EAST AFR. PROT.

No. 25953

DESPATCH

25953

18 JUL

Governor.	No.
Sadler	311

1908

26 June.

Last previous Paper.

25572

(Subject.)

Mombasa Water Supply

Sends report on investigations made at Voi river, Tsavo river & in Shimba Hills with covering report on various sources of water supply by Commr of Public Works. Submits obsns & reports appt of Commee of Enquiry, whose recommendations will be sent in due course.

(Minutes.)

Mr Antrobus

Ref: Mr Gibbs's intimation that of recd of the 18th of July that a desp: has now been recd from the Govr of the Protte enclosing various reports relating to the question. This acting on a request made by a member of the Legve Council on behalf of the inhabitants of Mombasa he had appointed a Committee of officials & non-officials ~~~~ for the purpose of examining the question of the alleged insufficiency & impurity of the present water supply & estimating the quantity required for the town & port &c

To Mr ... 29 July

with copy to Govr 382 29 July

Subsequent Paper

28237

that [illegible] probably [illegible] considerable time before H. S. of S. will be in a position to decide what action should be taken in the matter -- Send a copy of our 28572 5/Ke, with copy of our d[illegible] on this paper to the Gov. for info. D.C.?

H. J. K.

24/8/7

Governor's Office,
Mombasa,
June 28th, 1908.

146

EAST AFRICA PROTECTORATE.

No. 311.
(Incl. 8.)

My Lord,

I have the honour to reply to Lord Elgin's despatch No. 372 of the 4th July last, and subsequent reminders on the subject of a water supply for Mombasa.

2. The report by Mr. Ross of the 30th November 1906 referred to in Mr. Currie's memorandum of the 3rd December 1906 is enclosed.

3. Since the receipt of the despatch under reply preliminary investigations have been made at the Voi river, the Tsavo river, and in the Shimba hills, and the results are contained in the reports of Messrs. Blain, Bush and Hay, (the map and estimates accompanying Mr. Hay's report will follow later) dated, respectively, the 22nd June 1907, the 20th December 1907, and February 1908, which are enclosed, together with a further minute by Mr. Ross of the 11th September 1907, and a Minute by Mr. Watts of the 10th October 1907.

4. These investigations, complete as far as the staff available could make them, have been carefully carried out, and a mass of valuable information

The Principal Secretary of State
for the Colonies,
Downing Street,
LONDON, S.W.

Governor's Office,
Mombasa,
June 20th /1908.

146

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The Principal Secretary of State
for the Colonies,
Downing Street,
LONDON, S.W.

information has been obtained.

5. In his latter Minute Mr.Ross draws attention to a arithmetical error in his minute of the 20th November 1906.

6. Finally the whole question of the various sources of water supply is reviewed and dealt with in Mr.Watts' letter of the 28th May last.

7. In considering the question of this water supply there are two main points to be taken into account, the supply for Mombasa and the supply required for the Railway through the Taru desert. I set aside the proposal to irrigate the Taru desert, the conception is a grand one, but it is not needed yet; storage would be required, and the expenditure involved would render the scheme impracticable unless we could induce immigration on a large scale the result of which would be problematical.

8. The Manager of the Uganda Railway is considering with the Commissioner of Public Works the question of supplying the railway stations; possibly a means will be found for practically damming for irrigation meeting the difficulty.

9. But the main question upon which public opinion is very strong, is the supply of potable water for the port of Mombasa. Acting on a request put forward by a Member of the Legislative Council on behalf of the inhabitants of Mombasa, I have appointed a Committee of officials and non officials to go into the question of the alleged insufficiency and impurity of the present supply, and to estimate the quantity required for the town and port, and the revenue that would be obtainable from

from various sources. Their report, after review by the Commissioner of Works and the Treasurer, will enable me to judge how far I shall be justified in approaching Your Lordship with a view to the final solution of this very important question.

10. In the meanwhile I would wish to record the opinion that it would only be as the last resort that I and my advisers would recommend such a matter of general convenience to a large and increasing town as its water supply being left in the hands of a private Company.

11. Your Lordship will observe from the papers now submitted that at no time has the matter under reference been lost sight of; time was required, with the means at my disposal, for the necessary preliminary investigations and for obtaining the results I have now the honour to submit.

12. Turning to the various schemes which have been put forward in the correspondence the only practicable one seems to be the one surveyed by Mr. Hay and recommended by Mr. Watts. This is a modification of Colonel Bogle's Shimba Hills scheme, at a considerable reduction of estimated cost. This supply is conveniently situated for Mombasa, and the scheme will I feel confident be found to be the only feasible one from engineering and financial points of view.

13. Samples of the water from this source are being obtained for analysis and I will communicate the results in due course.

14. In the meanwhile Mr. Macgregor Ross is checking the details of Colonel Bogle's scheme for distribution, and checking Mr. Hay's levels for the main pipe.

15. I am sending an engineer to look into the possibilities of the Sagalla scheme and also to examine the available supplies in the Mwele hills; but I have little faith in either scheme coming to anything; I feel sure neither will compare in feasibility with the Shimba hills scheme.

