EAST AFR PROT
72230
C.O.
72230

Impl. Mineral Resources Bureau

1919
5 Dec

Last previous Paper.
72099

Mr Parkinson's Report on the Reconnaissance N.F.D.

States of great scientific interest & paper might be read before Geological or Mineralogical Society. Desirable author should be present.

PRINTED FOR PARLIAMENT
Colonial Reports

Sir H Read. ... 72099.

These papers ... with Mr Parkinson's ... accumulated ... the ... Savoy ... and April ...

You agree that ... should be published together in the Miscellaneous Series

A. Report on the Geology ... the Northern Part of the ... 72099 ...

B. Contribution to the Petrology of ... N.F.D. (72230)

The maps ...

Subsequent Paper.
10074/20

... ... from the illustrations, but this can be discussed with Mr Parkinson. The immediate need is to get the letterpress in type so that Mr Parkinson can revise it before he leaves England.

Wd. for authority to print.

C.W.A. 16.7.20

at once.

H.J.R.

16/VII/20

Two proof copies given to Mr Bottomley today ...

Mr Bottomley

Sir H Read

I attach a proof of the Report as it will appear, subject to a few slight alterations which have been made by Mr Parkinson. We may I presume publish forthwith?

For convenience of reference I have attached to this paper the various ...

Sir G. [illegible]
[illegible] (summaries)
2 [illegible] forty
[illegible]

2/6/20
Sir [illegible] Read
I suppose you are satisfied [illegible] it is proper to incur the expense of printing this as a Parlt. Paper? [illegible] 2/6

[illegible]
[illegible]

Mr Bottomley
This Report has now been published. Action has now to be taken on your minute of 4/6/20.
Below is a packet containing the 60 copies of the broken negatives which can be sent to him with the copies of the Report which the [illegible] will supply.
[illegible]
5/7/20

[illegible]
[illegible] 7/20

Sir G. ~~Fiddes~~

Colonies

26 forsig

WW

Sir W. Read 2/6/20

I suppose you are satisfied that it is proper to incur the expense of printing this as a Parlt Paper? G.F. 2/6

~~Sir G. Fiddes~~

Yes. I have heard from the head of the Geological Survey of this Country that Dr. Stanley, & Dr. Evans have said to me on the subject that it is most essential. — & not only that, but I believe that the paper will have a good sale & more than pay expenses. An earlier report of a similar kind had an excellent sale

H. J. R. 2/VI

259

THE ATHENÆUM,

PALL MALL, S.W.1.

March 17th 1920

Dear Mr. Bottomley.

A propos of our
conversation of this morning.
consent is given to the publication
my petrological paper would you
me have it for a few hours
it goes to the printers, as I
a few alterations to make?
this Club will always find me.

Yours sincerely,

John Parkinson.

Sent 17/3. asked to call
... at 11 ...
illustrations.

munications on this subject should
ssed to—
THE SECRETARY,
following Number quoted:—

Registered Telegraphic Address:—
IMRESBUR, LONDON.
Telephone Number:—Victoria 9360.

IMPERIAL MINERAL RESOURCES BUREAU,
2, QUEEN ANNE'S GATE BUILDINGS,
WESTMINSTER,
LONDON, S.W.1.

P/—
Ref. 591/1918/19

C 15th Dec. 1919.

72830

260

Sir,

I return Mr. Parkinson's paper which I have carefully considered and discussed with other authorities on the geology of the metamorphic rocks, especially those in Africa.

The observations it contains although of no economic importance are of great scientific interest and the paper might be read before the Geological or Mineralogical Society. It is however, very desirable that the author should be present to read it and if there were any probability of his re-visiting this country at an early date, its presentation should be postponed with that view.

I am, Sir,

Your obedient Servant,

John W. Evans

Under Secretary of State,
COLONIAL OFFICE.
S.W.1.

nting Department.

Mr. J. Parkinson hopes to let me have tomorrow
ncte on gneisses schists and also some diagrams
ustrating the main report.

But I should be glad if immediate steps could
taken to get the main report into type, and also to
ange for the re-production of the main map which I
lex.

With regard to the map, I assume that the tints
ll be shewn by hatching, and Mr. Parkinson has suggested
e different kinds of hatching which I have marked on the
p against the illustrative covers. It is difficult to
e where the volcanic tint ends and the rather dusky
rface of the plain paper begins. I have drawn a
ncil line where the boundary comes, but it should be made clear
the re-producer that this pencil line should not be
awn, the matching of the volcanic area being left with
vague outline. There is one isolated patch of
olcanic rock which I have indicated by a pencil line.
e rest of the blank part in that district is to remain
lank.

W.G.J. 26/2/10

DOWNING STREET, 262

27th March, 1920.

Dear Sir,

This work is to be included in our series of Colonial Reports, Miscellaneous, which is covered by our annual demand for Colonial Reports No.354 of 2nd January, 1920:

Six proofs (Rl.octvo) should be supplied at an early date in order that they may be checked by Mr. Parkinson (the author) who is returning to East Africa shortly. Messrs. Barclay and Fry are notoriously dilatory in rendering proofs of our papers, so perhaps you will kindly impress on them the necessity for a very early delivery in this case.

As regards the reproduction of the maps it is assumed that the tints will be shown by "hatching" and will be differentiated by the distinctive kinds of hatching marked on the originals against the illustrative covers. In the large map it is difficult to see where the volcanic tint ends and the rather dusky surface of the plain paper begins. A pencil line has been drawn where the boundary comes, but it should be made clear to the reproducer that the pencil line should not be drawn, but that the hatching of the volcanic areas should be left with a vague outline. There is one isolated patch of volcanic rock which is indicated by a pencil line. The remainder of the blank part in that district is to remain blank.

We shall not require the maps, diagrams and photos to be inserted in the body of the report as it is intended to treat them as appendices. Negatives as well as copies of the photos are enclosed for convenience of working. The proofs of the printed matter can therefore be put in hand without waiting for the illustrations, but they also are required at an early date for Mr. Parkinson to examine them.

I may add that the Secretary of State regards this as

a valuable scientific work, and that the appendices are an absolutely essential part of it.

Yours faithfully,

PRINTING SECTION.
PUBLICATIONS BRANCH,
H.M. STATIONERY OFFICE,
WESTMINSTER, S.W.1.

Telephone—
...A 3820-3830
(...usive).

31 March 1920

264

...ar Sir

The East Africa Protectorate (Geological) Report has been sent forward to Barclay & Fry for 6 slip proof by April 9.

We have taken special steps to ensure delivery by that date. The litho plates & maps are in the hands of H. & C. Graham, and proof should reach you also on April 9.

The proof of the half-tone

19th April 1910

Dear Mr Bottomley,

I enclose the proof corrected
copy for the number of the illustrations.
I will leave me have those maps and photos when
they are ready with or without the accompanying
letter-press, but if possible I should like to have
the whole thing together
by which time I have the proof now returned with a second
proof of the letterpress

Yours very sincerely
John Galsworthy

DOWNING STREET,

21st April, 1920.

PRESSING.

266

Gentlemen,

You have in hand the preparation of certain maps, etc., for inclusion in a Colonial Office Miscellaneous Report on Geology and geography East Africa Protectorate. I was told by the Stationery Office in a letter of 31st March that proofs should reach me by 9th April.

In response to a telephone reminder to you, last week someone on your staff faithfully promised to let me have the proofs by the morning of yesterday (Tuesday) 20th April. As they have not come to hand, I must ask you, if they are not already on their way, to let me have them sometime Thursday 22nd April, as the Author of the Report is leaving this country very shortly, and must examine the proofs before his departure.

The delay has caused and is causing considerable inconvenience.

Yours faithfully,

MESSRS. H. & C. GRAHAM.

Mr. [illegible].

I am at last able to send you one proof of each of the 7 photos, and 2 proofs of the 5 sketch maps. I have further copies of the latter if required. The originals are also enclosed for Mr. Parkinson's convenience.

Would you ask him to add anything he wishes in the way of description on the illustrations at this stage, so that there will be no need for future revision, and also to specify the number of each plate as appendices. I attach a further copy of the old proof in case he may want it, but perhaps he would like to wait for the revise which I am expecting any day now.

I have worried the lithographers constantly but this is the earliest success I have achieved.

T
22/4/20

Mr. Bottomley.

Herewith two proofs of the East Africa Protectorate Report revised in book form, with the corrected galley proof.

Should not the note also be signed?

As there are already two appendices "A" and "B" to the report perhaps Mr. Parkinson will letter the plates etc., as further appendices.

Is it intended to give footnote references to them in the text? If so, will Mr. Parkinson kindly make these additions on the accompanying proofs wherever references may occur.

I can let you have a copy of the proof for yourself if you wish for one.

Messrs. Barclay & Fry.

29th April, 20

269

Proofs of the three Figures and the two maps are attached, in order that you may see the nature of the appendices, but revises are being struck off, and Messrs. H.& C.Graham 195-200 Camberwell Road, S.E.5 are being instructed to send you at the earliest possible moment four revises for inclusion in the revised volume.

OST URGENT

270

DOWNING STREET,

29th April, 1920.

Gentlemen,

Please have six revises of these five plates prepared at once, and send four of them direct to Mr. Hawker, C/o. Messrs. Barclay & Fry, The Grove, Southwark, S.E. The other two should be sent to me here, with the corrected proofs.

It is absolutely necessary to have revises of the work in which your plates are to be included not later than 5th May. Will you therefore make arrangements to let Messrs. Barclay & Fry have the revised plates in the course of the next day or so.

Yours faithfully,

RB. H. & C. GRAHAM, LTD.

