85

EAST AFR. PROT

54231

Parkinson J.

1915

23 Nov.

Last previous Paper.

C.O. 48699/15 Conf.

P. 51546

Water reconnaissance to Northern Dist.

Submits report with geological sketch map and two diagrams.

Mr Bottomley

JHS 28/11/15

Mr Read

It has been decided (P/51546) that this report is not to be published at present.

The geological ... contains ... of the ...

... the other two ...

no additional ... of any ...

except the water analyses at Wajhir, Moyale, & the Gurar Nyiro. The first, & no doubt the others, were conducted at the ... and the results are ...

The geological ...

Next subsequent Paper.

nothing that need go to the Prst. at present
I ack. [thank] (to T'day) [address] & explain as to the postponement
of publication

Chas. 27 xi 13

attonce

H. S. R.
30/XI/'15

Royal Societies Club, 86
St. James's Street,
S.W.

23 November 1915.

No. 48595/1915.

Sir,

Herewith I have the honour to enclose my report for publication in the Colonial Miscellaneous series, together with a geological sketch-map of the country and two diagrams for insertion in the text. The map has been done in colours; should this prove unsuitable for reproduction I shall have pleasure, if it be forwarded to me, in substituting hatching.

2) Unfortunately I have to proceed immediately to Trinidad on a professional engagement and have accordingly to request that the proofs of the report may be sent to me

c/o The Royal Bank of Canada,
Port of Spain,
Trinidad. B.W.I.

when they shall at once be corrected and returned.

I have the honour to be,
Sir,
Your obedient servant,

John Parkinson

The Under Secretary of State,
Colonial Office,
S.W.

P. 54231/1915

E&P

2 December 1915

DRAFT.

[...] Parkinson Esq.
[Trinidad address]

[...] 1/12/1915

Bottomley 1 12 15

[...] to convey [...] for the

Sir,

I am to ack: the ~~thank~~ recd: of your ~~you for your letter of~~ the 23rd November ~~with the~~ accompanying Report on the results of the Geological Reconnaissance undertaken by you in the Northern Frontier District and the Upland Provinces ~~of the E.A.P.~~

2. ~~I am to add~~ that in view of the urgent need for economy at the present time it has been

decided to postpone

the publication of the

Report until after the

war.

decided to postpone
the publication of the
Report until after the
war.

ADMIRALTY WAR STAFF,
Intelligence Division. 32.
Tel. Mayfair 0873.

G.1086/18

88

Hertford House,
Manchester Square, W. 1.
February 8, 1918.

Dear Sir Herbert Read,

I have just received your note of yesterday, and hasten to return the Report on the Geology of British East Africa by Mr Parkinson. I am very sorry that it was not returned sooner, but it apparently got put on one side when we migrated from the Royal Geographical Society's rooms. I shall be glad to have a copy of the printed work when it is ready.

With reference to those parts generally, I should like to say that we have been asked by the War Office to prepare Handbooks on British East Africa, Uganda, and the Sudan, and I shall be very glad if you can give us any assistance in the way of material. Perhaps I might send the member of our staff who is in charge of the work to the Colonial Office one day later on to confer with someone whom you may appoint to see him?

Yours sincerely,

Sir Herbert Read, C.B., K.C.M.G.
Colonial Office,
S.W.1.

16.5.18 89

DRAFT.

Dear ~~Dr [illegible]~~ Sir,

Sir Herbert Read has [illegible] to me the MS. of the Preliminary [illegible] on the Geology of the E.A.P. which you sent back to him in February. It has been decided not to print the report at present, but ~~before [illegible]~~ in going through the papers before they are put away I find that the maps and diagrams are lost with the report.

Would you very kindly have search made to make sure that they are not filed with your staff?

I return [illegible] the form of receipt which you sent with the report.

Yours truly
[illegible]

[illegible] Dickson Esq [illegible]

Draft

15 [illegible]

ADMIRALTY WAR STAFF,
Intelligence Division. 32.
Tel. Mayfair 5373.

M.I.756/18.

Hertford House,
Manchester Square, W. 1.

May 20, 1918.

Dear Mr Bottomley,

I am sorry to say that so far the search for the Map and Diagram accompanying Mr Parkinson's Report on the Geology of the East African Protectorate has proved in vain, in fact I have no very definite evidence that we ever received them from Cozens-Hardy. It is just possible that they may be found in one quarter which has not yet been investigated, and which I hope to get searched in the course of a day or two. I will let you know, of course, if they turn up, but it seemed better not to delay any longer in letting you know how the matter stands.

Yours very truly,

Ste. N. Dickson

W.G.Bottomley, Esq.
Colonial Office,
S.W.1.

M2 · Mr Read 91
Recirculated. ?
Have not yet removed Cons?
L.R.

Recirculate in 1 month ?

the papers referred to in the minutes M. 28465/15, 61546/15, & 52231/15 have not been returned by the Sq. Comm. Cozens Hardy of the Adm. Details Dept.