I have the honour to be,
With the highest respect,
My Lord,
Your Lordship's most obedient,
humble servant,

(J. Hayes Sadler)

Public Works Office,
Mombasa, November 20th 1906

Sir,

I have the honour to submit the following remarks as to the present state of affairs with reference to the long-projected water supply to Mombasa. At a cost of about £5,000 a preliminary survey and estimate was made in 1899 by Colonel Bogle R.E. for a pipe line from the Shimba Hills. As a result, it is definitely stated that a supply of about 400,000 gallons per day could be laid on from a tributary of the river Pemba at a cost of 295,000. If the whole available supply were sold at nine pence per thousand gallons a loan of £100,000 for the work could be extinguished in both principal and interest in forty annual instalments of £4,326 each. As however 400,000 gallons per ady is in excess of the present requirements of the town and port, the charge would have to be higher than 9 pence per 1000 gallons or also the period for payment repayment would have to be extended beyond forty years. Although the cost of this scheme was estimated at £95,000 in 1898 it could probably be done for something below this figure now. The Public Works Department is now a much larger organization than it was then and on the item of staff alone, a reduction of over £3,000 could now be made. I shall however be able to give a revised estimate of the work in full detail upon receipt of the plans of Colonel Bogle's proposed pipe line and I understand that Your Excellency has already written home for these.

On hitch with regards to this proposal has however occurred. I have had samples taken from a tributary of the Pemba which is almost certainly the one referred to in Colonel Bogle's report, Though I cannot be absolutely sure of this until I receive the plans, and Dr. Rose having analyzed it in Nairobi reports that it "shows evidence of sewage contamination and is not suitable for drinking purposes". This is a rather extraordinary result as there were no native shambas or dwellings in the vicinity. I am however going to have the actual source of the tributary cleared of all jungle and soil and take fresh samples at the point where it actually bubbles out of the rock. If these prove satisfactory, the question will be definitely settled that Mombasa can have a supply of 400,000 gallons per day at at a cost of less than £100,000 and that after a period of 40 or 50 years this will no longer be an encumbrance to the Protectorate, but a most satisfactory source of revenue. I need scarcely express my opinion that whatever is done should be done as a State measure and not put into the hands of any private company or concessionaire.

The weak point in this scheme is that the entire available supply is a very small one for a tropical city of 30,000 souls and for a couple of sea ports, one of which may be expected to exhibit striking developments in the course of a decade or two.

Colonel Bogle suggests that the supply might be augmented by drawing upon the Pemba river itself. The analysis given in his report states that it is less pure than the hill stream alluded to, above. "In its present state it is not well fitted for drinking or domestic purposes but would probably be made substantially improved by filtration". In this view Colonel Will concurs. On samples from the main river which I forwarded to him he reports that "the water would require efficient filtration before it would be fit for drinking" and with regard to another sample from the same source he says: "This sample of water is an impure water not suitable for dot drinking purposes". So the expansion of the original supply of 400,000 gallons per day would not be on very satisfactory lines. Having laid on what is declared to be " an ideal water supply" we should ultimately be under the necessity of mixing with it a large exc excess of some what impure water which would necessitate at least the filtration, and possibly the purification by some what expensive methods, of the entire supply. An alternative, which cannot be viewed with approval, would be to lay water supply systems in duplicate the pure one for the European quarter and the shipping and the less pure one for the native town. This proposal however scarcely deserves consideration.

The supply from the Shimba Hills should therefore in my opinion, not be adopted unless it appears that it is the only scheme at present available. There are however two alternative schemes. One is to sink a bore hole to a depth sufficient to intercept the water which is circulating on the sands, grits and grits of the Taru desert between miles 12 and 50 - almost certainly flowing actually over the surface of the underlaying gneiss. This would preferably be done at about mile 10 from which point, if water were obtained, it would have to be conveyed in pipes to Mombasa. Mr. Muff, the geologist states that there is little or no prospect that an artesian system exists there. The water would however most probably rise a considerable distance in the borehole, but would finally have to be brought to the surface by pumping or by means of compressed air.

I do not consider this a hopeful solution of the question though it is frequently the case that a deep bore may yield results of an astonishingly satisfactory nature. Even if it were not so in this case, the money would not be entirely wasted as the information gained would be of the greatest interest from a geological point of view.

One consideration which should be taken into account is that many of the formations in that part of the country appear to render streams flowing over them salt, the salinity increasing in wet weather and diminishing as the stream dwindle in hot weather. So even if water were struck it might turn out to be salt. So the proposal to put down a deep bore may thus very well be left until funds are sufficiently plentful to allow of its being done as an item of scientific investigation.

The cost of a bore three or four thousand feet deep would probably amount to upwards of £3000, though much depends on the nature of the strata met with.

Another alternative which exists is a supply from the river Tsavo - 135 miles away. Whereas the former would cost £100,000 and take perhaps 2½ years to instal, the latter could not cost less then a quarter of a million and would, I should say, take at least four years for construction. However the latter would be a much more productive public Work than the former scheme as and would in fact have a far reaching effect on the development of the Easter portion of the Protectorate and on the prosperity of the Railway.