27th April 1910

Dear Mr Bottomley,

Herewith the proofs and illustrations & Baily's corrected

If between now and May 8th another proof is prepared, please let me see it — but I rather gather the book will now go straight to press.

In most Scientific Societies a certain number of copies — say 50 — are allowed to the writer of a paper — is this the case in this instance?

The illustrations, I think, have come out quite well.

With very many thanks for the interest you have taken —

Yours very sincerely,

John Parkinson

(1) The question of how many copies of the published report Mr. Parkinson is to have is one for the Office to decide. It will be a Government publication on sale like the ordinary Annual Reports, and the Library could order extra copies to meet the case so long as they do not exceed 300, any supply beyond that number requires special Treasury sanction.

Fifty copies seem rather a lot for Mr. Parkinson to dispose of, but that point is outside my province.

(2) We must certainly have a revise containing all the illustrations before sending for press, and I have impressed on the printers the urgency for getting it by 5th May. I doubt if they will do it, but it would be much more satisfactory if Mr. Parkinson could see the Volume as it will ultimately be published. By giving 5th May I have left a fair margin.

(3) As regards the glass negatives we can only express regret and state that every care in packing them was taken here, and that the parcel was sent over by hand to the Stationery Office, marked "Glass with care". The Stationery Office official states that they were received cracked and we have no means of knowing how the packet was handled before reaching him. The broken parts can be joined together and would show only a line in any subsequent photograph. But as reproductions of the originals will appear in our published report, there may be no further use for the plates.

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Downing Street,

/ May, 1920.

273

Dear Mr.Parkinson,

I have your letter of the 27th, and we will do everything possible to get a revise of the paper to you by May 5th.

As to extra copies for yourself, fifty was considered rather too many, so I have compromised on twenty five. I hope that will be sufficient for your requirements.

I am very sorry to say that your glass negatives are broken. Every care was taken here in packing them, and the parcel was sent over to the Stationery Office by hand, marked "Glass with care". They were found cracked by the Stationery Office official who opened the parcel. How it had suffered from others who handled it there we cannot know. I am told that the broken parts can be joined together, and that only

a

PARKINSON, ESQ.,

line would show in any subsequent print, but I
ould like you to come here, if you can, and take
arge of these and the film negatives before further
idents happen.

The illustrations for the report were (as a
tter of fact) taken from the positives and not the
atives, and we propose, by way of a practical expression
our regret for the accident, that you should have
ies of the illustrations corresponding to the broken
atives.

Yours sincerely,

May 1922

Orders for [illegible]

DRAFT.

J. [illegible] Parkinson Esq

MINUTE.

Mr. N. S. Hornby 30/4
Mr.
Mr.
Mr. Grindle.
Sir H. Lambert.
Sir H. Read.
Sir G. Fiddes.
Col. Amery.
Lord Milner.

Dear Mr Parkinson,

[illegible] your letter of the 27th [illegible] we will do everything possible to get a revise of the [illegible] by May 5th.

As to extra copies for your staff fifty were considered rather too many so I have cut [illegible] to twentyfive & hope that will be sufficient for your requirements.

I am very sorry to say that your glass negatives were broken. Every care was taken in packing them, & the parcel was sent over to the Stationery Office by hand, marked "glass with care". They were found cracked by the

276

3rd May 1920

Dear Mr Bottomley,

Very many thanks for
letter of the 1st.
ease don't bother about the
ctrics, they have served their
pose and are not wanted, but
will certainly look in & collect
ak to anything you don't want.
Thanks for the reprints.

Yours sincerely,

John Parkinson.

277

2nd June, 20

Dear Sir,

The copy for press of your Job 566, Colonial Report Miscellaneous E.A.P., Report on Geology and Geography by John Parkinson will be going to the Stationery Office in the course of the next day or so.

Will you, meanwhile, please have struck off fifty further copies of Appendix D (Fig.a and Fig.b.) comprising the two illustrations on one page dealing with Felspar, Spinel, Hornblende, Garnet and Epidote.

These copies are required quite separately from the report itself for another purpose.

Yours faithfully,

DM

Kindly send the 50 copies to me when ready DM

MR. HAWKER.

No. E.A.P.

72230

17

Encl.

July 1920

DRAFT.

[illegible] Esq

[illegible]
[illegible] Hall (Sw.)

MINUTE.

Mr. [illegible] 5/7
Mr.
Mr.
Mr. Grindle.
Sir H. Lambert.
Sir H. Read.
Sir G. Fiddes.
Col. Amery.
Lord Milner.

~~(Copy for Library)~~

(Copies of photographs of petrological illustrations which are [illegible])

Sir,

I ~~have~~ am directed by ~~Viscount~~ Milner to transmit to you the acc. 25 copies of your report on the Geology and Geography of the Northern Part of E.A.P., ~~together with~~ which has now been published. I am at the same time to enclose 50 copies of the petrological photographs which are included in the report.

2. I am to convey to

you an expression of Lord
Kitchener's satisfaction with
the excellent report which
you have prepared.

(Signed) H. J. READ.

COLONIAL OFFICE,

DOWNING STREET, S.W.1.

3rd November, 1920.

Dear Sir,

Messrs. Barclay & Fry have requested me to notify to the Stationery Office that authority was given by this Department for the supply of 50 copies of Appendix D (Fig.a and Fig.b) of Colonial Reports Miscellaneous No.91 East Africa Protectorate; published under Annual demand No.354 2nd January, 1920.

These copies were required by the Under Secretary of State quite apart from the number to be ordered by the Stationery Office for the published issue, but I understand from Messrs. Barclay and Fry that the Stationery Office decline to admit the charge for these copies.

To prevent further delay I am writing this to certify that the copies in question were required for the use of the Colonial Office, and were duly received. A copy of the letter sent on 2nd June to the firm is enclosed, and I presume nothing further is required to pass this detail of the account.

Yours faithfully,

SUPERINTENDENT OF PUBLICATIONS.

CO 533/224 (1)

PUBLIC RECORD OFFICE.

One Document, being a sketch plan of dry watercourses between Lodernuit and Archer's Post.

has been removed to MPG 1106

2 iii 71 H. Anderson

On the PHYSICAL CHARACTERS of the NORTHERN PART of the EAST AFRICA PROTECTORATE.

CO533/224 1 2 END

PUBLIC RECORD OFFICE.

Four
~~One~~ Documents being 1) E. Africa Protectorate – Gen. Plan.

2) Plan showing cross section of iron oxide sphere etc.

3) Photograph " " of rock with quartz, magnetite & pyroxene

4) Contour map showing area between Kavirondo & Ollorenado.

has been removed to MPG 1106.

2.iii.71 M. Anderson

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PUBLIC RECORD OFFICE
C.O. 533 / 221