H.J.R.
5/I/16

S.R.
Comm. Cozens-Hardy wants to keep for a short time longer. Recirculate in a month.

H.J.R.
8/II/16

Mr Read Recirculated Cutt 8/3/16 ?S-R ?

Sir B. [illegible]

Sir J. [illegible]on.

Mr. [illegible] Maitland.

Mr. Bonar Law.

Governor of Uganda

that you are desirous

of resigning your

appointment as a

District Commr in the

Protectorate

2. In the circs Mr

Bonar Law has decided

(P.T.O.)

Dft to C.A. as for. signed

[illegible]

[illegible]

Sir H. Just.

Sir J. Anderson.

Mr. Steel-Maitland.

Mr. Bonar Law.

Governor of Uganda that you are desirous of resigning your appointment as a District Commr in the Protectorate

2. In the circs Mr Bonar Law has decided ~~is prepared~~

(P.T.O.)

Dft to C.O. for. required then this [illegible] for [illegible]

[illegible]

Part II.

Survey of the Northern Frontier District.

Existing types of wells.

Probable character of future wells.

Detailed account of route taken and Recommendations as to sites.

(a) Archer's Post to Merti.

(b) Merti to Wajhir.

(c) Wajhir to Moyale.

(d) Moyale and neighbourhood.

(e) Abyssinian Frontier (Ramutt) to Archer's Post.

(f) Moyale to Eil Wak.

Existing types of wells.

In many instances the wells of the District are merely holes dug in the sandy beds of dried-up rivers, e.g., on the Marsabit route, north of Archer's Post; at Moyale and wells adjacent to that Station on the Abyssinian frontier; at Buna, north of Wajhir.

Others, in country where such stream beds are less well developed or are absent, derive their supply from creeks and fissures in solid rock.

Several instances of these wells occur north of Wajhir (Ajow and Buttalin) and on the flats near Moyale (Mangatt and Arittcha).

All these are found in the more westerly parts of the District, the only wells which deserve the name are those dug in the eastern area of sedimentary rocks, viz., at Wajhir and Eil Wak.

Of these, the former are carefully made cylindrical excavations about 3 feet 6 inches in diameter and of a maximum depth of 45 feet; the latter are much larger and more irregular pits often 69 feet deep.

A sample of water from a protected well at Wajhir was analysed in the Government Laboratory in Nairobi. The result was as follows, in parts per 100,000.

Nitrogen as saline ammonia	...	.002
" " albuminoid	...	.015
" " nitrate	...	distinct
" " nitrite	...	very high.
Oxygen absorbed, 3 hours lab. temp.		.5367
Chlorine		43.0
Hardness Temporary	...	53.0
Permanent	...	12.0
Solid residue	...	155.4

Remarks: This water is highly polluted and quite unfit for a drinking supply.

The pollution conditions seem to indicate a sub-surface movement of water from one well to another, some of the wells in the neighbourhood being exceedingly foul.

The water from Eil Thli in the Wajhir district and that from Eil Wak is very disagreeable owing to the content of sulphur; the former is at certain

seasons of the year rejected by animals. */

An analysis of the water from Moyale used in the station and derived from shallow pits in gravels overlying gneiss and schists and with no obvious source of pollution gave the following results:-

Nitrogen as saline ammonia	...	.013
" " albuminoid	...	.076
" " nitrate ...	...	nil.
" " nitrite ...	...	trace.
Oxygen absorbed, 3 hours lab.temp.	...	.515
Chlorine ...	...	9.0
Hardness - Temporary ...	...	5.5
Permanent ...	...	2.5
Solid residue ...	...	63.0

Remarks:- The water is polluted and is unfit for a drinking supply.

On the other hand the water from the Guaso Nyiro, a few hundred yards below Archer's Post, the sample being taken when the stream was near to its lowest level, gave comparatively good results.

These were:-

Nitrogen as saline ammonia	...	trace.
" " albuminoid	...	.006
" " nitrate ...	...	nil.
" " nitrite ...	...	minute trace.
Oxygen absorbed, 3 hours lab. temp.		.0693
Chlorine ...	...	1.0
Hardness - Temporary ...	...	5.0
Permanent ...	...	3.0
Solid residue ...	...	13.6

*/See Capt.Salkeld, Geogr. Jour. July 1915, p.52.

Probable character of [illegible] wells.

With possible exceptions in the neighbourhood of Wil Wak, where a deep shaft might be sunk to tap some particular stratum, any wells put down in this district will be of depths probably not exceeding 100-150 feet.

Unfortunately owing to lack of water within reasonable distance of the sites, boring is impossible, and shafts of as small a cross sectional area as is consistent with the skill of native workmen will have to be sunk.

In the event of several wells being required within a radius of about a mile from an already established productive well, a hand-boring rig could be employed with much saving of time and trouble.

Wells in rocks similar to those of Wajhir will not require timbering.

Detailed account of route taken and recommendations as to sites.

(a) Archer's Post to Merti.

For this stretch of the road, dams are the simplest solution of the water problem.