The Tsavo river appears to be of a quality beyond suspicion and the supply available is said to be at the rate of about 9 million gallons per hour. Supposing that 20 million gallons per day were abstracted, the effect on the river would be scarcely perceptible and it would allow of a of our irrigating more then eighty square miles of country in the Taru desert and still having a supply of 2 million gallons per day at Mombasa, as well as a supply of 200,000 gallons per day to the Railway along the line. The scheme would begin to yield a large direct and indirect revenue years before supply was completed down to Mombasa. No insuperable engineering difficulties presented themselves and I should certainly advise Your Excellency to permit a rough preliminary survey and estimates to be made before any final decision is come to as to the supply of water to Mombasa. If the scheme were found to be financially impossible, there should then be no delay in commencing the supply from Shimba. The possibility of the failure of one rainy season now opens up a prospect of the very gravest nature. It is more then possible that the Island would have to be largely evacuated until the advent of rain as its occupation in the absence of rain and the consequent drying up of many of the wells would quite impossible. With a view to obtaining information as to this scheme I included in my next years Estimates a sum of £1800 for preliminary investigation for new work in the Colony. This would provide for a survey party of four white men for four months say one at £40 per month, one at £30 and two at £25 (total £480) plus a sum of £720 for porters and workmen, supply of water to the party by the Railway, camp equipment, travelling expenses, rations,

...ing &c. After a rough reconnaissance extending over say four months as proposed I should be in a position to at least give a rough preliminary estimate of probable cost and annual revenue.

Suggestions have been made as to the possibility of obtaining a supply from the head waters of the Voi River. I imagine however that this would prove insufficient in quantity. During the greater part of the year the Voi River is dry for some miles from the Railway lines It will however be quite easy to see at the end of the dry weather, say early in March, what the flow amounts to in the upper reaches. Even if it proves to be sufficient for the requirements of Mombasa it would I consider be very undesirable to have 100 miles of pipe line for the supply of Mombasa when by going a little further on, to the Tsavo, sufficient water could be obtained not only for the Railway and for Mombasa but also to render fertile and highly productive at least 80 square miles of territory which it appears will otherwise remain permanently barren.

It may be mentioned that if the question of obtaining water from Tsavo received any attention an extensive geological survey of the dirtricts on route ought to be carried out. The [illegible] such as the lower slopes between Changamwe and the sea and those between Mageras and Changamwe which at present [illegible] treatment would ever render fertile on account of the [illegible] extensive beds of shales there. It would be [illegible] should be carefully mapped before any large [illegible] considered. Further before a copious supply of water is laid on to Mombasa arrangements will have to be made on the Island for the collection and disposal of soiled water after use.

Finally I venture to express a hope that what is done in connetion with the impending supply of water to Mombasa will be left from preliminary investigation to ultimate construction to the Public Works Department, Subject of course to the approval of the consulting Sanitary Engineers on the Colonial Office staff.

I have the honour to be,

Sir,

Your Excellency's

Most obedient servant,

sd/ W.M.Ross

Director of Public Works

His Excellency the Commissioner,

East Africa Protectorate.

Public Works Office
Naivasha June 22nd 1907

25953

Report on the Voi river in connection with the proposed Mombasa water supply Project.

Rec'd 18 JUL 08

The attached rough survey shows the Voi river from the swamp formed by the river at the Voi Railway Station to its pricipal source on the slopes of Yali and Rumi hills. Following the river from the source, the elevation being about 4000 feet above sea level, four good springs - the remaining angles of the hill contours, carrying small tributaries, to form the beginning of the river, and receive at intervals along the right bank, other small tributaries rising in untilla at the point A on the plan the volume of the stream is 160 cubic feet per minute.

The river has now all the characteristics of a hill stream with numerous rapids and falls, flowing over a clean rock and boulder bed. The banks, on both sides, are thickly covered with jungle growth making approach to the river difficult except by the recognised native paths or tracks. The upper reaches of the more considerable tributaries are cultivated and there are usually a few native huts. At the point B, opposite the hill "Sungluru" the volume is increased to 312 cubic feet or 1953 gallons. per minute, and at the point C, just below the Church Missionary Society Mission station the volume of the flow was 985 cubic feet or 6155 gallons per minute. The river retains its character as a hill stream till the point D is reached, when the grade rapidly falls off to about 16 feet per mile; the rocks and boulders disappeared, a sandy bed between earthen banks taking their place.

This character is retained till the river reaches the swamp at the Voi Railway Station. Below the point D two ohter tributaries join the main stream. Both these tributaries were considerable in volume at the time they were seen early in March; but I was informed that both, in very dry seasons entirely disappear and are not reliable. The main stream is perennial and has not been known - even during an exceptionally dry season - to be reduced to less than, say, 1/5th. to 1/6th. its volume as measured by me and given above. These measurements were made early in March 07 when it was hoped that the river would be found at its minimum flow. This, unfortunately for the object in view, was not the case. The river was unusually full for the time of year, and I was informed that the best time to find the river at its lowest was during September and October.

Taking the requiredwater supply for Mombasa to be 250,000 gallons per day or 170 gallons per minute, and that the take off of the pipe line would be at the point B on the plan. At this point the measured volume of the stream was 1953 gallons per minute or 11½ times the quantityrequired for Mombasa which appears to be an ample margin if the stream, during a dry year, is not less that 1/5th. to 1/6th the volume as measured. The elevation of this point B is, say 4000 feet above sea level and the distribution reservoir at Mombasa would be say 500 feet above the sea level. This would give a difference in level beween the point B and the reservoir at Mombasa of 3500 feet available as "head" to overcome friction etc. in a pipe line from that point to mombasa.

Taking the length of this main to be 103-22 miles, 125 miles and the whole of this head, 3500 were utilized; then a pipe line 9" in a diameter would deliver 250,000 gallons per diem at Mombasa.