PUBLIC RECORD OFFICE
C.O. 533/224
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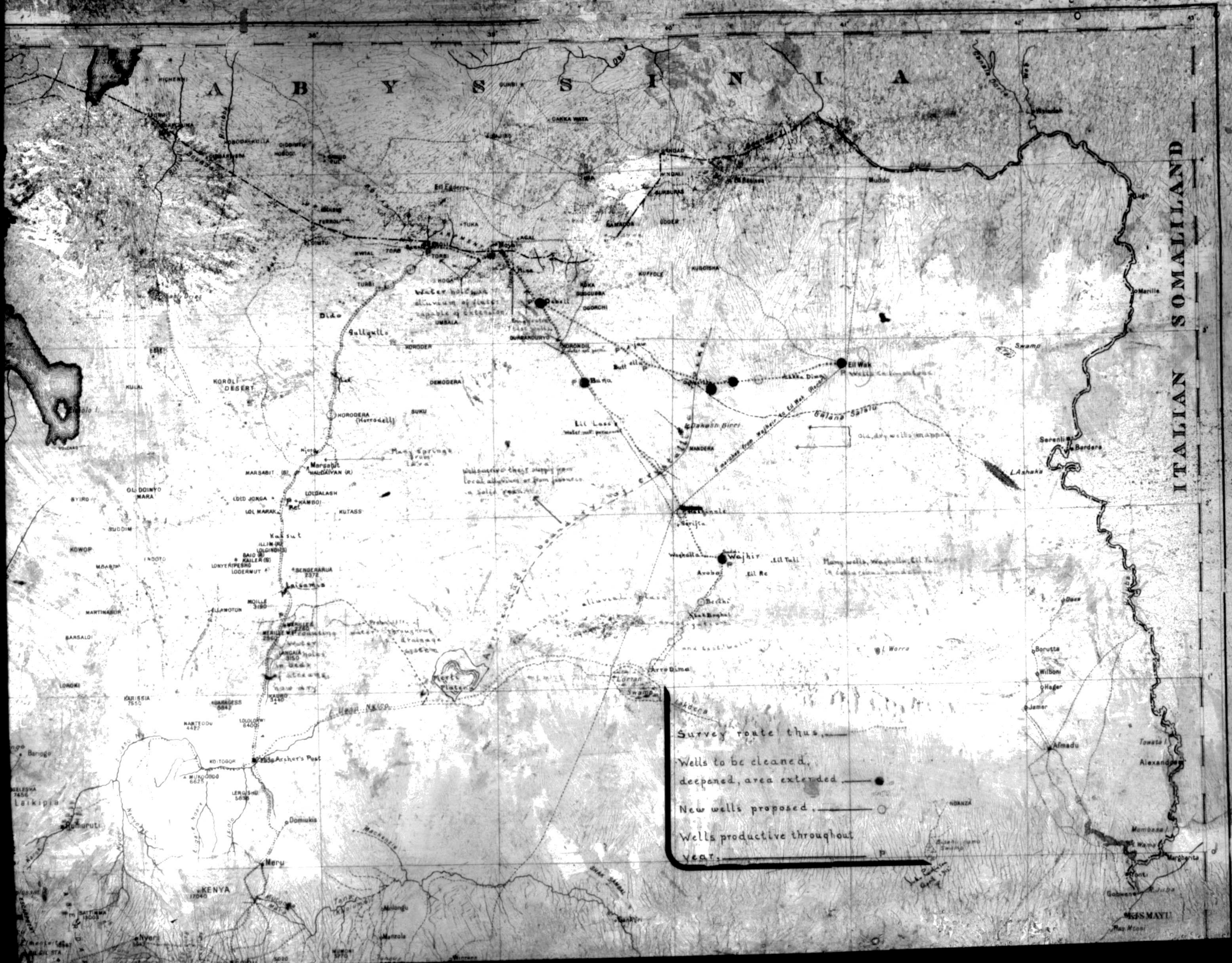
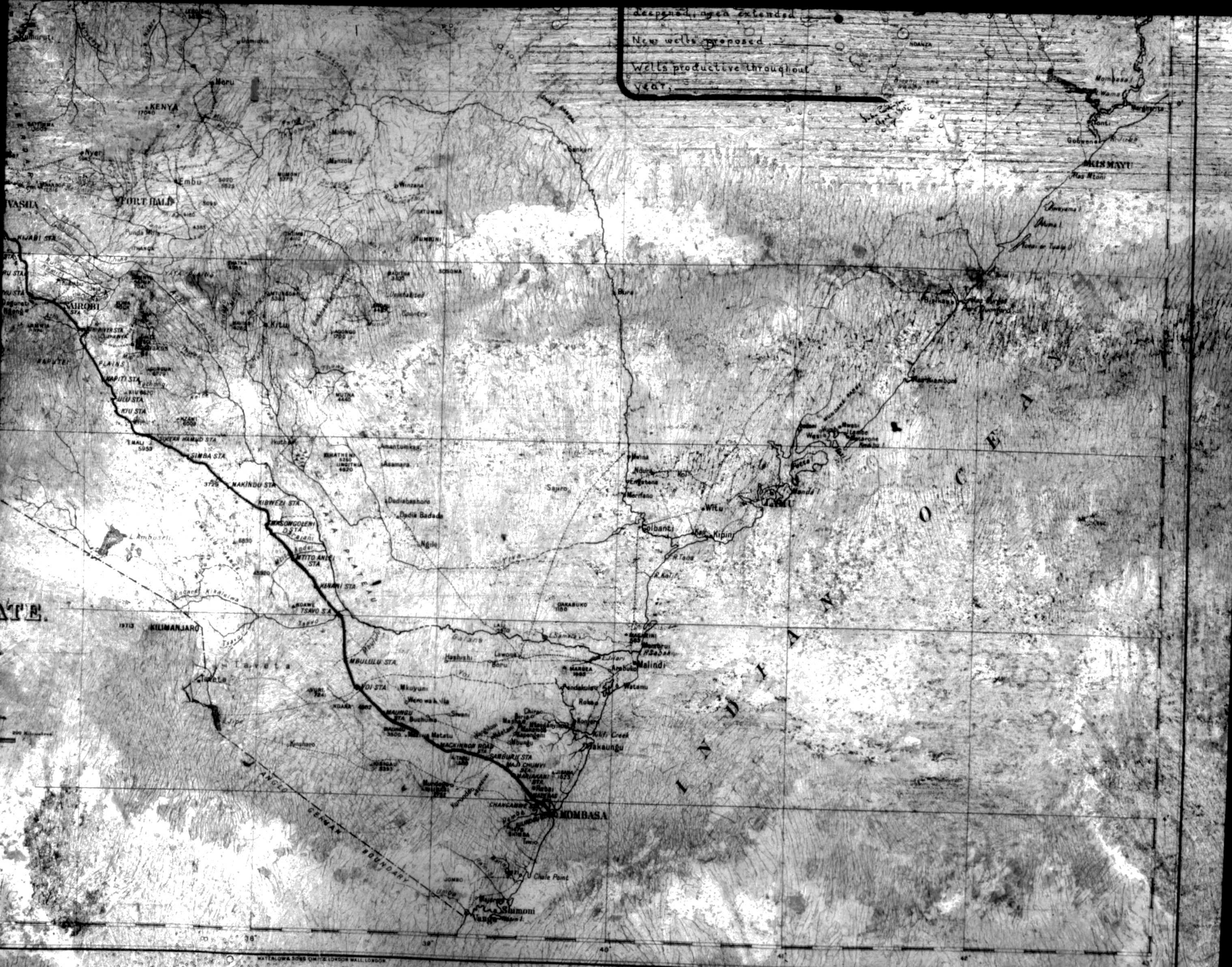


ABYSSINIA
ITALIAN SOMALILAND
KOROLI DESERT
Marsabit
Laisamis
Archer's Post
Meru
KENYA
Laikipia
Rumuruti
Eil Wak
Wajhir
Buna
Mandera
Serenli
Bardera
Afmadu
Alexandra
KISMAYU
Lorian Swamp
Merti Plateau
Survey route thus
Wells to be cleaned, deepened, area extended
New wells proposed
Wells productive throughout year

EAST AFRICA PROTECTORATE.
GENERAL PLAN (Provisional.)
Scale 1 in 1,500,000 or 1 Inch to 23·674 Miles.
SURVEY DEPARTMENT,
CADASTRAL BRANCH
January, 1912.
KISUMU
Kericho
Karungu
Kisii
NAIVASHA
FORT HALL
KENYA
Meru
Nyeri
Embu
NAIROBI
Machakos
Kitui
KAPITI PLAINS
YATA PLAINS
L. Magadi
L. Natron
L. Amboseli
KILIMANJARO
Taveta
TSAVO STA
MOMBASA
Malindi
Takaungu
Kilifi Creek
Shimoni
Vanga
ANGLO GERMAN BOUNDARY
VICTORIA NYANZA


deepened, area extended
New wells proposed
Wells productive throughout year
KENYA
FORT HALL
Embu
Meru
NAIROBI
Kitu
ATE.
KILIMANJARO
Taveta
MAKINDU STA
KIBWEZI STA
SIMBA STA
TSAVO STA
VOI STA
TARU STA
MOMBASA
Malindi
Takaungu
Kilifi Creek
Watamu
Shimoni
Vanga
Chale Point
KISMAYU
Witu
Kipini
Golbanti
Bura
Lamu
ANGLO GERMAN BOUNDARY
INDIAN OCEAN
TAITA PLATEAU

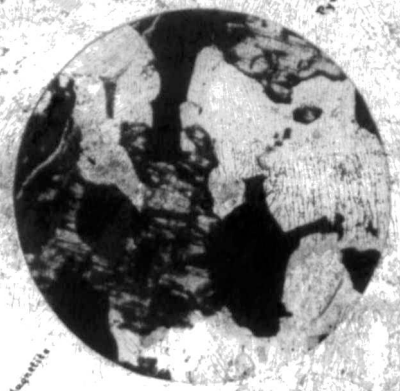
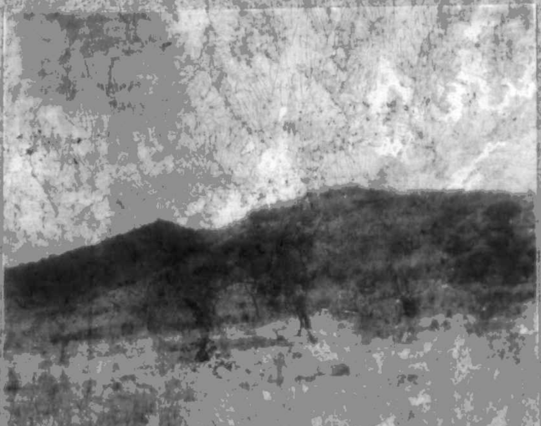


Fig. 4.

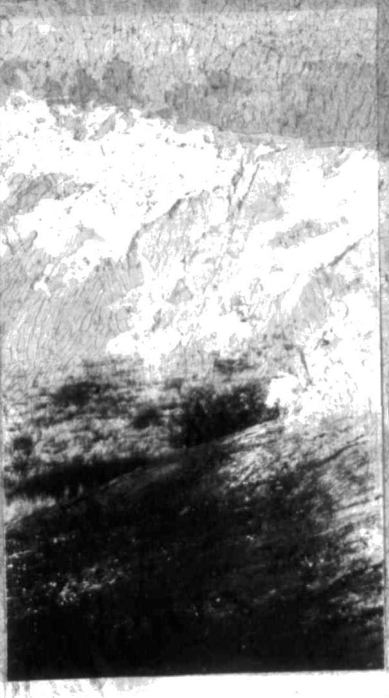
Fig. 1.

E Naso Nyiro. Rgn.
Between Chanler's Falls & Marti Plateau.

Drainage channel in gneiss, Laisamis, looking E.N.E. In foreground water-holes protected by thorn fences (boma); in distance right, edge of gneiss plateau with covering of lava.



Edge of the Abyssinian Highlands.
a head of the [illegible] valley.
[illegible] Near Mangatt. [illegible]



Extinct pays rising from the central lava plateau of Marsabit.

Explosion or Pit Crater, N. Marsabit. About 300 feet deep. 800 yards across.

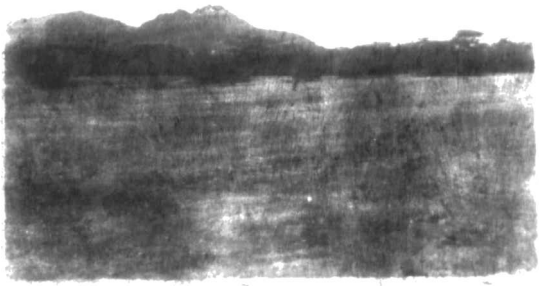


Fig. Site of a well, Wajhir. In background is one of the artificial mounds mentioned by Horley. Geogr. Jour. 44.1914.p.473.