The amount of surface soil overlying the crystalline rocks is inconsiderable and its storage capacity accordingly may be neglected.

(b) Merti to Arro Dima and thence to Wajhir.

On leaving Merti the conditions which obtain as far as Wajhir and beyond commence; lavas and the older

crystalline rocks [illegible] and the country opens out into a featureless plain.

The calcareous sands of Wajir and the neighbourhood indicate the former existence of an expanse of fresh water of considerable magnitude; the detritus which accumulated therein buried the old and greatly worn surface of crystalline rocks and provided the reservoir capacity to which the present water supply of Wajhir is due.

The Wajhir beds are covered with sharp red sand, which, as these strata are practically horizontal; masks the outcrop, hence it can merely be inferred, though the inference is perfectly justifiable, that they extend beyond the area bounded by the wells. The extent of the area formed by these sediments is all important, and it is to their delimitation that unfortunately no certain guide can, at first sight, be obtained.

As far as I can judge, it appears probable that, thickness may up to 70 feet of sediments may exist. Further information can only be obtained by sinking a few shallow pits, for incurring which expense the probability of finding water gives ample justification. Much useful knowledge will be deduced from the ground passed through; anything denoting presence of crystalline rocks, such as angular fragments of quartz or of gneiss should be avoided.

If the hard underlying surface is struck, the well should be abandoned and another started in an easterly or westerly direction.

Recommendations.

From Gura Dima to Wajhir is between 62 and 64 miles in a straight line, and I would recommend that, if the former settlement is to be maintained as a sub-station, a line should be cut to Arobo (the most southerly of the Wajhir group of wells) about 55 miles in a direct line, and that shafts be sunk at distances of, say, 17 and 37 miles upon it.

Near mile 37 an area of soft brown silt, less wooded than its surroundings, known as Berchi, would be suitable for a well. A short distance to the north of this place fragments of the Wajhir limestone begin to appear in the surface soil.

A pit in the course of the Lak Boghal, about seven miles south of Berchi, would be of interest.

(c) Wajhir to Moyale.

The route taken was via the wells of Waghalla, the last wells of the Wajhir district in this direction, thence by the rain pools of Hashinnleh, leaving Derifta on the West, to join the more usual track near the hill known as Bil Yees.

Limestone fragments on the surface between Waghalla and Hashinnleh are probably due to the northerly extension of the Wajhir beds, but about six miles north of the most southerly pools (Hashinnleh) indications of the rising of the underlying rocky floor are seen and continue at intervals, until eighteen miles north of Hashinnleh the first outcrops of gneiss appear and extend to Buna and beyond. This stretch of country, from

a few miles north of Hashinnleh to near Korondil, is therefore unsuitable for wells.

At Debell, two days south of Moyale, surface soil and decomposed rock beneath afford sufficient reservoir capacity to allow of several wells obtaining water at a depth of about 40 feet.

These, on the southern side of the hill, are doubtless capable of extension.

Two more wells, yielding excellent water, are found a short distance to the north. They have, I believe, been sunk on lines of great rock crushing, presumably originally following springs.

Recommendations.

I would suggest a well near Hashinnleh the necessary water being taken from Waghalla when the rain-pools had dried.

Areas of grey silt, both to the north and south of the hill known as Korondil, would be worth testing by shallow shafts, the men being supplied in the rains from the pools under the hill.

At Debell, the supply could doubtless be increased.

Between Debell and the foot of the Abyssinian escarpment the distance is not great and the ground on the whole unsuitable for sinking wells.

A few patches of black silt occur some nine or ten miles north of Debell and again about five miles north of Misa. If water is necessary along this part of the route, these would be the best sites. The nearness of the crystalline rocks on

all sides renders it [illegible] that the surface soil be very thick; if so, the success of the well would be dependent on the degree of decomposition of the underlying rock.

Some of these proposed wells I am forced to look upon as experimental, but failure should not be taken as indicative of the impossibility of obtaining additional supplies.

(d) Moyale and the neighbourhood.

The wells which supply the Station, including those of Holali, three or four miles distant, are, with two exceptions, merely hollows dug in the sands and gravels of the adjacent valleys.

The position of Moyale, on the edge of the Abyssinian scarp, is naturally unfavourable for obtaining a constant and even fairly large output of water.

Near the Station, the heads of the valleys, which provide the present supply for the Government Officials are narrow with steep sides and rapid fall, they contain but little alluvium and consequently have a considerable run-off and poor reservoir capacity. Moreover, in open pools the rate of evaporation is very high.

The two exceptions to these shallow pits have been dug in the rock forming the valley.

One, sunk by an Indian, on an unsuitable site, in semi-rotten gneiss, for a depth after passing through the surface soil of nearly twenty feet,

gave about two buckets of water a day (end of December).

It is the only well worthy the name in the Station. The other is close at hand, dug in similar rock to a depth of four or five feet.

Further experiments of this kind so near the heads of valleys cannot be recommended.