The Director of Public Works Mombasa

The pressure at the Voi end of the main would be high, but not impractically so. It would be a question to be determined whether it would be more economical in capital cost to utilise this head, which would give a smaller main, or, to reduce the head and give a larger main of a cheaper class of piping. This cannot be determined till the longitudinal section of the pipe line is known; that is, between Voi and point B in the attached plan. The remaining portion of the section being likely to follow the Railway line between Voi and Mombasa, and is therefore known. Altogether it is considered that the project of obtaining an ample and good supply from the Voi River for Mombasa are sufficiently good to warrant further investigation, i.e.

(1) A careful survey of the upper reaches of the river with measurements of the water flow in each tributary when at its minimum, and careful inquiries, as far as possible, as to their reliability in the dryest year.

(2) The practicability of laying pipe lines direct from each spring (which should be properly protected from contamination by surface drainage during the rainy season) and converging to a central collecting tank. From this tank the main pipe line would take off.

(3) A line of levels from Voi Railway Station to the point B or situation of the central collecting tank noted above.

sd/- W.Blain

Ex. Engineer P.W.D.

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To Director of Public Works
Mombasa.

From
Asst. Engineer,
Mombasa.

C.O. [illegible]

Tsavo,
November [illegible] 08

Sir,

I have the honour to forward you my report on the course of the Tsavo River, from a point at mile 45 above Tsavo bridge to Tsavo bridge.

The River flows N.E. from above mile 43, then to the South West base of the N'[illegible] hills at mile [illegible], which base it follows to mile 27 and then [illegible] E. [illegible] Bridge.

The surface of the [illegible] 10' - 15' below the banks, then there [illegible] rising away in country on either [illegible]

About every six [illegible] large dry watercourse leading to [illegible]

These have [illegible] and I think must in rain time, carry [illegible] river.

The largest of these was at [illegible] the width of the course was at least [illegible] yds.

I walked up [illegible] course about [illegible] found that it branched away [illegible] directions [illegible] drain the whole countryside.

About this [illegible] country was [illegible] gravel [illegible] in places.

The whole of the [illegible] through which I [illegible] was covered with dense thornscrub [illegible] which it is most difficult to pass.

One can rarely see [illegible] ten yards ahead, so it was impossible to see anything of the country.

I saw no traces of [illegible] at all, but had there been rain the day before there would [illegible] no trace left.

At each of my [illegible] I upset a bucket of water to see how soon it would be absorbed - in each case it had entirely disappeared in less than [illegible] minutes.

The bed of the river is mostly rock or gravel ascertained by trials in many places.

The banks are usually steep, covered with vegetation-Palm and thorn trees, Papyrus and rank grass right down to, and often overhanging, the water.

I can find no traces of high water anywhere along the course up to mile fortyfive.

There are three places where a dam might be erected to throw the river back for some miles.

One at about mile 5- where a dam of any length from 200 yds. to 1000 yds. might be built.

Another at about mile 20 where the river flows between two hills of Gneiss rock, here a dam of from 300 yds. to 1000 or more might be placed.

At mile 43 is the most favourable position where the river passes between two hills - one of Gneiss and the other of some volcanic rock and then through a gorge with almost perpendicular walls of rock about 40 feet apart.

Just above this gorge and between the hills a dam might be erected of from [illegible] to [illegible] mile long, which would make [illegible] miles back along the river.

D. P. O.

The country above this point is apparently a huge plain, and from the top of one of the hills one can see the course of the river for [illegible] over ten miles.

I could not take any cross sections in these dam sites as the bush was far too thick to cut without a number of axes and matchets which I did not possess. From this point it seems there is a depression in an easterly direction to the S.W. of the Mwatate Hills. There are no tributaries or springs anywhere along the course of the river.

There is no timber of any value for cutting along the course.

Dew - nightly.

There are no natives or settlers in the district so far as I could ascertain.

From my observations I find that there is an average flow of about 6,710,000 gallons per hour i.e. 299 cubic feet per second.

Here-with results of observations.

I found no part of the river where a temporary weir might be erected so that I have had to depend entirely upon float observations.

I have the honour to be,

Sir,

Your Most Obedient servant,

[illegible]

Assistant Engineer.

The country above this point is apparently a huge plain, and from the top of one of the hills one can see the course of the river for over ten miles.

I could not take any cross sections of these dam sites as the bush was far too thick to cut without a number of axes and matchets which I did not possess. From this point it seems there is a depression in an easterly direction to the S.W. of the Nyatate Hills. There are no tributaries or springs anywhere along the course of the river.

There is no timber of any value for cutting along the course.

Dew - nightly.

There are no natives or cattle in the district so far as I could ascertain.

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I have the honour to be,

Sir,

Your Most Obedient servant,

Assistant Engineer.

Encl. 4 in No.

157

C.O.
25953
18 [illegible] 08

MINUTE.

C.O. despatch No. 372.