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Fig. Mouth of a well, Bil Bak.

On the PHYSICAL CHARACTERS of the NORTHERN PART of the EAST AFRICA PROTECTORATE.

CONTENTS.

Note. Subject to slight alterations and additions.

John Parkinson.
Nov. 1918.

INTRODUCTION.

During the first year of the War, the Writer had the opportunity of travelling through the Provinces of the Northern Frontier District and Jubaland, which together constitute so large a proportion of the East Africa Protectorate, on a mission involving an ex-amination of the Geological conditions there obtain-ing with the object of augmenting the existing water supply.

With this purpose the journey was commenced at Archer's Post on the E Uaso Nyiro, almost due north of Meru, a station on the flanks of Kenya, and carried to the Lorian Swamp, thence northwards to Wajhir and finally to Moyale on the Abyssinian frontier.

From Moyale, a somewhat arduous journey was made in a south-easterly direction to the District of Eil Wak, and eventually the return from Moyale to Marsabit to Archer's Post. The E Uaso Nyiro was followed up to Rumuruti and the Rift Valley entered north of Lake Olbollosat. Later, the Survey proceeded to Kismu in Jubaland and up the Juba River to Gerenli. (See Map.)

Mr. H.E.Evans, who accompanied the Survey, did excellent work in prismatic compass surveys and in fix-ing the latitudes of such important places as Arhadu and Wajhir, previously undetermined.

Unfortunately, the scarcity or absence of water away from the main caravan routes and the difficulties of trans-

-port over distances which are not small, seriously hand-
-icap the traveller through this country, and force
him, upon occasion, to leave unvisited many districts
where additional evidence of the structure could proba-
-bly be obtained.

In its broad outlines, however, this structure is suf-
-ficiently clear, moreover, the physical features stand
in obvious relation to the character of the rocks involv-
-ved.

The neighbourhood of the Rift Valley on the west, the
abrupt rise of the Abyssinian Highlands on the north,
the great alluvial plain of Jubaland and its north-wes-
-tern extension towards Lake Rudolf as a well-marked
depression, now gripped by the huge Marsabit Volcano
are among the more obvious points of interest in a land
which bristles with geographical problems of the most
important kind. (Compare Orographical Map, 1/2,000,000,
Fig 1).

Viewed in its relationship to the surrounding parts
of Africa, the East Africa Protectorate is distinguished
from the great mass of the Continent to the south-west
by the absence, save for the local occurrence of the
Karagwe Series, of beds later than the earlier Palaeozoic
and later than those of Swaziland age.

A general N. and S. trend of the foliation of the
predominant gneiss, characteristic of much of Africa, is
usual, and as usual this basement platform has undergone

4.

enormous erosion.

The but slightly disturbed attitude of the Mesozoic and Tertiary sediments is noteworthy."

Entering into the composition of this ground, as an important component, the so-called "Turoka Series" is correlated with the Swaziland Series of the south, as a group of entirely reconstituted para-schists varying from coarse quartzites to coarsely crystalline marbles, a group which it is hard to avoid comparing in regard to degree of metamorphism and position in the geological column with the Grenville Series of Canada.

"See Scott Elliot and Gregory, "The Geology of Mount Ruwenzori," Q.J.G.S. 51, 1895, p.577. and the Nandi quartzites mentioned by Oswald, Q.J.G.S. 70, 1914, p.150.

"The quartzite has been traced to the southern end of Tanganyika and is probably of the same age as the Waterburg Series of the Transvaal: i.e. presumably Devonian."

The Karagwe beds cover a considerable area between Lakes Kivu and Victoria. See Map after Curt Gagel. "La Face de la Terre" t.3. [illegible] p.257.

"As far as the evidence goes, and from the nature of the case it is scanty, the period of absence of disturbance can be considerably extended, at least locally. Oswald records that the Nandi quartzites, [illegible] and of Devonian age, are nearly horizontal. [illegible] 150.

This area, with a western extension to the Central African Trough, is by far the more important of the two great districts of Africa wherein Tertiary volcanicity is manifest, the results of its action being the most conspicuous of the physiographical features of the Protectorate, both in the lava flows and cones which characterize the Rift Valley and in the great volcanoes which mantle its margin.

Westward of the protectorate, the crystalline basement platform extends through Uganda and the Nile Provinces to the Central African Trough; southwards these rocks, reinforced by granite intrusions, continue to form over the greater part of the late German Colony, but a progressively increasing development of Upper Karoo and Mesozoic beds is apparent.

The "inlier" of the former in the neighbourhood of Arusha and the great spread of the "Tree Sandstone" in the basin of the Rufiji are examples.

To the N.E. and N. Italian Somaliland and Abyssinia bound the Protectorate. In regard to the former, but little information is available, the Jurassic beds of the Juba below Serenli extend eastwards and crystalline rocks are recorded, hence it is perhaps possible to consider this country, as far as the Highlands of Abyssinia, as the result, after steady elevation, [illegible] ing of an archipelago of crystalline rocks by the sedi-

-sents of successive Mesozoic and Tertiary seas.

In Abyssinia, the Grès d'Adigrat, of presumed Triassic age, has an extension northwards to beyond the 14th. parallel and westward to long. 36°.

The succeeding Calcaire d'Antalo indicates an important extension of the Jurassic sea in the same direction, but the products of volcanicity, which apparently began much earlier here than on other parts of the east coast, the Trappean Series of Blanford, hide the earlier sediments, and in successive outpourings occupy by far the greater part of the Abyssinian Plateau.

A. The Northern Frontier District.

1) Drainage.

The highest ground of the country under discussion is found on the west and south, where the Highlands of Laikipia reach an elevation of over 6,500 feet and form the eastern border of the Rift Valley on the floor of which, some 2,500 feet below lie Lakes [illegible] and Baringo.

On this high ground the E. Uaso Narok and the [illegible] Uaso Nyiro rise and flowing N.E. and N. respectively, [illegible] over the lavas of the Plateau, join to the east of Rumuruti, whence under the latter name the River takes a general [illegible] course to the Lorian Swamp. *

Emerging from this unsalubrious, mosquito-haunted spot the stream, greatly diminished in volume, continues about ten miles further to [illegible], where it disappears into the sands of its bed.

Its channel, however, now known as the [illegible] Dera, can still be traced as a dry meandering "water-course" for

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* See Dracopoli, I.N. "Across Southern Jubaland to the Lorian Swamp." Geogr. Jour. 42, 1913, p.128. Also, "Through Jubaland to the Lorian Swamp." Appendix A.p. 302-3.

North of Aro Dima, situated near the N. [illegible] of the swamp, on the way to Wajir small quartz pebbles are abundant and doubtless represent an [illegible] of the former-ly greater River.

220 miles, measured in a straight line, when, having been joined by the equally important Lak Jira, it connects with the Juba River, not far north of the port of Kismayu.

The E Uaso Nyiro can then be divided into three parts: an upper measured from its source to the sharp drop in level north of Olloromacha, a middle portion including this descent from the Highlands to the great plain of erosion of the Northern Frontier District and the traverse of that plain; and, finally, a terminal portion, a sandy channel which winds through a plain of another character, the great alluvial plain of Southern Jubaland.

Three types of country distinguish these three divisions: the first includes the cool open parklands of Laikipia, the second the hot unfrequented sparsely forested rocky country of the middle reaches, the third the desolate waterless thorn-scrub tenanted only by roving bands of Somalis and rarely crossed by a European.

Fig.3 gives the profiles of the upper and the greater part of the middle reaches of the River and shows the more rapid fall in level at the locality "A".

It is noteworthy that small swamps are rather characteristic of the Plateau of the upper E Uaso Nyiro and the Seya River systems, whilst the rapid descent at "A" to another stretch having mature form, suggests a rejuvenation of the stream.

Fig.4 taken from the E.A.G.S. Sheets N.A.37 S&T, shows this part of the course of the River at the peculiar right-angled turn to a direction where the flow is normal to the "grain" of the country.

Here the want of detailed information is sadly felt, but it is in the Writer's opinion significant that, at the point where the change in direction takes place, one of the headwaters of the Seya system continues the line of flow of the E Uaso Nyiro and suggests an original carrying northwards of its waters.

If such were indeed the original course of the Nyiro, it is conceivable that the lower ground being then largely covered with lava, the scattered remnants of which will be discussed, the grain of the country would be disregarded by any consequent stream and that an elevation of its western portion, or the lowering of its eastern, would increase its rate of flow and enable it to capture the more southerly of the streams of the Seya system.[5]

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[5] That such an elevation is more than local is indicated in the juvenile character of the gorge of the Bahr el Jebel, from Duffile to Gondokoro (Gregory, Geogr. Jour. 4.1894.p.513.) in the juvenile character of the Turkwell, (Hobley, Geogr. Jour. 1905.p.100), and the "zoned park-lands" of the southern end of Lake Albert, described by Moore(" The Tanganyika Problem", pp.114 et seq.).

The grade of the last section of the River is approx-
-imately 1 in 1,700.

TheE.Uaso Nyiro is the only River in the Northern Fron-
-tier District, but drainage channels, proving the former existence of others, equally if not more important occur, and of these, three systems are sufficiently remarkable to warrant short descriptions.

The type of channel known in Jubaland as a Lar or Lugga is dealt with later.

Concerning the first two of these extinct or almost extinct systems but little can be said as they were not seen by the Survey and are only mentioned for the sake of completeness and because of their importance as being the basis of the water supply.