On the other hand the wells of Molali, which supply the native part of the Station and the animals, are situated in the lower part of the valley of that name near its exit from the hills where it has a far larger cross sectional area and is of less grade than nearer the head, the consequence being that the quantity of alluvium which has collected is greater and the water storage proportionately increased.

This supply, I understand, is not known to fail.

The Molali Valley, at some distance from the Station is obviously badly situated strategically, and I think the advisability of constructing a dam, as near the Station as possible, should be considered.

Stone is abundant in the neighbourhood and a suitable site could be found without difficulty.

It is very important that the rainfall of Moyale should be carefully kept.

Between Moyale "boma" and Mamatt, along the edge of the Abyssinian frontier, are a number of wells sunk either in alluvium, or, where the alluvium is thin, into the underlying schists.

In the latter case the foliation ("grain")

of the Schloot is usually partially or nearly parallel to the trend of the valley at the point where the well has been sunk (Arittcha, Mangatt).

The wells of Ramutt (2) in British territory have been dug in the alluvium of the valley and are obviously capable of improvement. They contain but little water, the requirements of 'safaris' proceeding to Marsabit being taken from wells higher up the valley in Abyssinian territory.

The thickness of alluvium in the Ramutt valley under the flank of Burroli is about 40 feet in one instance and certainly suggests that towards the centre of the flat a still greater thickness would be found.

At the depth of 40 feet the sand contained water. This is of interest in view of the fact that the majority of the valley heads between Mangatt and Ramutt are in Abyssinian territory and that these contain the present wells, e.g. Mutchi.

There appears to be no reason why a shaft sunk where any considerable valley, having a good catchment area, commences to broaden into the plain to the south of the scarp should not be successful in obtaining water. It should be noted that such a shaft will require timbering.

The number of producing wells along this part of the scarp shows that there is no scarcity of water in the neighbourhood.

(e) Archer's Post via Marsabit to Ramutt

(Abyssinian frontier) taken from [illegible]

Along both, one, if not the most important of the main routes of the district, the present water supply is derived from:

(a) springs in the lavas and associated ash beds of the Marsabit volcano, and

(b) from water collected in the sandy beds of the channels draining the eastern flank of the Mathews Range and the northern parts of Lololokwi and Olkanjo. This drainage system, which was doubtless formerly of very considerable importance, leaves the neighbourhood of the Marsabit road by a well-defined valley which can be seen stretching in an east-south-easterly direction from a point about half way between Merille and Laisamis.

The published map shows that the main line of drainage takes a south-easterly course to the west of the Merti plateau.

Water appears to be abundant in the sands of this system; thus travelling from south to north, at the Kauro camp on the main channel one hole about ten feet deep in slightly consolidated sand afforded without delay sufficient water for 'safari' of 38 individuals; at Kinya, also on the main channel, doubtless water can be obtained in abundance; at Tengeza, the next stopping place the water is provided by springs, trickling at the rate of about 1,500 gallons a day.

Merille is on a large tributary to the principal channel. Nearly all the holes in the sand contained water when the Survey passed at the end of February.

At Laisamis two of the water holes are in decomposed gneiss having penetrated the side of the Lak; of others, one in the bed of a tributary, two are in rock for the last few feet, the remainder entirely in sand.

It would be of great interest to follow up the main channel to the Guaso Nyiro above Merti and ascertain whether it is possible to obtain water for the whole distance.

In the event of a diagonal means of communication being required, I would call attention to the possibility of locating one from Merille to Merti.

That the supply of water from the sandy channels of the Laisamis-Kauro system could be augmented is sufficiently obvious from the details given.

On the northern stretch of the road, i.e. from Marsabit to Ramutt, fresh wells might be sunk at the following localities taken from south to north with reasonable prospect of success.

(1) On the northern flank of the Marsabit mass ash beds are found in considerable thickness.

There, I understand, water is occasionally obtained. With a little labour this locality gives a good prospect of an auxiliary supply.

(2) On the slopes of Horrodeli (Haro Deri of maps and about 19 miles in a direct line to the N.N.E of "Delamere's Nyoro").

This is a conspicuous ash cone at the base of which a well is reported to have existed.

The ash beds are sufficiently porous to hold water.

(3) To the north of Mordeli, on the southern edge of the lava desert (Dido Gulligullo) a lak crosses the track, its neighbourhood rendered conspicuous by the presence of trees.

The catchment area is considerably less than that, for instance of the Laisamis lak, but in view of the great importance of finding water along the Marsabit-Moyale route an experimental shaft should be put down. A supply for part of the year, if not the whole would be of great value in this position.

Turbi. I reached Turbi after dark and left before dawn. There was no water at the time of my visit. Such supply as there may be is "run-off" from the hill side and is purely temporary.

Between Turbi Hill and Hamutt on the frontier, about eleven hours journey, I noted two localities which, in view of the need for an additional supply on the northern side of the lava desert should be further examined. These are,

(a) Six miles to the east of Turbi.

Here I found on the surface soil fragments of bivalve shells showing that this ground was once covered with water and it is possible that underlying beds consisting of sediments deposited thereby might be found which would prove of sufficient thickness and capacity to provide a supply for at least part of the year. The question would not take long to settle, water for the well sinking party could be obtained from Turbi during and for a short time after the rains.