With reference to paragraph [illegible] I presume it [illegible] be conceded that expenditure on a supply of water to Mombasa would be properly chargeable to the general funds of the Protectorate if the scheme included an extensive irrigation project, as might be the case if [illegible] -tion of the [illegible] River were decided [illegible]. If [illegible] the case, as [illegible] in an old Railway report, that the flow of the Tana is at the rate of [illegible] million gallons per [illegible], it should suffice [illegible] Mombasa and [illegible] on the [illegible] Railway and for the irrigation [illegible] under cotton [illegible] soil [illegible] the [illegible] require pretty much the same [illegible] cotton areas in Egypt [illegible] of [illegible] tons [illegible] 19 day [illegible] Only [illegible] locality can enable [illegible] there are [illegible] square miles of land suitable for irrigation in the neighbourhood of [illegible]. [illegible] by an official in the Egyptian [illegible] the conditions of soil and climate in the Tana [illegible] not altogether dissimilar to those prevailing in some of the cotton areas in Egypt. Suppose however that only [illegible] square miles or say 20,000 acres were irrigated. If a water rate of [illegible] per acre were [illegible] and the scheme were [illegible] as is [illegible] the case in India, at the rate of [illegible] per acre [illegible] the revenue from [illegible] land rendered cultivable, there would accrue a direct [illegible] Rs. 80,000 or over £[illegible] per annum independent of any

[illegible]

revenue derived from consumers in Protectorate by the Uganda Railway. Under such circumstances the objection to expenditure being met from Protectorate funds would, I presume, no longer be maintained.

The situation appears to be one in which a modest course of action is likely to be attended with only indifferent results, whereas the prosecution of a bolder and more comprehensive scheme could scarcely fail to have a startling effect upon the development of a large portion of the Protectorate which is now practically useless. It appears to me so probable that the scheme would not only pay for itself in a generation or two but give a handsome source of revenue that I trust that (whatever its dimensions as finally sanctioned may be) it will be kept free from the control of Railway concessionaires, and dealt with solely as a Government measure.

Paragraph 5 and Mr. Hobley's Minute.

The collection and storage of rainfall in the Mombasa district is practically removed from the sphere of feasible methods on account of the absence of any available gathering ground in the vicinity. Certain of strata met with for a considerable distance round Mombasa render water that has access to them pronouncedly [illegible]. I estimated two years ago for a small water supply by rainfall collection for a proposed quarantine station at Mombasa, but in that case the collecting area was to have been

one of corrugated iron sheets, one acre in extent, and the storage reservoirs lined with concrete, a system not capable of expansion for the requirements of the whole island except at prohibitive cost. Moreover with regard to any suggestions as to storage of water near Mombasa it must be borne in mind that the evaporation from an uncovered surface of water is enormous frequently approaching 0.25 foot per day.

The suggested supply from the Shimba hills (28 miles away) is from springs, the discharge of which appears to be independent of the local rainfall.

Paragraph 6. The necessity of installing a drainage system concurrently with a copious water supply is admitted and was referred to in my report of November 20th 1906.

Paragraph 7. In case my report of November 20th 1906 is forwarded home, I desire to corroborate the fact, pointed out by Mr. Currie at the time, that there is an arithmetical error in it. It is the total flow of the entire river that would [illegible] supply and suffice for the irrigation of [illegible] mentioned in that report and not one twelfth of the total quantity available or two hours' flow per day as stated on page 5.

Paragraph 8. I now have a further report on the supply of water from the Voi river which I will submit to the Commissioner of Works on his arrival. It appears from observations carried out by Executive Engineer Mr. Blain that the quantity of water available at Voi would amply suffice for [illegible] but not for irrigation to any considerable extent.

I wish to point out that while a thorough investigation of the various schemes which promise possible solutions is being carried from year to year the situation at Mombasa is becoming increasingly serious and I suggest that the principal Medical Officer should be referred to for an expression of his views. The population of the town is steadily increasing - particularly in the native quarter, and is now probably nearer 50,000 than 35,000 mentioned in the despatch under review. The drainage the town walls is much more efficient and more complete than was the case some years ago. It is now difficult to imagine what would happen if a couple of "rains" failed in succession - a contingency which has been known to occur in the past. All the tanks in the European quarter would soon be dry. Many of the wells would dry up altogether and the water of most of those which continued to yield would in that first case become brackish and then dangerous. After six or 8 months of drought the amount of water obtainable on the Island from all sources would probably be actually insufficient for the barest requirements of the population and a considerable evacuation of the Island would have to occur - over to Zanzibar and into the Shimba Hills. For those unable to leave the Island, water would probably have to be towed down by Government lighters from streams at the head of Port Reitz and Port Tudor and served out as drinking rations. The obstruction of business, the dislocation of Government work, and the general discomfort that would have prevailed before this stage was arrived at may be hinted at, but scarcely imagined. I trust that adequate provision will be made in the estimates now under preparation for full investigation next year of schemes for the requisite supply.

Given

I am sorry it cannot be arranged that any [illegible] be available much before the years end.

[illegible] W. MITCHELL R.E.
Director of P. Works.

Mombasa,
September 12th 1907.

MINUTE BY THE COMMISSIONER OF WORKS, E.A.P.&T.

IN THE PROPOSED MOMBASA WATER SUPPLY

It is very difficult to "Minute" on the [illegible] because it is incomplete and several reports are not in it. I trust however that the information and suggestions which I am about to give may be of some use.

We file before me deals with:-

(a) A proposal to supply Mombasa with water from the Shimba Hills.

(b) To supply the Town from the Voi River.

(c) To bore for water.

(d) To supply Mombasa from the Tsavo River, and to irrigate certain tracks.