For information about them I am indebted to Capt. Athill.

In regard to the first, the Seya after traversing the higher ground north of the Laikipia Plateau is join-

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See Holmes, "On the Structure of the Tanganyika-Nile Rift Valley," (Geogr. Jour.48.1916.p.154).

Terraces on such lakes as Nyasa, especially several hundred feet above present water level, may indicate continued and recent sinking along old fault lines.

-ed by the important [illegible] [illegible] rising on the S.W. flanks of the Mathews Range, and [illegible] mapped by Capt. Athill as flowing through that [illegible] [illegible] and losing itself towards the Elgess.

The second system, perhaps the more important, is the Dalasse. The word signifies a water-hole, and the country round the northern Horr, south of Dalandabli, is known to travelling natives as the "Dalasse" because of the [illegible] water-holes [illegible] [illegible].

In general terms it is the country north of the Elgess and the Koroli Desert.‖

The gathering channels of the system are in the southern Horr Valley, between Mt. Nyiro and El Donyo Mare, where permanent water may be found in the head-water streams, which however do not join if the rains fail.

‖ The Koroli Desert is geographically of considerable interest. Count Wickenburg describes it as the dry bed of an old lake. (Geogr. Jour. 22.1903.p.5[illegible].) Capt. Athill informs me that the desert consists of [illegible]-coloured sand, without pebbles, locally [illegible] with [illegible] up to a distance of three miles from the "scarp".

This "scarp", [illegible] on the [illegible] map, is described as a wall which varies greatly in height, but is not more than 30 feet and is composed of [illegible]. Presumably it represents the [illegible] of the [illegible] and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] scarp [illegible] not the [illegible] [illegible] for the [illegible] [illegible]

Thence the channel passes round the S.E. and S. flanks of Mt. Kulal* and dies out to the south of lat. 2° 30 in the series of water-holes aforementioned.

Capt. Athill puts forward the very probable suggestion that the "Balessa Plain" extends northwards to include Lake Stefanie.

The third direction of drainage, like those preceding, is northerly, the head channels rise not far from Archer's Post and thence follow the grain of the country as given by the foliation of the crystalline rocks (see plan Fig. 5) through Kauro and Kinya, where the valley is about 25 and 100 yards wide respectively, to Langaia where it passes along the western side of a low escarpment of gneiss capped with lava.

At Merille an important tributary is received from the

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* I am indebted to Capt. Athill for the following. "The general formation of Kulal is a hog's back, with sharp spurs separated by precipitous kloofs. General direction of ridge N. and S. with spurs E. and W. Lava rubble covers the lower slopes, but higher up the mountain frees itself of this and is apparently granite. Its length is divided by a gorge, running E. and W. at about the centre point." The height of Kulal is 7810 feet. In Toula's map (Denkr. k. Akad. Wiss. 58. 1891. p. 521.) Kulal is given as formed of young volcanic rocks. Kulal is visible from the northern slopes of Marsabit.

west, and shortly afterwards, before Laisamis is reached, the valley, now greatly broadened, turns abruptly in an easterly direction, a wide flat-bottomed thalweg with lava capped cliffs [illegible], 300 to 400 feet high on either hand.

At Laisamis a second large tributary from the west trends eastwards over ridges of felspathic gneiss and presumably joins the Kauro - Merille system.[22] Fig 6.

As these dry channels provide, except for occasional springs, all the available water by means of shallow pits dug in the sands of their beds, they are of very considerable importance in the development of the country.

Mr. G.F. Archer, C.M.G., who has mapped this area and that part of his work which covers the ground between

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[21] Compare Holmes and Wray, "Mozambique, a Geographical Sketch." Geogr. Jour. 42.1913.p.143. "Nearly all the river systems are intimately related to the strike of the gneiss. The primary watershed follows a zigzag line which is either parallel or at right angles to the direction of foliation." (p.149)

[22] The Laisamis - Merille system is mapped by Donaldson Smith as joining the Ewaso Nyiro about 8 miles below Chanler's Falls. "Through Unknown African Countries" 1897. Mr. Archer concurs with this. Geogr. Jour. 42. 1913.p.421.

* Now His Majesty's [illegible] Commissioner [illegible].

[illegible] and [illegible] is given in Fig. 5 with some Geo-
[illegible] added. [illegible] may be mentioned
[illegible]
[illegible] Gregory's [illegible]
[illegible]
[illegible] approximately the [illegible]
[illegible] and the [illegible] between Kenya
[illegible]

The "newer [illegible] are distinguished by their [illegible] rougher surface, by their [illegible] "proper" structure, [illegible] [illegible] soil and corresponding [illegible] vegetation.
[illegible] Section from the neighbourhood of [illegible]

[illegible] Composition.

The [illegible] part of the Laikipia [illegible], with a northern extension through [illegible] and [illegible] Lake Rudolf, together with the [illegible] the lower plain of erosion, [illegible] are composed of gneisses and schists [illegible] to collectively as the [illegible]
The accompanying [illegible] in general terms the extent of [illegible] rocks [illegible] Pre-Cambrian [illegible]
To the west and [illegible] to the north-east [illegible] out-

-pouring [illegible] of igneous rock, not [illegible] [illegible] the Abyssinian Highlands are nearly approached.

Eastward it sinks beneath the alluvium of Central Jubaland. [illegible] is so usual over the coast line of Equatorial Africa, post-Palaeozoic sediments have been discovered [illegible] [illegible] it is [illegible] not until the mid-Jurassic period is reached that [illegible] [illegible] [illegible] [illegible] which [illegible] but [illegible] although [illegible] [illegible] to the present time.

Geology [illegible] to Geology [illegible]

A full consideration [illegible] the platform of ancient rocks over this part of the Protectorate would require the geological mapping of the ground east and south of the Lorian Swamp. It would appear, however, and I am greatly indebted to the kindness of Mr. C.W. Hobley, C.M.G. for information on this point, [illegible] [illegible] of the alluvial and [illegible] older sedimentary [illegible] [illegible] [illegible] about 30 miles [illegible] the Lorian Swamp, the edge of [illegible] [illegible] [illegible] [illegible] Tana River about 30 [illegible] [illegible] skirting the [illegible] [illegible] [illegible] [illegible] S.S.W. and crosses the Uganda Railway in the neighbourhood of Mackinnon Road, Mile 57 (Mazeras).

To the east and west of this line, the physiography and in consequence the economic conditions will naturally vary.

Restricting ourselves to the northern half of the Protectorate, the general type of country formed by the crystalline rocks in the Northern Frontier District is an undulating plain broken by conspicuous ridges, which are scarcely "inselberge" in the typical sense.

The foliation of the [illegible] schists determines the "grain" of the country and varies but little, as a rule, from a north and south direction.

The planes of foliation are frequently vertical or [illegible] so and the differential weathering of the [illegible] rocks often causes a more resisting band to stand out and produce a triangular cross section to the ridge, which is not the typical "inselberg" form.

It is also noteworthy that the homogeneous [illegible] character of, for example, [illegible] of the [illegible] "inselberge" is replaced [illegible] by [illegible] diverse [illegible] rocks of [illegible]

As a general statement, the [illegible]-like [illegible] -[illegible]ating surface, [illegible] homogeneity of composition, is not common in the Northern Frontier District: thus Olkanjo (Fig. [illegible]) [illegible] distance [illegible] the east [illegible], has a top almost [illegible]-rated [illegible], [illegible] itself is [illegible] -ped: nor are the [illegible] outstanding [illegible]

[illegible] Sub-[illegible] typical [illegible]

The participation of lava outliers in that part of the country formed [illegible] of the old [illegible] rocks is of some importance; remnants of plateau eruptions have been already mentioned and it is noteworthy that a considerable amount of erosion has been [illegible] since [illegible] these early lava flows.

An example occurs at [illegible], where lava-capped [illegible] stand as isolated elevations [illegible] about 400 [illegible] above [illegible] surface.

[illegible] Arphan's Po[illegible] [illegible] structure. [illegible] Similarly, [illegible] overlying [illegible] of the [illegible] of E. [illegible] [illegible] from [illegible] to Chanler's Falls, 40 to 100 feet thick, are an account of the depth to which the [illegible] has [illegible] since these flows took place.

A [illegible] instance, unfortunately seen by the

G. L. Collie[illegible] Plateau of British East Africa. Bull. Soc. Geol. Amer. 23, 1912, p. 297) mentions [illegible] rocks in the neighbourhood of [illegible] Kip and Voi [illegible] residuals lying parallel to the foliation of the gneiss (N.N.W.-S.S.E.) [illegible] in [illegible] cases the steep and precipitous [illegible] are evidently [illegible].

Holmes and Wray are of the [illegible] opinion [illegible] inselberge of Mozambique [illegible] Jour. [illegible]

Reconnaissance only from a distance as that of Lembuguli* clearly visible from the northern bank of the E Uaso Nyiro where a black capping of vertical-sided rock, some 60 feet thick, which is believed to be lava, stands in very remarkable relief above the white conical gneiss hill which forms the southern end of a long disjointed spur. [illegible]

Although the ridge was not seen except from a distance, it is almost impossible to doubt that this is the correct explanation and that we have in Lembuguli the remnant of once far more important lava flows.

Equally arrestive to the eye as Lembuguli, the Marti Plateau, ~~on the edge of the [illegible] Plain,~~ west of the Lorian Swamp, which was passed by the Survey consists of crystalline rocks capped by lava."

Beds of old alluvium containing well-rounded quartz pebbles occur on its flanks.

It is worthy of note that in passing the eastern end of the Plateau, portions outstanding from the main mass

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* [illegible] of maps.