(b) At a place called the "Lagga", about five

hours from Ramutt, one or two rain pools lingered when I passed early in Feb[illegible]. A drainage system exists here which, though of no great importance, has a catchment area larger than appeared probable when the flatness of the country was considered.

Examination of the topography followed by a few trial wells should prove successful in finding a temporary if not a permanent supply.

Summary.

To sum up the water question from Archer's Post to the Abyssinian frontier at Ramutt, the supply as far north as Laisamis presents no difficulty. From Laisamis to the pools at Ret[x] (derived from springs in lava on the southern edge of Marsabit) is a waterless tract - the Kaisut - occupying eleven or twelve hours in transit, i.e. two days for an ordinary "Safari". A well sunk south of the Kaisut, about half a days journey north of Laisamis might be successful, but the country is not easy to judge and no definite opinion can be expressed as to the likelihood of success after only a short examination.

North of the Marsabit many suggestions have been made whereby a water supply might be obtained. (a) at Horrodeli and in the law to the north of it, and (b) between Turti and Ramutt.

(f) Moyale to the Waso.

This journey was not made from Wajhir, as I should have preferred, owing to the shortage of food for the men at that Station, which made it imperative that the Survey should proceed to Moyale as soon as possible.

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[x] These springs may not last in times of drought.

For the first two days the route followed was a return upon the Wajhir trail to the wells at Debell, then in a general south-easterly direction to Buttellu (Bartullo of maps), which is part of an alternative route from Moyale to Wajhir.

Travelling at the ordinary "safari" rate, Eil Wak is five days from Buttellu. The trail is waterless throughout, although near Oghberali, reached at the end of the second day, one well was found which produced a cupful of water. Others probably exist in the neighbourhood, as two "manyattas" not far distant were occupied by Sakuye when I passed. The Wajhir - Eil Wak trail is taken after leaving Oghberali; the first named locality being three days distant.

From Oghberali eastwards to Eil Wak, and I have no doubt further, the conditions, given a tolerable rainfall, are distinctly favourable for obtaining water. The accompanying east and west section, from Buttellu to Eil Wak shows, as far as I have been able to read it in so short a time, the structure of the country.

A few miles beyond Oghberali a coarse pebbly sandstone (cemented detrital) occasionally very ferruginous and derived from the degradation of the crystalline rocks, forms an inconspicuous hillock (Gabba Hamesa).

Near and to the east of Gabba Hamesa old wells

are found, associated with large mounds and ridges of earth, which are said to have been made by former inhabitants with the object of forming reservoirs. The wells at Oghberali and in the neighbourhood of Gabba Hamesa are in lateritic rock: the deepest seen was 55 feet.

After crossing the flat known as Chukali Ghofu, a very poor exposure is found of a shelly limestone, which is followed by characteristic flat-topped hills of ferruginous and micaceous sandstone.

The next rocks met with are the far younger gypsiferous limestones of Kil Wak.

Recommendations.

(1) I conclude that the country from the Buttellu Hills to within a few miles of Oghberali is unsuitable for wells, but that those of Oghberali and to the east might be deepened and others constructed in their neighbourhood with a considerable prospect of success.

(2) In the event of water being obtained in reasonable quantities a shaft should be sunk at Chukali Ghofu.

Part III.

Survey of Central Jubaland.

General Description.

The Lack of Water Channels in the neighbourhood of Afmadu.

Probabilities of supplementing the existing supply.

Note on the Rainfall of Kismayu and Alexandria.

Evaporation.

General Description.

Two expeditions were made in Jubaland for the purpose of seeing more of the great alluvial plain which commences at the Merti Plateau, includes the neighbourhood of Wajhir and extends eastwards to the Indian Ocean.

As far as examined along the River banks, the Jurassic rocks consist of much [illegible] grey mudstones with some sand-stones and thin bands of a limestone crowded with fragmentary shell remains.

Given a fair rainfall, [illegible] would provide a moderate water supply.

Of greater economic interest is the occurrence at intervals, apparently occupying lower ground between the hills formed by the older rocks, of the more recent lime-stones [illegible] calcareous material which are conspicuous at Serenli itself, to the north of Lawita Flats, above Arabi and elsewhere and which closely resemble the water-bearing beds of Wajhir and Eil Wak.

That these rocks are found at such widely separated localities suggests that they may occur at intermediate places where, as at Wajhir, they would prove of importance as a source of water.

A well could, I think, be sunk through these deposits by digging or by a hand boring rig, but for the Jubaland Series a steam plant would be necessary.

The second journey was from Kismayu via the Debkek Wama and the Debkek Gumbi to Afmadu and thence westwards along the Lak Jera in the direction of Wajnir.

The character of the country was such as I had expected to find and it appeared to be both expensive and unnecessary to continue the expedition further, especially in view of the descriptions of the intermediate ground given by others. This part of Jubaland is a slightly undulating or flat country superficially formed of fine sand or silt, most monotonous in its characters and traversed by numerous Laks, i.e. channels containing water only in the rainy season.