Proposal (a) seems to be a doubtful one on account of the expense of filtration, which would be entailed, owing to the presence of salt impurities in the water. There would however be no difficulty in constructing an artificial lake to impound water in those hills not very far from Mombasa, provided that Catch Water Drains were made round the Hills to intercept the natural drainage area. This system has been followed with success in constructing the water supplies of [illegible]

MINUTE BY THE COMMISSIONER [illegible] WORKS [illegible]

ON THE PROPOSED MOMBASA W[illegible]

It is very difficult to [illegible] [illegible] because it is incomplete and several [illegible] are not in it. I [illegible] however [illegible] [illegible] and suggestions which [illegible] [illegible], may be of some value.

The file before me deals [illegible]

(a) A proposal to supply Mombasa with water [illegible] the Shimba Hills.

(b) To supply the town from the [illegible] River.

(c) To bore for water.

(d) [illegible] Mombasa from the [illegible] River, [illegible] irrigate certain tracts.

[illegible] proposal (a) seems to be a doubtful one on account of the expense of filtration, which would be entailed, owing to the presence of salt impurities in the water. There would however be no difficulty in constructing an artificial lake to impound water in these hills not very far from Mombasa, provided that [illegible] water [illegible] [illegible] round the hills to increase the natural [illegible] area. This [illegible] has been followed with [illegible] in constructing the water supplies of [illegible]

I. Mbeya, in the General Province)
II. Aarseti City, in Harar) India.

and the physical features of the country [illegible]
Towns are somewhat similar to those in the Salsette Hills.
I do not however advocate this scheme [illegible] for supplying Mombasa with water, and [illegible] similar on scheme (d) proves too unremunerative.

Proposal (b) is of slight utility, because of the superiority of the Tsavo River.

Proposal (c) would be expensive, and its success is very doubtful. If however its success could be made certain it would have superior claims to Scheme (a) or (b).

Proposal (d) seems to be by far the best one, and Mr. Ross, in his able Minute, has made out a strong case for its investigation. I cannot however criticise this project in detail for want of data. I however strongly support the proposal for a preliminary investigation, and I think it should be carried out without delay.

One point has not as yet been touched on viz: the loss of water by absorption &c. when running through the Irrigation Channels. I can however obtain information regarding this in similar soils in India from Mr. H. Marsh Marrow C.I.E. (late member of the Legislative Council, and Chief Engineer and Secretary P.W.D. in the United Provinces, and now employed on the Hydrographic Survey in Central India.) As he is a great authority on this subject, his information would be of great value here.

regarding water stealing, and payment of Irrigation [illegible], from "[illegible]" &c. would have to go to the Civil Authorities; thus bringing on them the trying of a number of vexatious petty cases.

(111.) An Engineer serving a private Company would merely try to make his charge pay, and in doing so, might ride roughshod over the rights of Indian Cultivators; whereas an Engineer serving Government would look both to the paying capacity of his charge, and to the rights of the Cultivators, and strike a balance between the two.

(1V) All Government Irrigation Engineers have to pass the P.W.D. Departmental Examination in Hindustani and also in the Language of the particular Province to which they are attached.. e.g. Punjabee in the Punjab, Mahratti in the Deccan &c. and also in "Canal Law". These tests are enforced so that Government may have an assurance that its Engineers are qualified to deal with Indian Cultivators. Would any private Company insist on similar tests?

5. In India, so far as I am aware, all water supplies to Cities and Towns are the property of Municipalities for [illegible] similar reasons to those stated above. Owing to the [illegible] of conditions existing between [illegible] and the [illegible] River, I think these views should be carefully [illegible] before granting private [illegible] concessions for [illegible] large tracks in the East Africa Protectorate, or for providing Municipalities with water.

necessary to see preliminary investigation of the Irrigation Projects in order to carry out expeditiously, a staff specially trained in Irrigation Works would be necessary. So far as I am aware there is no such trained staff available in the East African Protectorate, and I am venture to make the following proposals for obtaining the necessary Engineers and

1st. I suggest that I be allowed to ask Mr. G. M. Harriott C.I.E. (Superintending Engineer and Deputy Secretary for Irrigation in the Central Provinces and Berar) to engage a complete Staff of Temporary Engineers &c. for one year.

2nd. As he cannot possibly spare any Engineers trained at home, because he has few at his command, I think European Temporary Engineers, who have been trained in India, and who are expert in the preparation of Irrigation Projects, would be capable of carrying out the necessary preliminary investigation, under the guidance of Mr. McGregor Ross and myself. These Engineers would know Hindustani thoroughly; they are accustomed to work in harmony with Civil Officers, and to deal both with Indians and with Aborigines. (In Central Provinces and Berar there are several races of Semi-Savages e.g. Gonds, Korkus &c.&c.) Climatic considerations would not weigh much with them, nor would a lonely jungle life; and they would see nothing novel in the physical features between Mombasa and the Tsavo River. They are non-pensionable servants, [illegible] to the East Africa Protectorate (on the advice of Mr. Harriott and

Commissioner's Office, P.W.D.

Nairobi, [illegible] 1900.

[illegible] reference [illegible] orders of [illegible] to take the six [illegible] Manager in orde[illegible] [illegible] not be a success, [illegible] Manager Ross that Mr. Huff the [illegible] to the [illegible] lie [illegible] containing water in [illegible]

[illegible] the Manager's permis-[illegible] Harbour [illegible] plan and [illegible] with [illegible] to try the [illegible] to take [illegible] the [illegible] water-[illegible] a height of about [illegible] Mombasa via [illegible] and [illegible]

[illegible] pipe [illegible]

2. Service Rese[illegible]

3. Distribution [illegible]

[illegible] Secretary,

[illegible]

[illegible]

This scheme has [illegible]

(a) He proposes to supply sufficient water for the present needs of Mombasa.