" See A. Arkell-Hardwick, "An Ivory Trader in North Kenya," 1903 Longmans. "The plateau is composed largely of gneiss rock, with large [illegible] of lava liberally sprinkled on its surface and sides." See also Dracopoli.

The Marti Plateau is the [illegible] Plateau of the [illegible] Staff map, No. 3455, 1914.

become visible, in appearance strongly resembling the stacks detached by marine erosion from the cliffs of a shore line. Three or four miles of alluvium lie between the base of the plateau and the E Uaso Nyiro, which has no corresponding high ground on the southern side, while the change in the scenery after leaving the plateau in travelling eastwards is very remarkable: a change from a land formed of massive streaky and slabby gneisses, barely covered by surface soil and rising here and there as rocky hills, to the fine silt and unbroken rockless surface of the alluvial plain covered with thorn scrub which stretches for nearly 300 miles to the Indian Ocean. Upon such evidence as I possess, I see no escape from the conclusion that, since or at the time of the deposition of these lavas, the sea has extended northwards as far as long. 39 in the lat. N. parallel, and that the alluvial plain of Jubaland is the raised floor. This is equivalent to an elevation since that time of 400 metres (1,300 feet).

Faulting as a Contributing Factor.

Much additional work is required before it can be definitely said how far faulting has contributed to the typical scenery of this part of the Protectorate, excluding the Rift Valley proper, but the impression I got [illegible] was that this factor is unimportant in the greater part

of the Northern Frontier District.*

* Compare the Geological Sketch Map of German East Africa after Curt Hagel, reproduced in "La Terre" t.3 3me. ser.p.967, in which the radiating faults drawn S. of Kilimanjaro are worthy of much attention. The faulted trough of the Pangani R. and the curving fault shown as forming its eastern edge on the W. boundary of the Pare Mts. and the Usambara Highlands are of special interest as bearing on the origin of similar abrupt and precipitous slopes elsewhere. Collie has already been quoted. Fault scarps are inserted on either side of the Athi River by Emm.de Martonne (Traité de Géographie Physique, Paris,1909.fig.219. Possibly then faulting should be given a greater prominence in the Northern Frontier District than I, when there, considered probable.

For clear indication of extensive faults W. of Lake Rudolf see "The Northern Territories of the Uganda Protectorate," by the late Capt. S.H.Leeke (Geogr. Jour. 59.1917.p.201) For still more westerly faults between Lake Albert and Gondokoro see map illustrating papers by Major C.H.Stigand and Dr. Holmes. (Geogr. Jour.58. 1916.p.147.) These scarps have a general parallelism to the edge of the Abyssinian Highlands, S. of Moyale, and to the trend of the Nyiro and Ndoto Hills S.E. of Lake Rudolf, suggesting these features may be the result of fracture lines. In a letter to myself, dated the 28th

Near the S.E. end of Lake Rudolf, however, judging from photographs and descriptions given me by Capt. Athill, faulting is largely responsible for the scenery round the Harr Valley between Mt. Nyiro and El Donyo Sam. (Fig.), an interesting country which requires much more attention, while escarpments exist on both sides of Sogota, the descent from El Barta being precipitous.

These suggested faults would be the northerly continuation, albeit farther to the east than perhaps might have been considered probable, of the Rift Valley System west of Rumurati.

The question of whether the rapid rise or "scarp" of the Abyssinian Highlands is due to a fault across the prevalent grain of the country, is of some importance, but the presence of foothills, though not of great size and the irregular nature of the edge of the scarp, if such it may be called, militate against the suggestion. Fig.

The rapid emergence of the parallel ridges which stretch from the higher ground like fingers, southwards, and which as isolated hills are the most prominent feature of the southern plain, produces the effect of these highlands having been built up by a process of overlapping of out-

October 1917, Major Stigand remarks, "The drop from the General Mathews Range to the low level of the Elgas is probably a fault scarp."

-lying eminences, which is not the effect of a fault. It may be observed that, stripped of alluvium which is locally of considerable thickness, the dissected nature of the edge of these Highlands would be still more apparent, hence if faulting has contributed to the production of this feature it was, most probably of considerable [illegible] [illegible] As travel in Abyssinia was inadvisable at the time and to investigate the scarp for more than thirty or forty miles beyond the scope of my work, I was unable to make additional observations.

Of great value in this connection are the remarks of Blanford* who records the presence on the Abyssinian Plateau of Bathonian and Astartian Beds, the Calcaire d'Antalo, outcropping at a height of 2,600 metres at Gamma and again 400 kilom. to the south at 1,800 metres. H.Douvillé remarks that the Jurassic formations of Abyssinia are nearly horizontal or at least plunge gently to the south.Ψ

In British East Africa, on the [illegible] River and the Uganda Railway, Oxfordian beds appear raised only a few hundreds of feet above sea-level.

An important post-Oxfordian uplift is implied, resulting in the formation of the Abyssinian Plateau; whether this could take place without peripheral faulting [illegible]

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* Blanford, [illegible] J.G.S.25.1869.[illegible] 404.

Ψ Aubry [illegible] Soc.[illegible] [illegible] 3[illegible] [illegible] 4.[illegible] 201

[illegible] Douvillé [illegible]

to be doubtful. As far as it goes, the evidence from the Stefanie region is corroborative of a faulted margin.

Maud describes theGoro Escarpment as a "great natural feature" and states that it continues in a broad sweep as far as Kaddaduma.[1]

Donaldson Smith describes the ground west of Meg, a volcano lying to the east ofthe Goro scarp, as a precipice.

Lake Stefanie itself is described by Ed.Suess as being in "eine weitere Grabenförmige Senkung".[2]

The evidence, on the whole, though inconclusive, appears to be in favour of an old fault circumscribing, in part at least, the southern edge of the plateau.

An apparent fault cutting through the mass of Mt. Mulal is mentioned by several travellers. G.F.Archer describes it as a cleft 100 feet across at the crest, which "falls sheer for probably 3000 feet", thus dividing the mountain into equalparts[3]

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[1] Geogr. Jour. 23.1904.p.552. A very broken edge"sweep"as already noted.

[2] "Die Brüche des östlichen Afrika".Denkr. k. Akad. Wiss. Vien. math. natur.Classe. 58.1891.p.574. Compare, "Les Fossés de l'Afrique Orientale d'après Exn. de Martonne. Traité de Géographie Physique in 8vo. Paris. 1909 p.487.fig.219, quoted also in "La Face de la Terre", t.3 Dié.p.970. A faulted sunk-land is here shown treading from the country between Lakes Stefanie and Abbai in a direction in general S.E.

[3] Geogr. Jour.42.1913.p.421.

without communication".

Von Höhnel refers to it as "der mächtige Ausbruch des Kulal welcher dessen südwestseite spaltete und die Senke im Süden des Rudolf Sees verlegte, mag den See in zwei Theile getrennt haben".

Capt. Athill has also mentioned this extraordinary feature.

Another possibility of an extensive fault having produced a marked effect upon scenery is to be noted in the S.W. part of the district, near Chloromode, passed in travelling from Archer's Post to Sumuruti, where the ground rises sharply between Karissia and the base of Kenya, in places at a grade of 45°. This ascent over massive gneisses is remarkable enough, and the wide stretch of country seen from the edge of the Plateau thus reached across the middle stretches of E Uaso Nyiro, 2,500 feet below, vies with the view from the northern slopes of Kenya in its fascination, and tends perhaps to emphasize the importance of the feature. On the ground, in spite of its striking nature, there appeared to me, however, but little reason for attributing this sharp difference in elevation to a fault. Sections plotted to true scale across it show a well-marked terrace, but there is no precipitous descent such as one is accustomed to see, for instance, in some of the scarps of the Rift Valley.[§]

~~The edge of the feature is greatly dissected, and faulting, if~~

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[*] Denkr. k.Akad.Wiss. 58,1891.p. 464.

[§] E.g. the Ngurumun scarp, W. of Lake Magadi.

The edge of the feature is greatly dissected, and faulting, if is existed, must be of considerable age.

(However, see Section, Fig.3 from Lake Solai to Lenbuguli. For additional comparison a section from Lake Nakuru across the Aberdare Range is given.)

Travelling westwards, we leave Olloromade to enter a rolling grass-land, rarely dotted with thorn-trees, which gradually rising continues until Rumuruti is approached, when the covering lavas again hide the older rocks and eventually at a height of 6,500 feet form the huge scarp of the Rift Valley.

The abrupt ascent at Olloromade, albeit greatly worn and eroded, is doubtless - whether faulted or otherwise - the edge of the true highlands of this part of East Africa; an edge which extends S.E. from Lake Rudolf through Nyiro and Karissia, leaving the Ndoto and the Mathews Range as strongly defined detached fragments, passes beneath Kenya, and thence, gradually dropping, reaches Fort Hall again to die away beneath the ash beds and lavas of Nairobi.

The more easterly and lower shelf of crystalline rocks comprises the ground, barely 1,500 feet above sea level, which forms the eastern side of the Northern Frontier District, southwards includes the slow rise to the hills round which the Tana River sweeps, and which, at an elevation of about 5,000 feet, finally blends with the inner shelf of the Highlands on the plains of Kapiti.

Extent and Character of the Volcanic Country.

The N.W. part of the East Africa Protectorate is characterized no less than the S.W. by Vulcanism: lava fields cover about half of the areaof the Northern Frontier District and volcanoes of enormous size form one of the most interesting features of this part of the Protectorate.

The serrated mass of Kenya, so different from the almost perfect cone of the Kibo summit of KilimaNjaro, dominates the southern part of the district and is sufficiently well known, but attention should be called to the great volcanoes of the north, since but little information about them is available, due doubtless to their inaccessibility.