There can be no doubt that the alluvial plain of Central and Southern Jubaland as far westwards as the Lorian Swamp owes its origin to the raising of a portion of the sea-bed, accompanied by the pouring in of sediment principally from the neighbourhood of the Mertl Plateau.

During this time the coral reefs of the Coast were raised to their present position of 100-150 feet above sea level; the corresponding submergence, it should be noted, would be sufficient to cover the country with water for a considerable part of the distance to Afmadu.

Economically this point is of importance, because the comparatively recent accumulation of detritus hides whatever of underlying formations may exist, although there can be, I think, no doubt that in the neighbourhood of the Laks west of Afmadu a considerable thickness of alluvium and possibly other and older sediments would be passed through before the basement platform of crystalline rocks was reached.

The Lake is the neighbourhood of [illegible].

As is sufficiently well known, the northern Guasa Nyiro, after passing through the Lorian Swamp, emerges as a "narrow shallow stream" and finally dies away in a series of water holes at a locality named Madolan. (1)

The bed of the River is thereafter known as the Lak Dera. Dracopoli, who has studied the eastern end of the Lorian Swamp and the western end of the Lak Dera more closely than other travellers, states that "after a plentiful rainy season water runs from the Lorian to the Deshek Wama", and also, "At Afmadu the wells are dug in the River-bed, and the water supply is permanent. This would seem to show that there is an underground flow of water, and in my opinion there is such a flow from Madolen eastwards." (2)

Elsewhere he says, "The Deshek Wama is a large shallow depression about 16 miles long by two broad, thus forming a natural lake. It was fed by a stream that issued from the Juba, and also, during the rains by the combined waters of the Lak Jera and Lak Dera -----" (3)

Sir Charles Eliot quotes Fava's opinion to the effect that the Guasa Nyiro "really passes underground through Rahtu, Afmadu, Kumbi and the Deshek Wama to the Juba, the permanent water in these places being otherwise hard to explain." (4)

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(1) Dracopoli. I.N. Geogr. Jour. Aug. 1915. p. 139.

(2) Geogr. Jour. Aug. 1915. p. 140.

(3) "Through Jubaland to the Lorian Swamp" p. 75. Dracopoli's statements concerning the Deshek Wama and Afmadu were presumably derived from native sources, as it does not appear that he himself visited either locality.

(4) "East Africa Protectorate." Arnold. London. 2nd. Ed. 1905. p.76. See also Tate. Geogr. Jour. Feb. 1904. "A Journey to Rendile."

Mr. C.F. Archer's opinion is diametrically opposite. In a Report dated 12th August 1914, he says, "The interesting question of the connection (if any) between the Uaso Nyiro and the Lak Dera..... still remains to be determined, though it would appear, if the writer may be allowed to hazard an opinion, that there is no outlet to the Lorian, and that the River merely exhausts itself in a succession of swamps in its lower reaches. In support of which it may be stated that Captain Williams R.E. proved by recent investigation that no water reached the Juba River through the Desheh Wama into which the Lak Dera was supposed to flow."

Captain Salkeld, in a Report dated the 6th of April 1914, speaking of the wells of the Afmadu area says, "All of these except Afmadu are surface wells and are not always reliable, they however contain excellent water which appears to be supplied by the Lak Jara and Lak Dera, but how far they depend on local rainfall is unknown.

The Afmadu wells are permanent and have frequently been described. It is sufficient to say they are about 60' deep, up on the banks of the Lak Dera not in the bed and appear to tap a permanent underground supply furnished by the Lak Dera or Lak Jara or both."

Later he adds, the Lak Dera "is the water trough. [illegible] springs up from the Lorian and though it is a mystery where all the water of the Uaso Nyiro disappears it may be supposed to flow underground and appear in the Afmadu wells."

The existence of sub-surface permanent water in either or both the principal Laks is a point of fundamental importance in opening a main line of communication from Kismayu either to Afmadu or Wajir, but as already

[illegible] throughout this part of the Survey, except the raised coral reefs fringing the coast and the western end of the Deshek Wama, no solid rock of any kind was found.

This was disappointing, as a knowledge of what lay beneath the extensive alluvial plain of Jubaland would have been of the greatest value in forecasting the probabilities of the future water supply.

With the exception of the wells at Afmadu, which are 40 feet deep, so Salkeld says, and are dug in the soft slightly micaceous silt of the River bank, I saw nothing in the district that deserved to be called a well; the pits at Muggar, Fangal, Gulleman and Yeye are mere slight [illegible] of excavations occasionally about 12 feet deep but usually much less.

At the time of my visit to Afmadu the wells were empty, i.e. had not been cleaned out in preparation for the dry season and the Somalis were obtaining their water from the rain-pools scattered throughout the neighbourhood.*

One of these, the size of an average English horse-pond was situated a few yards from the wells.

