should be an experienced officer to take charge of the survey; and that a Topographer should be unnecessary in the early stages; It is suggested that it would be preferable that the organisation should be modelled on the excellent example of Nyasaland, where the work has been highly successful. On this basis the estimates would be as follows:-

First Year

A. Capital

Purchase of instruments, tools and equipment...	£400

B. Recurrent.

Salary of Director	£1,000
Salary of Field Geologist. (£600-30-£840)	£ 600
Passages	£ 150
Transport and Travelling	£ 600
Assaying, etc.	£ 50
Contingencies	£ 200
Total	£3,000

Second/Years

Recurrent

	Second Year	Third Year
Salary of Director	£1,000	£1000
Salary of Field Geologist ...	630	660
Transport and Travelling ...	600	600
Equipment, assays and Library	150	150
Contingencies	[illegible]	200
Passages		100
Total ...	£ 2,[illegible]	[illegible]

It will be observed that these estimates are substantially the same as those contained in the

application

For [?] substitute "The S of S proposes to obtain technical advice on the scheme from the Geological Section of the Colonial Survey Committee but it would seem necessary in the first instance to ascertain whether the Colonial Development Advisory Committee is prepared to agree in principle that it is one that can properly be assisted from the Col. Development Fund."

application by the Kenya Government. [If the Committee are prepared to consider the matter favourably the Secretary of State would propose before asking for a definitive recommendation to refer the matter to the appropriate technical body (namely the Geological Section of the Colonial Survey Committee). It is, however, inconvenient to hold a meeting of that body before the autumn and there would in any case be no point in referring the matter to them if the Committee were unable to ~~recommend any grant of assistance for the scheme~~ consider the scheme favourably.]

2. <u>Period of assistance from Colonial Development Fund</u>.

No limit is set in the Governor's application to the term during which assistance should be granted from the Fund. It is realised that the Committee could hardly be expected to accept an indefinite liability. At the same time it is impossible to say that the work will be complete within any measurable period of years. If the survey is to be of any ~~real use and not to degenerate into merely an expedition~~ practical & lasting value, the ~~survey~~ work must be ~~effected~~ carried on permanently and there must be a ~~consequent~~ steady accumulation and record of knowledge embodied largely in maps and available to Government and the public.

Admittedly, therefore, what is now desired is the establishment of a permanent department, and ~~it has been suggested that~~ the S of S realises that for this reason the Committee may consider that the project is of an administrative nature and therefore unsuitable for assistance from the Colonial Development Fund. ~~The Secretary of State~~ He is however

would

~~would however urge~~ [they] that in the present impoverished condition of the Kenya finances it would be quite impossible for the work to be begun within the next few years unless the whole cost (apart from the provision of office accommodation, etc.) is borne by the Fund. ~~He therefore~~ [they therefore suggest] ~~urge~~ that the ~~Committee should recommend that the~~ whole cost of the ~~survey~~ for the first three years should be borne by the Colonial Development Fund on the understanding that after that period the work would be carried on by the Kenya Government ~~if it were at that time at all~~ [unless] financial~~ly possible~~ conditions make it absolutely impossible to do so.

To summarise, the Secretary of State ~~[illegible]~~ [hopes] that the Committee will see their way to ~~recommend~~ [agree in favourable to] the grant of assistance from the Colonial Development Fund to meet the whole cost of the establishment of the [proposed] geological survey in Kenya and the running of it for the first three years on the understanding (i) that ~~if at all possible financially~~, the Kenya Government will then continue the work ~~and~~ [unless financial conditions make it absolutely impossible to do so] (ii) that the ~~detailed consideration of the~~ scheme [will be referred to] ~~should be dependent upon the recommendations of~~ the Geological Section of the Colonial [Advisory] Survey Committee; [but the [illegible] ... [illegible]] ~~[illegible]~~ [to the Colonial Development Advisory Committee for a final recommendation [illegible]] [subsequent submission to the Colonial Survey Committee has been received.]

The small amount that would fall to be met by the Colonial Development Fund in the current

financial

financial year is unlikely to be large as it would hardly be possible to initiate the scheme before ~~Christmas~~ the end of the present year. ~~The figures might perhaps be tentatively put as follows:-~~

1931-32.	£1,150 [illegible]
(¼ of £3,000)	£750.
1932-33	
(¾ of £3,000 plus ¼ of £2,600)	~~£2,900~~ 3,[illegible]
1933-34	2,600.
1934-35	
(¾ of £2,600)	1,950.