(b) He has a water [illegible] at the point where Col.Begle proposed to tap the water, which could be brought into Mombasa by a second pipe when necessary.

(c) He has plenty of available "Head".

(d) No pumping arrangements are necessary.

(e) This pipe line avoids unhealthy Ravines. The only thing against his scheme is the questionable purity of the water. This however should be analysed at once and then the nature of the purifying or filtering Plant could be ascertained and estimated for. In choosing this Plant there should be no difficulty and as regards its erection and working there is ample "Head" which could be lost without impairing the efficiency of the Project.

As regards the Main Pipe I advocate using Macfarlane's welded steel pipes which can stand a head of pressure of 400 feet and would be thicker to 600 feet Head, because they are cheaper than cast iron, are less likely to be broken in transit and are lighter to handle.

To show the saving in cost from using these Tubes over cast iron once an instance is given in the [illegible] prepared by Messrs Macfarlane & Co. of Liverpool and headed "Steel Pipes & Culverts" viz.

Cambrai. 40,000 feet of 16 inch pipe delivered to a town 200 miles from Madras.

[illegible]

Carriage:

By [illegible]

By Rail

By Road

[illegible] . . . . 1[illegible]

. . . . 800

[illegible] . . . . [illegible]77

Total Saving £.10[illegible]

The Cast Iron pipes if used would have cost £.[illegible]

" Steel " as actually used cost £.[illegible]

Saving £.10[illegible]

In the case of Mombasa I think the Steel Main would not cost more than £20,000 if so much. This would cause a saving of £.(26661 - 20000) £.6661.

My rough estimate for the water supply of the Town would therefore be:

1. Main pipe line £.20,000 (approximate)
2. Service Reservoir " 9,330
3. Distribution Main " 24,704
4. Purifying Plant " 10,000 (")

Total £[illegible]

(3) No investigation has been made towards constructing a Reservoir in the Sagalla Hills, but if proposal (2) as modified by Mr. Roy and myself is not approved, a search should be made for a suitable site. This scheme however would be very expensive.

(4) & (5) have already been condemned so I need not dwell on them.

(6) In December last I sent Mr. Rush [illegible] to ascertain the discharge of the [illegible]

Secretary with the consent of the Honourable the Chief Commissioner) without reference to India; and their salaries would not be extravagant.

7. The reasons why I lay great stress on obtaining Engineer from the Central Provinces, are, because the physical features between Mombasa and Nairobi are identical with those of the Central Provinces, and I believe there will soon be men to spare from those Provinces as the investigation of Irrigation Projects is now well forward. I am not in a position to state the probable cost of the preliminary investigation of the Project, but should I be allowed to communicate with Mr. Harriett I shall soon be able to submit an accurate Estimate.

8. I have not touched on the financial part of the Irrigation Scheme, because no accurate Estimate of its cost can be framed, until the preliminary investigation has taken place. I have also not dealt with the question of water rates, because there are many systems in force in India and Egypt, and it would be necessary to compare the several system before deciding which one would be the most suitable for the Irrigation Scheme under discussion.

9. With reference to the water supply of Mombasa the Town would be provided with water by a Canal from the Tsavo River, the Canal terminating on a hill as near as possible to Mombasa, where the necessary Settling Basins, Filter Beds and Service Reservoirs would be constructed. From these Service Reservoirs, the water would run in Iron Mains to Mombasa, and be distributed by smaller Iron Mains and Branches. The question of supply