Much of the rainfall is, no doubt, held up in [illegible] by the clayey surface, and, forming pools, is there evaporated. Favourable conditions of porous soil and heavy rain at intervals would allow of a much larger proportion of the fall being absorbed.

The country is so uniformly flat that any note-worthy grades leading to the Lake appear to be rare, but when such occur a large proportion of the rainfall enters the Lak as run-off.

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* It is only after the failure of the rain-pools that the Mohammed Zubir return to Afmadu and clean out and deepen the wells to the water horizon.

Thus, heavy rain was met with in the middle of June near Lak Dagali Wam, converting the paths into miniature rivulets flowing rapidly towards the swamp, which undoubtedly received the greater part of the supply. The beds of nearly all the Laks in the Afmadu area are ill-defined, e.g. the Lak Dera west of the wells at Afmadu consists of small channels which might easily be crossed without the observer being aware that he was in the neighbourhood of a formerly important water-course. The belts of bigger trees which mark the banks of the principal Laks are the readiest indicators of their positions. About 36 miles W.N.W. of Afmadu (the furthest point reached by the Survey) the Lak Jera was crossed in two places, separated by some 6 miles of channel at both of which water was flowing and in one was about two feet deep. On the following day the Lak Jera was seen again at Fangal, about 12 miles below the most easterly of the two localities mentioned. Here rain water was abundant in surface pools, but, as at Afmadu, the deeper pits and water channels were dry. Possibly the water seen further up may not have had time to reach Fangal, but I incline to the opinion that it sinks rapidly into the ground.

On the Laks above there were no signs of a regular annual flow of water.

I conclude accordingly,-

1) that such a flow of water as was seen in the Lak Jera is maintained for a relatively short distance, when the water is absorbed and continues to percolate along the channel bed for a greater or less distance, dependsnt on the slope and the nature of the soil or the strata traversed, and

2) that the permanent water at Afmadu taps such a

supply, its position near a confluence of Laks having been chosen possibly for this reason.

Mention should be made of the two swamps (Deshek) into which the Lak Dera successively flows, or ~~passes~~ overflows, after leaving Afmadu.

The Deshek Wama (about 12 miles north of Yonti) the larger and more southerly of the two, is an irregular grass covered swamp, with a well-marked bank consisting, at least on the western side of "coral", similar to that of Yonti and Gobwen. There is I think little doubt that it is an old arm of the sea.

The swamp at Gumbi (about one mile N.N.E. of the camping ground known as Kurrumi-Wulldumerr, (roughly 24 miles S.E. of Afmadu) appears to be about 1½ miles long by about ½ mile broad and was full of water when I saw it.

As in the Deshek Wama, the centre was a mass of grass and reeds.

A spot called Haballofua, about five miles N.W. of Gumbi on the Afmadu track, bears evidence of frequent running water, which in one place was actually flowing when the Survey passed it on the outward journey.

The Lak Dera here is quite close to the track and the locality appears favourable for wells.

I am indebted to Mr. F.R. Villaul, Ag. District Commissioner at Alexandra and to Mr. Rattray Gardiner of the Department of Public Works for information concerning the ground lying west of the Juba River from Afmadu southwards. There appears to be no doubt that a number of channels and depressions exist in this part of the alluvial plain of the River, that they are frequently filled during the flood season by overflow and that in all probability water is supplied to the Deshek Wama and the Deshek Gumbi by this

means, while it seems at LONG [illegible] that a certain amount may reach Afmadu via the locality known as Subhi Wadi.

Taking this into consideration, together with the fact that as far as measured the rainfall at Alexandra is considerably higher than that of Kismayu there seems strong probability of water being found by sinking throughout the triangle of country contained between Mfudu - Afmadu and Yonti.

Probabilities of supplementing the present Supply.

I see no reason to suppose that a permanent supply of water sufficient for the needs of an ordinary "safari" would not be found by sinking shallow bore-holes anywhere along the banks of the principal Laks.

The permanent water at Afmadu and the number of shallow pits which have been dug at Fangal, Muggar and elsewhere to the west, periodically at least productive, go far to prove that such is the case.

The amount of labour expended by the Somalis in cleaning out or in deepening the pits they have constructed is very small: for instance the Mohammed Zubir at Feye informed me that some slight excavations in the neighbourhood of the Lak had contained no water for four years.

These depressions were but a few feet deep: it can scarcely be doubted that, had they taken the trouble to dig, water would have been obtained.

For a description of the country between the Kuroli "escarpment" and Lake Rudolf I am indebted to the accounts of Capt. Stigand and especially to information kindly given by Capt. Athill. The Kuroli scarp extends "like a wall," "in many places almost perpendicular," for a distance of at least 200 miles, occasionally not being more than 30 feet high and roughly conformable in trend

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Apart from the River, the actual and potential water resources of Jubaland may be thus summed up.

a) The Deshek Wama.

b) The Deshek Gumbi and the neighbourhood of Habaliefua.

c) The increased output by development of the Afmadu wells.

d) The probable production of a small permanent supply by sinking comparatively shallow wells along the banks of the Lak Dera to Arro Dima and along the banks of the Lak Jera to Wajhir, and

e) The location of additional occurrences in the north-central parts of the Province of soft calcareous sandstones and limestones resembling the water-bearing beds of Bil Wak and Wajhir. If found these should provide a certain amount of permanent water comparable in quantity with that obtained at the localities named.