The greater part of the volcanic country traversed by the Survey is composed of lava flows, of which the vents of origin are not now apparent and which may be taken as a whole to be older than the volcanic phase, the active remnants of which existed, or recently existed, south of Lake Rudolf.

E.g. Teleki's Volcano. Compare Joseph Thomson, "Through Masai Land", 1887, New Ed.p.317, for "the most remarkable evidence of recent volcanic activity" at the northern end of Lake Baringo. J.W.Gregory also mentions (Geogr. Jour.4.1894.p.315) mentions "lava streams surprisingly fresh" in the Erri Mts. of the same locality.

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Travelling southwards from Burroli on the edge of the Abyssinian Plateau, lavas soon replace the gneisses, and continue, spreading round the bases of such old hills as Turbi, until the volcano of Marsabit is approached.

The central part of this lava field is known as the Dido Gullgullo, a uniform waterless plain of angular fragments of lava usually less than a foot, rarely as much as a yard across. These flows from their appearance of age may be correlated in general terms with the early flows capping the eroded gneiss at Laisamis, Archer's Post, the Merti Plateau, etc., and constitute in the Writer's opinion the first great phase.

The second was doubtless the formation of the Marsabit and Huri* volcanoes, the former of which was examined by the Survey. Both are clearly visible at the same time during the journey across the Dido Gullgullo, and although Huri was perforce left unvisited, there can be but little doubt from the peculiarly characteristic form common to both that the one originated as did the other. That in outline Marsabit does not resemble the typical volcano, such as KilimaNjaro, the obvious instance with which to compare it, but appears as a long low

* Huri, Clouds (Oromo), Gagawa of the Rendile. See Count Wicklenburg's Journey from Jibuti to Lamu. Geogr. Jour. 22. 1903. p. 698. Huri, "a continuous chain of conical hills, rising to some 5000 feet runs N.E. to S.W. for 50 miles." See Peterm. Mitt. Nos. 9&10 Jahrgang 1903. Taf. 19 - 20.

ridge of very gentle slopes and without any obvious crater probably accounts for the fact that its true nature remained for so long unsuspected.

According to the excellent map of Mr. Archer the base of Mar-sabit is a rough ellipse, 30 miles long and 20 wide, but, as I estimate, having a slope along the major axis of only 2° 11' (approx.). The top of the crater rim is about 5,100 feet above sea level. Considerable erosion has taken place since the outwelling of the lavas which built up this singularly flat cone; the columnar basalts of the eastern side have been cut through to a depth of about 100 feet, but an important fragment of the crater wall as still remains and the age, as already remarked, is most probably less than that of the flows to the north.

Eleven days were spent on Marsabit and a journey made round the south-eastern and southern parts of the mass as well as the north. Except on the north, ash beds are uncommon and there seems no doubt that the volcano was produced by successive outpourings from a central vent, which slowly built up by a process of accretion the huge flat cone, which sufficiently interesting in itself, is, in the abundance of its vegetation and animal life, in very welcome contrast to its surroundings.

The usual camping ground close to the spring known as Delassere's Nyoro lies on the edge of a grass-covered plateau of lava forming the centre of the volcano and at the base of a densely

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§ Geogr. Jour. 42, 1913, p. 421

forested hill of crescentric shape, which I thought could be resolved into three arcs of progressively diminishing size, representing as many craters. The ground is greatly broken and without detailed mapping it is exceedingly difficult to be certain of the structure, especially as the forest hides any view which might otherwise be obtained.

The well-known crater lake of Marsabit, an instance of the late explosive phase, is about 800 or 900 yards in diameter, and a second, now a mere swamp is situated near to Delamere's Nyoro.' Fig.14 Both appear to lie within the two outer rings, and from the rim of the latter, the wall of the outermost crater can be seen towering up.

This later, more explosive form of vulcanicity, gave rise to a large number of puys built up of mingled lava and ash, which stud the edge of the central plateau and give a peculiar serrated outline to the volcano when seen from a distance, a peculiarity shared with Huri. Figs.15,16.

Certain small craters, presumably slightly earlier occur on the flanks of the central plateau with vertical walls and no cones resembling the "pit craters" of Hawaii and which Daly[5] considers were produced by "melting perforation", an explanation which seems

[5] "Igneous Rocks and Their Origin," 1914,p.141 & fig.96,p.142, closely recalling instances at Marsabit. Compare C.W.Gwynn, Geogr. Jour.38.1911 p.113 where the lines of craters S. of Stefanie are mentioned. The Dorai Group are especially curious, notably Dillo, hardly showing a projecting rim above the level of the ground, but forming cliff-lined pits some a mile in diameter and several hundred feet deep".

applicable to those of Marsabit, when the resemblance between the Pacific and these East African volcanoes is taken into account Fig. 1.

In consideration of the waterless nature of the country for several days in any direction from Marsabit, it may be interesting to record the presence of fish in one of the streams on the S.E. flank and the almost universal occurrence wherever there was water, of a large number of gasteropods.

B. Jubaland.

Excluding the Juba River, the northern and central parts of the Province of Jubaland, with which this paper deals are waterless, except that during the wet season rainpools form and provide a temporary supply for the wandering bands of Somalis.

As already stated the country is extraordinarily flat: after leaving the fringe of sand dunes and raised coral reefs which border the Coast, only the most insignificant elevations are passed: apart from these the ground rises very gradually in a general north-westerly direction.

Northward on the eastern border of the Province, hills of Jur-assic strata, kindly identified by the late Mr. G.C.Crick as of Oxfordian age, were found on the Juba River in 1° N.lat. and

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See Abs. Proc.Geol. Soc. No.980. Nov.25th. 1915.p.6.

reach an elevation of at least 2,000 feet above sea level. Ferruginous sandstones and local conglomerates, which are believed to belong to the same series occur to the west of Eil Wak (about 40°E.long), where the gently inclined strata of which the hill is formed are seen truncated against their singularly flat tops, suggesting sub-aqueous erosion of no great age. Fig.13.

The southerly extension of the great Jubaland Plain towards the Tana has yet to be investigated, but from the accounts of the travels of Dracopoli* it appears to continue for a considerable distance, the whole forming no small proportion of the entire Protectorate.

In spite of its monotony, the country possesses a certain charm; its present inhospitality, its probable former luxurious vegetation, the progress of desiccation, thepractical problems of Government, perhaps the sense of the little known, lend fascination to a land almost entirely devoid of Nature's commoner attractions.

In dealing with Jubaland from the administrative or economic standpoint, thechief problem is, of course, the water supply, and in this connection the system of normally dry channels by which the country is traversed becomes of interest as holding out hopes of successful exploitation. Such a drainage line is known as a Lak or Lugga§ and a considerable divergence of opinion exists among travellers concerning the amount of surface water any one may periodically contain, the frequency

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*Geogr. Jour. 42. 1913. p. 128.

§According to Stigand, Lagga, stream or watercourse, Galla and Boran.

of surface and the passage of underground flows.

These important details await connected observations before definite conclusions can be reached.

For the sake of clearness, two main systems of these Laks may be distinguished in an exceedingly complicated network of channels: a more southerly which is the easterly extension of the E Uaso Nyiro onwards from Madoleh, this is known as the Lak Dera and a more north-westerly, the system of the Lak Jira which receives many branches south of Wajhir, which with a general south-east-erly trend joins the Lak Dera immediately to the west of Afmadu and which may be continuous north-westwards with the Lak traced through Gerifta, Eil Lass and Buna.

The Laks Dera and Jira, thus joined, continue under the former name to the swamps called Deshek Gumbi and the far larger Deshek Wama, whence rather obscure channels lead to the Juba River. The slopes which indicate the approach to one of these dry water-courses are typically very slight, banks in the ordinary sense scarcely exist, while the bed of the channel is overgrown with vegetation so that the line of drainage is usually distinguished from a distance by a belt of trees, more closely growing, of greater height and more abundant folia-tion than the scattered thorn trees which elsewhere emphasize so forcibly the monotony and aridity of the land. Fig.49.

Although surface flows do take place, for one was seen by the Reconnaissance, the water moving at the rate of several miles an hour and being several inches, or even in some channels a

few feet deep, yet the local nature of the rain storms, the ex-
-tremely slight grade and the pervious character of the bed of
the Lak taken in conjunction with a very high rate of evaporation
render it almost impossible that such surface movements can
be maintained for long.

No evidence was found to show that surface flows take place annu-
-ally, but the wide distribution and commoness -locally the
abundance - of the shells of Ampullaria and Lanistes as well
as of several other genera of freshwater molluscs and the presence
of crabs in the Lak Jira, at least go far to show that surface
water does in fact occur with some frequency.‖

At my request, Mr. V.G.Glenday, of the Political Service, has
very kindly furnished me with the following details concerning
the rainfall of Moyale which has a bearing on the question of
water supply to the southerly channels along this edge of the
Abyssinian Highlands.

Much of this country was traversed by the Survey during the dry

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‖To the west of Afmadu many birds were seen such as ibis, duck
heron. During the rains they doubtless extend their feeding
grounds from the Desheks and the Juba River. In regard to this
question note Salkeld (Geogr. Jour. 46.1915.p.511, "There has been
no instance within European knowledge of the Lak Dera or the
Lak Jira carrying surface water."

season, December 1914 to February 1915.

Writing of Moyale, Mr. Glenday says, "Summarizing I would say 1914 was a year of drought, 1915 a good year and 1916 an extra--ordinary good year, as only three months of this year were a negligible quantity. Of course things are very different on the plains, though even there the years were good. The draw--back is that on the plains the rains vary greatly year by year in their distribution. On the plains the rain months can be more clearly defined,i.e. "big rains" in April, May and possi--bly June, "lesser rains" October and November or, if late, Nov--em er and December. January, February March are generally very dry and very hot. One might get an average of the rain--fall on the plains by taking the Moyale figures for these months."