Alternatively if the [illegible] the initiation of the scheme is deferred until the [illegible] beginning of the financial year 1932-33.

~~[illegible] capital £400 passages £[illegible] [illegible] £1250 [illegible] £[illegible]~~

at £~~[illegible]~~ 1200 made up of the capital expenditure £400, the current expenditure £600 expenditure on passages £150 [illegible] £[illegible].

Alternatively the initiation of the scheme might be deferred until the beginning of the financial year 1932-3.

C. O.
13th August

10 1a 47

Note on the Financial Position of Kenya.

REVENUE AND EXPENDITURE.

The revenue and expenditure of the Colony since 1928 is shown in the following table, but it should be noted that in order to arrive at the real revenue and expenditure a substantial amount has to be subtracted on account of reimbursements and gross entries: the amount in respect of 1931 being about £950,000.

Year.	Revenue.	Expenditure.
	£	£
1928	[illegible],[illegible]0,694	[illegible],[illegible],[illegible]47.
1929	3,333,740	[illegible],5[illegible],072 (x)
1930 [illegible]	3 401,[illegible]51	3 549,729 (x)
1931		
Original Estimate	[illegible],[illegible]15,[illegible]	[illegible],[illegible],
Revised Estimate at [illegible] July.	[illegible],[illegible], [illegible]	[illegible],[illegible]06,149

x Including special expenditure from surplus balances.

The original estimates for 1931 prepared in [illegible] were based on the hope of an increase in trade returns and [illegible] as [illegible] compared [illegible] 1930. They [illegible] surplus [illegible] £73,[illegible], but [illegible] continuance [illegible] trade depression [illegible] due to [illegible] the [illegible] revised estimates [illegible] a deficit of [illegible], [illegible] reduced by unexpected [illegible] according to the latest [illegible] the deficit on transactions of 1931 is now [illegible] at [illegible]. Some additional revenue is being raised from increased customs duties on motorcars, share parts, re and from increased postal rates, and economies amounting to about £170,000 have already been made. [illegible]

expenditure

expenditure chiefly to meet the locust menace has amounted to some £35,000; and [although] ~~in present circumstances~~ a deficit [of £100,000] on the [year's] working [is at present foreshadowed,] ~~would seem unavoidable~~ ~~although~~ every endeavour ~~has~~ [will continue to] been made to reduce it to the smallest possible proportion. Drastic reductions have been made in the 1932 Estimates which have been prepared with the object of budgeting for a surplus of £62,000.

SURPLUS BALANCES.

The total surplus balances, i.e. assets over liabilities, amount[ed], according to the latest appreciation of the position, to £510,702. Virtually the whole of this sum is earmarked for working capital, and unallocated stores, agricultural advances, etc., and the unreserved surplus was put at £68,700. Against this has to be set the anticipated deficit of £100,000 in 1932, leaving a balance on the wrong side of £[illegible], but it is understood that the margin of working capital and allocated stores will more than cover the Colony's cash requirements. It may be mentioned that the financial policy recently laid down in consultation with the Treasury was to aim at bringing up the total surplus balances to £1,000,000 by the end of [illegible]. Under present conditions there is, of course, no possibility of reaching that figure by that date, [but] ~~and~~ the policy of building the surplus up to £1,000,000 remains as ~~an object~~ [one to] to be achieved as soon as circumstances permit.

PUBLIC DEBT.

The Public Debt of the Colony consists of:-

£5,000,000 6 per cent stock 1946-56 issued in 1931 (in respect of which a sinking fund has been accumulated to the value of approximately £402,000).

£5,000,000

£5,000,000 5 per cent stock 1948-58 issued in 1927.

£3,500,000 4½ per cent stock 1950 issued in 1928.

£3,400,000 4½ per cent stock 1961-71 issued in 1930.

The charges on a large portion of these loans are payable by the Kenya and Uganda Railways and Harbours. The Colony's share of the loans is approximately £8,665,000.

The 1930 loan was in respect of works already completed or nearing completion, the cost of which has so far been met from advances. Further proposals for loan expenditure for Colony purposes amounting to approximately £1,300,000 have been approved by the Treasury but until the revenue outlook is brighter the Colonial Government will proceed slowly with all capital expenditure not directly and immediately productive. In point of fact the fresh loan expenditure on works ~~with~~ which ~~it~~ is likely ~~proposed~~ to be proceeded with at once only amounts to £165,775, all to be spent on works of great urgency or of a remunerative nature.