Owing to expeditions outside Serenli not being allowed, I was unable to make additional observations.

Note on the Rainfall of Kismayu and Alexandra.

As given in the Meteorological Records up to and including 1915, the rainfall of Kismayu has a mean average value of 10.14 inches taken over a period of 18 years.

During this time the maximum fall for any one year was 29.37 inches, the minimum 6.52, giving a difference of 22.85 inches, or a range, taking the mean annual fall as unity, of 1.51.

This compares with the average of 1.24 from 13 stations given by Binnie for rainfalls under 20 inches

observed for a total of 576 years. (1)

In the Kismayu records, 44.5% are above and 55.5% below the mean, a proportion which, as far as it goes, agrees very closely with Binnie's average value of 45% and 55%.

At Kismayu the average fall of the ten dry years was 11.10 inches, or 73.4% of the mean value, that is to say, for 55.5% of the years gauged the rainfall was 26.6% under the mean annual value.

Taking two or three consecutive years of low rainfall the results were practically identical.

Owing to the small total number of observations these figures cannot be considered as more than approximately accurate, but they at least show that a shortage of over 25% on the mean annual rainfall is to be anticipated.

It is to be noted, however, that the rainfall at Alexandra on the Juba River (Gosha) for 1911-1913 inclusive has an average value of 24.84 inches and apparently bears no relation to the rainfall at Kismayu.

Mr. V. Glenday informs me that the total rainfall at Moyale for March, April and May 1915 was 13.75 inches, the respective amounts per month being 4.3., 6.8, and 2.65 inches, the heaviest fall for one day being 1.72., 1.3, and 1.35 inches.

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(1) "Rainfall, Reservoirs and Water Supply." Sir Alex. Binnie. London. 1913. pp. 15-16.

Evaporation.

Throughout the whole of the Northern Frontier District evaporation is exceedingly heavy.

To measure this, tests were made at Wajhir, Archer's Post and Moyalf by means of a pan one foot square provided for the purpose. This was painted a light brown and was buried in sand in the most exposed positions obtainable. The amount of water lost during each twenty four hours was made up daily with a measuring glass.

At Archer's Post, a mean of seven tests, made during March gave an evaporation of 39.775 cub. ins. per sq. ft. per diem, of which rather more than half was lost between 11 a.m. and 5 p.m.

At Moyalf tests were made altogether for 15 days giving a mean of 40.336 cub. ins. per sq. ft. per diem, this being at the rate of 102 inches per annum.

At Wajhir, three observations which give only an approximate figure, had a mean of 42.57 cub. ins., no less than 107½ inches per annum.

I greatly regret that the thermometer specially made for this work by Ross of Bond Street was either not sent or failed to arrive; but at Moyalf the mean temperature by the Station thermometer for seven days was 70.8 at 6 a.m., the mean noon shade temperature for nine days, 83.2.

The observations at Moyalf were taken in the middle of December; I am informed the hottest time in the year.

John Parkinson

23rd Nov 1911

Explanation of the Map.

The geological sketch map shows approximately the distribution of the several rock types over the district under discussion, and was formed from data obtained principally during the progress of the Survey but also from information furnished by Protectorate Officers.

That supplied by Capt. Athill has enabled me to give some idea of the country lying to the east and south of Lake Rudolf.

The boundaries of the calcareous beds of Wajhir, Eil Wak etc. are left vague as these beds do not rise above the surface of the ground, save as insignificant domes or ridges, to form any feature and are consequently obscured by the thorn bush or covered by the alluvium of the Jubaland Plain.

All wells and water holes marked, with the exception of those to the east of Dabandabli, were visited by the Survey.

Many more, of course exist, which are not included in the map.

ADMIRALTY WAR STAFF,
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Hertford House. 120

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May 28, 1918.

1909/18

Dear Mr Bottomley,

With reference to my letter G.1756/18 of May 20, I find that we still have two Reports by Mr Perkinson, No.51546 on Central Jubaland and one on the central and eastern parts of the northern frontier district of British East Africa, No.5334.-20.

I am returning these herewith; both contain a number of maps and diagrams, but we are unable, so far, to find anything in the way of maps definitely belonging to the Report sent to you on Feb.8.

There is no actual evidence of our having received them, but of course a separate note may not have been made at the time, although this is usually done. I do not think they can be here, but I will continue to search as opportunity offers.

I greatly regret that there has been this trouble, which has arisen from the fact that the papers did not come to us direct, but went through an intermediate section of the Admiralty; they were received shortly after we began work, when our organization was in a very rudimentary state.

Yours very truly,

Hle. N. Dickson

W.C.Bottomley, Esq.
Colonial Office,
S.W.1.