On this assumption the rainfall on the plains would be 4.30 ins. for 1915 and 6.84 for 1916 as against total rain--falls at Moyale of 30.78 and 35.02 respectively.

At this Station in 1915 the heaviest falls in one day for March April and May were respectively 1.72, 1.20 and 1.35 ins., the total rainfall for each month being correspondingly 4.30, 6.90 and 4.55 ins.

It is noteworthy that Mr. Glenday records a fall of 3.48 ins. in one day in September 1916, the total fall for that month being 3.95 ins. On this occasion the Lak at Buna, a branch of the Ell Lass - Garifta Lak, some 55 miles S.E. of Moyale, contained sufficient water to form a wave which moved a closed and heavy copper vessel containing 10 or 11 gallons of water.

Clearly then these channels are subject to occasional, though probably rare inundations.

It should be remarked that the Buna Lak is a sandy expanse of considerable width, which furnished at the time of the Survey visit in December 1914, sufficient water (derived from shallow pits) for the maintenance of small herds of cattle. Figs. 20.21.

All the wells seen, excepting Wajhir, were either dug on the banks of one of the principal Laks or on one of their innumerable ramifications. The word "well" is, however, a misnomer for these excavations are in the great majority of instances little better than shallow pits, or, at best, irregular shafts of cross sectional area very disproportionate to their breadth. At Wajhir, on the contrary, true wells are found, three feet to three feet six inches in diameter, excavated in a compact calcareous sandstone to a depth of about 40 feet. Fig. 22. This group of wells extends over an area of some 240 miles and provides water which, with the exception of the most easterly at Eil Tuli[6] is not very unpalatable, but at Eil Wak to the N.E. beyond the Wajhir district it is exceedingly unpleasant. Figs. 23. At this important halting

[6] At Eil Tuli, Salkeld notes the strata in descending order are, gypsum, clay, black sand, stones and hard white sand. The black sand is impregnated with sulphur. Geogr. Jour. 46, 1915. p.51.

ground, the cavern-like wells are dug in compact fairly hard rocks, light-greenish grey to brownish-grey in colour almost entirely composed of gypsum, though in some instances a certain amount of carbonate must be present as active effer-vescence takes place with cold HCl.

Subangular grains of quartz are found only rarely.

The late Lieut. Aylmer in a careful and instructive paper† records "coral limestones" in the neighbourhood of Eil Wak: this was not seen by the Writer, who, however, did not travel far from the wells. These highly salt-w gypsifer-ous beds indicate the desiccation of a salt-water lagoon,‖ a noteworthy extension at that period of the sea, which possibly then carved out the Merti Plateau.

In regard to the origin of the water in the wells at Wajhir§

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†Geogr. Jour. 38.1911.p.293.

‖See, Data of Geochemistry, 3rd. Ed.U.S.G.S.Bull.616.pp211&576.

§See Mr. Bullen Newton's remarks, Abs.Proc.Geol.Soc.Nov.25. 1915.p.7. His note on Lake Assal in French Somaliland may be amplified by Aubry's statement that near the Lake are deposits of gypsum and salt, and that the beds containing freshwater shells are underlain by "cinérites siliceuses avec diatomées", the lake thus recalling in its deposits both those of Eil Wak and also of the former sheet of water occupying the Rift Valley, now traversed by the Magadi Branch Railway, where and at Kijabe, extensive deposits of diatomaceous earth exist. (Geogr.Jour.July. 1914.p.42). Al near Lake Rudolf, Toula (Denkschr.k.Akad.Wiss.Wien58.1891.p.551) refers to Diatomen-schiefer in einer mürben,erdigen und einer dichten, festen

the presence of freshwater shells (Bythinia and Planorbis spp.) in the limestone of the neighbourhood demonstrates the existence of a Lake at a former period on the edge of the crystalline platform. Such a Lake, destroyed by desiccation and silting might, the directions of drainage remaining unaltered, continue to be fed by subsurface flows, irregular and variable though these would be.[85]

It is very probable that the presence of surface water was the origin of the original settlement. As the supply diminished, wells would be dug, otherwise it is difficult to understand why an untutored people should laboriously sink wells here. The same argument applies to certain wells at Debell situated on a fault in crystalline rocks: a former spring is highly probable on the line of dislocation. Along the banks of the E Uaso Nyiro at and below Archer's Post freshwater limestones occur crowded with the remains of Melania tuberculata and Limnocharis rectistrigata, and at Chukali Ghofu, to the west of Eil Wak, vesicular concretions

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und harten Ausbildungsform der sich leicht zwischen den Fingern zu Pulver zerdrücken lässt, and weniger coherent ist, wie etwa jener von Bilin."

[85] For a general summary of this question, see Hobley. "The Alleged Desiccation of East Africa." Geogr. Jour. 44.1914. p.467.

[86] At the Post 90 ft. thick. About 2 miles below the Post three terraces occur, in which I did not find Planorbis, although this genus is found in quantity on the flood plain below.

of a calcareous mud sandstone scattered on the surface of the ground contain Rhacis rhodotaenia, Corbicula fluminalis and radiata, Melania tuberculata and Cleopatra bulimoides. Near the Abyssinian frontier, some six miles east of Turbi, fragments of pelecypods occur in the fine silt which forms the surface soil. It seems at least possible that fresh-water deposits exist, locally, up to the boundary scarp. It should be noted that a friable calcareous deposit found in the Lak Buma yielded Leptospatha spathuliformis and Corbicula fluminalis.

These facts go far to prove progressive desiccation. As Mr. Newton has pointed out, "the suggestion may be made that the northern half of British East Africa was probably an extensive freshwater region during Pliocene times, limited on the north by Lake Assal, on the east by Suddidima, on the south by Moder's Post and the Mount Kenya Plateau, and on the west by Lakes Rudolf, Stefanie and Marguerite."[3]

Whether the sea extended over the site of the then unformed Marsabit volcano as far as Lakes Rudolf and Stefanie is a point for travellers with greater opportunities than mine to decide.

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[3] Abs. Proc. Geol. Soc. No.980. 1915.

Compare the late Lieut. Aylmer in the paper already quoted (pp.290-1) who states, "Right up to the Anglo-Abyssinian border are to be found coral rock and marine deposits of recent age."

C. Summary.

As far as the evidence goes the following Summary gives approximately the sequence of changes.

a) Early and prolonged erosion.

b) Eruption of Plateau Lavas.

Formation of the Rift Valley.

c) Lacustrine and Fluviatile Period, with continued local erosion, the sea reaching to Marti, Lagoons of Eil Wak.

d) Volcanic (explosive) Phase. Elevation of the sea floor to form the Jubaland Plain. Drainage of Lakes. Desiccation and modern topography.

In other words, subsequent to the eruption of the early lavas a fluviatile, lacustrine phase existed, both inside and outside the Rift Valley, during which the Jubaland Plain was covered by a shallow sea. This was followed by a later phase of elevation and slow desiccation distinguished by the formation of the smaller volcanoes and puys.

Doubtless no hard and fast divisions can be true; in general terms the making of the Rift Valley preceded the lacustrine phase although evidence exists in the Lake Magadi district that some minor faulting took place during or subsequent to the existence of the

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lakes, but the inconspicuous erosion of the scarps suggests that there was, at least, of the faulting was later in the south than in the north.

John Sanderson

November 1908

NOTE to accompany Geological Sketch-map of the NORTHERN FRONTIER DISTRICT and part of JUBALAND, EAST AFRICA PROTECTORATE.

The degree of accuracy of the map may be partly judged by the fact that the journey, excluding stoppages at Nairobi and Mombasa, railway journeys and travel in the immediate vicinity of the Uganda Railway, occupied between eight and nine months.

It is, of course, impossible in so short a time to do more than outline in general terms the coastal plain of alluvium and sediments and the distribution of the lavas on the older crystalline rocks, and it will be understood that the boundaries make no pretence to be more than approximations.

It is for instance very doubtful if the volcanic rocks are continuous from the Merti Plateau to Marsabit, and the lava-capped hills east of Langaia and Laisamis are only roughly indicated.

The numerous volcances, in various stages of weathering, the hot springs, fumeroles, etc. S. of the Uganda Railway are not shown.

In regard to the Jurassic rocks, after they have once been recognized as flat-topped hills rising above the low thorn scrub-covered plain, it is not difficult from suitable eminences to judge of their occurrence at considerable distances.

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The undisturbed state of the coastal belt of sedi-
-ments in Equatorial Africa makes such an inference
far less hazardous than it would be in the majority
of countries, and it was thought better to show the
position of these beds, even in so rough an approx-
-imation, than to leave this part of the map a blank.
The much younger rocks of Sereni and Eil Wak pro-
-bably occur locally as outliers on the Jurassic
strata. It may be mentioned that travel between
Sereni and Eil Wak was not allowed.
The Koroli Desert is left uncoloured; it was not
visited, but consists, I am informed, of light col-
-oured sands without pebbles.
For much information concerning the ground from the
the S.E. of Lake Rudolf towards Merille, I am greatly
indebted to Capt. L.H.Athill, R.A., while other Pro-
-tectorate Officers have readily placed their know-
-ledge at my disposal. This information has in
been supplemented by the notes often placed on vari-
-ous route maps which were given me by the Survey Dep-
-ment of the Protectorate.
The latitudes of Eil Wak and Wajhir were fixed by
Mr. H.E.Evans, who accompanied the Reconnaissance.

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