LIABILITIES TO THE IMPERIAL EXCHEQUER.

The question of the settlement of Kenya's war debt to the Imperial Exchequer amounting to some £1,400,000 has been postponed until 1934. The settlement ~~Kenya~~ of the ~~also has a~~ liability ~~of about £5,500,000~~ in respect of the cost of the original Uganda Railway ~~. A settlement of this liability~~ has also been postponed until 1934. The amount involved is about £5,500,000

KENYA.

NO 180

GOVERNMENT HOUSE,
NAIROBI,
KENYA.

RECEIVED
20 APR 1931
COL. OFFICE

30th March, 1931.

My Lord,

I have the honour to refer to Your Lordship's despatch No. 467 of the 19th June last and to transmit an application for assistance from the Colonial Development Fund for the establishment of a Geological Survey in this Colony.

2. Sir Edward Grigg in his despatch No. 249 of the 26th April, 1930 referred to the circumstances in which the institution of this new and important service had been delayed. Since that despatch was written, a geological reconnaissance of the Southern Kavirondo area has been carried out by Mr. E.J. Wayland, Director of the Uganda Geological Survey, and his report, to which reference is made in the enclosure to this despatch, is at present being printed locally. Copies of this report will be transmitted to Your Lordship in due course.

3. The organisation now contemplated is considered to be the minimum which could operate with efficiency and, at the same time the maximum which, in the circumstances, could be suggested, in view of the fact that the assistance asked for from the Colonial Development Fund takes the form of a free grant of almost the whole cost of the service. It is hardly necessary for me to add that at the present time, when existing activities are being heavily curtailed, the Colony has no funds for this new service and that, in the /

THE RIGHT HONOURABLE LORD PASSFIELD, P.C.,
SECRETARY OF STATE FOR THE COLONIES,
DOWNING STREET,
LONDON.....S.W.1.

the absence of substantial financial assistance, the establishment of a Geological Survey would be indefinitely postponed.

4. This application is being submitted in advance of others which are still receiving consideration, in order that further delay may be avoided in instituting a service the desirability of which has been generally recognised for many years.

I have the honour to be,

My Lord,

Your Lordship's most obedient, humble servant,

BRIGADIER-GENERAL.

G O V E R N O R.

APPLICATION FOR ASSISTANCE FROM THE COLONIAL DEVELOPMENT FUND FOR THE ESTABLISHMENT OF A GEOLOGICAL SURVEY IN KENYA.

---

1. DESCRIPTION OF SCHEME.

The proposal is to initiate a Geological Survey in Kenya Colony. The East African Parliamentary Commission 1925 observed that in East Africa it was abundantly clear that an immense field existed for the investigation of mineral resources, which demands the services of geologists, and that, in view of the confident prediction of Mr. Wayland (Director of the Uganda Geological Survey) in regard to the petroleum areas in the Rift Valley, there was every need for the speedy establishment of a geological department.

Public prospecting, which is encouraged, is of necessity limited in its outlook. The aim of a geological survey is to discover the mineral constitution, geological structure and geological history of the territory and to correlate its discoveries with those made in other territories in order that the results may be applied to the solution of local economic and scientific problems which for their complete solution require consideration of one or more geological factors. It thus enters into mining, building construction, siting of dams and bridges, agriculture (rock derivatives as plant food and surface drainage), sanitation, roads, water supplies, mineral fuels and a number of other necessary activities. The East African Parliamentary Commission referred to the need of the territories for fuel other than wood and considered that the value of a Geological Department to the Railway and Public Works Departments could not be sufficiently emphasised.

The Advisory Council on Mineral Resources of the Imperial Institute, at a meeting held in 1929, agreed :-

(a) That from the standpoint of Imperial interests it is highly desirable that a more rapid development of the mineral resources of East Africa should be encouraged.

(b) That in order to achieve this purpose, an efficient and adequately staffed Geological Survey should be established in Kenya to carry out as early as possible a geological survey of that Colony, while at the same time it is necessary to expedite the completion of the geological surveys of Uganda and Tanganyika.

(c) That the funds requisite for this purpose should be in part provided from Imperial sources.

The Council further pointed out that, quite apart from the discovery of mineral resources, a geological survey is of the utmost value in dealing with all problems of water supply.

The Government of Uganda has been approached with the suggestion that a joint survey for Kenya and Uganda should be instituted, but considers that the formation of a joint service would only be justified if it included Tanganyika and prefers to await a decision regarding the question of closer union. Geological survey is, in the meantime, becoming more and more a necessity and if work is to be deferred until it is possible to organise a co-ordinated service for the three territories after the setting up of a common authority, further considerable delay is inevitable.

It is suggested, therefore, that work on a systematic geological survey of the Colony should be begun at once, the work and staff to be such that, when the time comes for the institution of a combined service, the work would not be wasted and the staff could be absorbed into the combined service.

A geological reconnaissance of the Southern Kavirondo area has recently been undertaken by the Director of the Uganda Geological Surveys and the following is taken from his Report :-

"Southern Kavirondo is worthy of much more detailed study than it has received; not only from the point of view of pure geology, which should provide a key to the study of other districts, but also as a possible area for economic minerals. The mapping of the area should form part of the work of a Geological Survey of Kenya, should one be formed at any time.

With regard to gold, further prospecting (in addition to that within the known auriferous area) should be undertaken by locating continuations of the shatter zone or determining others and prospecting quartz-dykes, etc., within them, as well as sampling stream beds and alluvial deposits.

<u>The occurrence of detrital tin</u> in the Kisii sandstone is of great interest .... The grains are angular and have not travelled far, and thus there would seem to be two possibilities, namely, the existence of useful lodes and derived deposits in Southern Kavirondo and the existence of alluvial deposits produced by the concentration of tin in stream beds or lake beaches - consequent upon the breakdown of the sandstone.

A study of the basin in which the Kisii sandstones were deposited should reveal the source of the tinstone ...."

Mr. Wayland considers that his reconnaissance has proved this area to be an extremely interesting and important one geologically, and one in which conditions conducive to mineralisation have obtained more than once.

Experience in Uganda shows that Mining Companies and the public make much use of the local Geological Survey and its laboratory staff; and (to quote Mr. Wayland) it is safe to say that were it not for the activities of that Department, the mineral discoveries of Ankole (tin), Ruwenzori (copper) and elsewhere would not have been made.

For the details of the scheme set out below the Government of Kenya is largely indebted to the Director of the Uganda Geological Survey.

The scheme involves the appointment of two field geologists and one topographer as a skeleton survey to be attached to the Commissioner of Mines, who would provide office accommodation and necessary clerical assistance. The Laboratory work is to be carried out in the Laboratory of the Government Analyst. This application deals with the three posts referred to and the initial capital cost of instruments and equipment.

2. ESTIMATED TOTAL COST.

FIRST YEAR.

(a) Capital.	£.
Purchase of instruments, tools and equipment.	400
(b) Recurrent.	
Two field geologists (£600 by £30 to £[illegible]) salary	1200
One topographer (£372 by £18 to £[illegible])	372
Passages	200
Transport and Travelling	850
Contingencies	100
	£ 3,122

SECOND YEAR.

Recurrent.	
Two field geologists, salary	1260
One topographer, salary	390
Transport and Travelling	850
Contingencies	100
	£ 2,600

3. EARLIEST ESTIMATED DATE OF COMMENCEMENT.

If and when this application is approved.

4. APPROXIMATE ESTIMATED DATE OF COMPLETION.

This it is impossible to foresee.

5. APPROXIMATE ESTIMATE OF ALLOCATION OF COST BETWEEN

(a) Local Expenditure;

(b) Expenditure in Great Britain.

First Year.

(a) Local expenditure	£ 2,722
(b) Expenditure in Great Britain Purchase of instruments, etc. (excluding freight and insurance)	325

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END

Thereafter, expenditure will be almost entirely local.

6. WHAT CIRCUMSTANCES HAVE PREVENTED THE WORK FROM BEING PUT IN HAND BEFORE?

Lack of funds.

7, 8, 9. These questions have been answered above.

10. FORM OF ASSISTANCE DESIRED.

A direct grant from the Fund of £5,000 in the first year, and thereafter a direct grant of £2,600 annually.

11. This question does not apply.

12. AMOUNT REQUIRED IN FIRST FINANCIAL YEAR.

Since some delay will inevitably occur in making the appointments, one half the 1st year's cost is estimated to be required during the financial year ending the 31st March, 1952. In the following financial year the grant if approved would amount to £2,750 and in ensuing years £2,600.