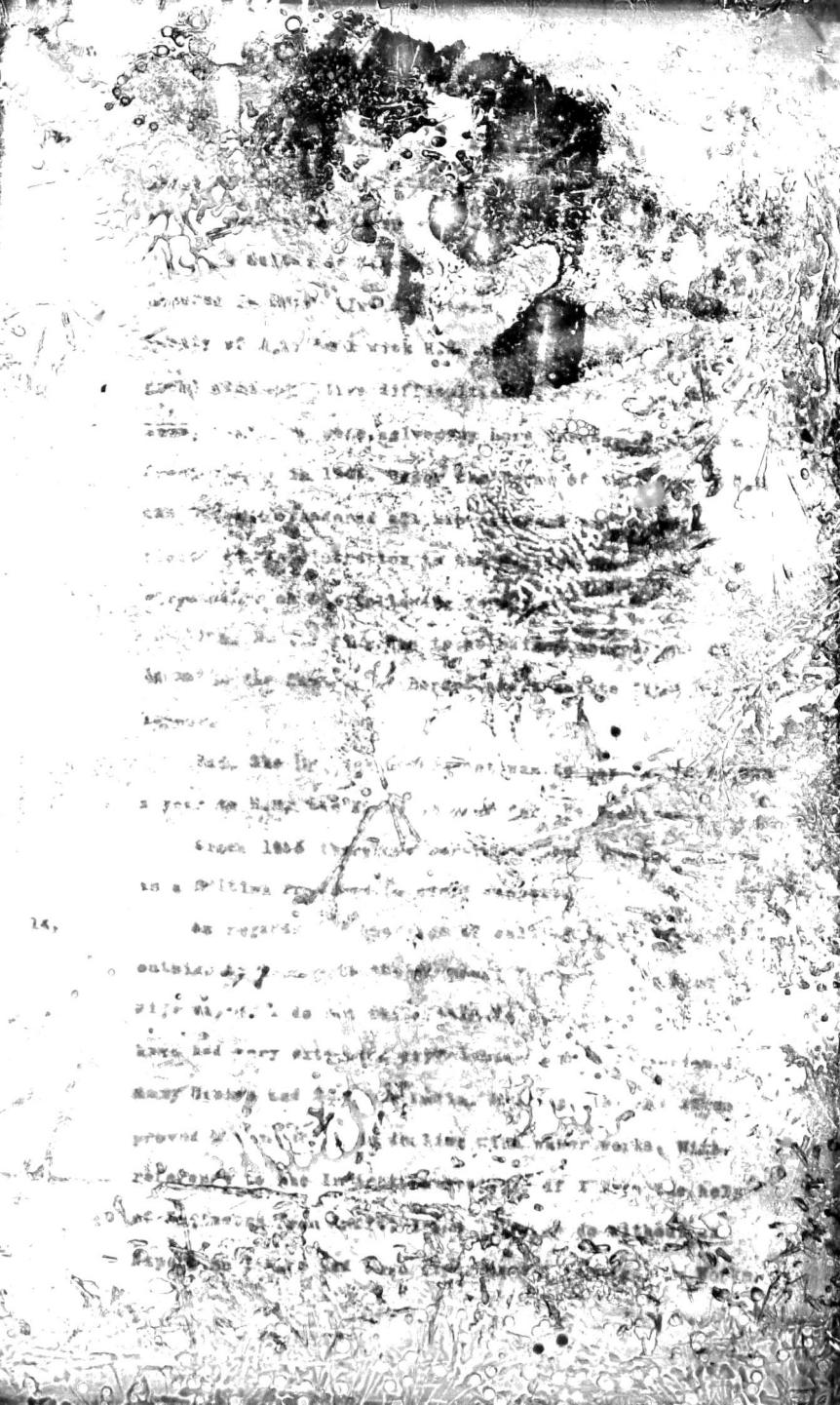
the German Railway [illegible] discussed in detail with the [illegible], when the preliminary Project was being prepared.

10. Allowing for a population of 50,000 people the water supply Scheme - as separate from the Irrigation one - should not cost more than Rs.15 x 50,000* people = Rs. 7,50,000 = £50,000.

11. The water supply will however probably be not the only expense. In other Oriental Towns e.g. Calcutta, Bombay, Agra, Lucknow, Nagpur &c.&c. where water supplies have been given without scientific drainage systems going on concurrently, the death rate has increased, consequent on the water logged state of the soil. Mombasa will [sooner or later] have to be drained after receiving its water supply. This Town however, unlike the many Indian Cities with which I am acquainted, enjoys a coral soil which seems to absorb all impurities - notwithstanding the presence of deep "Cess Pools" - and it may therefore be years before this soil is water logged. If this be so it may be possible to defer the construction of a Scientific drainage Scheme for some time. Of this however the Sanitary Authorities must be the judges.

12. If money can be forth coming from Government Sources I strongly advocate the Scheme being carried out. Failing funds from this source by Free Grant or by a Loan to the Municipality; then, I fear, we must fall back on private enterprise.

* This number allows for future increase in population.



I think do the Engineering part, and the Native Lands the Commissioner of Lands would have no difficulty in dealing with the financial aspect from a revenue point of view.

COMMISSIONER OF WORKS.

Nairobi 18/12/27.

The Treasury,

Mombasa 19th. December 1907.

Sir,

In conversation with the honour of having with the Right Hon'ble the Under Secretary of State on the occasion of his recent visit to East Africa, he stated that, in his opinion, all large and unproductive Public Works, involving a large expenditure of money, should be dealt with apart from the ordinary Protectorate estimates, and he cited, as an example, the proposed water supply for Mombasa Island, for which provision, for a preliminary survey, has been inserted in the draft estimates for next year. Mr. Churchill directed that the provision for this survey should be deleted from the estimates and that the desirability of the water supply should form the subject of a special report to the Colonial Office, when, if it were decided to embark upon the same, the arrangements for the supply of funds would be duly considered. This is in fact a reversion to the proposal made by His Excellency when he visited the Colonial Office last winter. On that occasion he submitted a list of certain items of expenditure which were too large to be met from the general revenues of the Protectorate, supplemented by the annual grants-in-aid, and this list included provision for supplying Mombasa with water from the Tsavo River.

When the debate on the estimates took place in the Legislative Council I was able, with His Excellency's consent, to make a statement to the effect that the Mombasa water supply was receiving the attention of the Government and that probably, in the near future further announcement would be made.

I have accordingly the honour to suggest that representation to the Colonial Office be made on this subject as soon as possible. I understand that for funds to be provided immediately it would be necessary for provision therefore to be made by the Treasury in ample time for the Budget debate in the House of Commons.

I think that in addition to the past reports on the water supply further memoranda by Mr. Rose and more recently by Mr. Watts, are available.

I have etc.,

C.C. Bowring

Treasurer

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is detailed in his letter of 20/12/[illegible] of [illegible] and 8 of the P. W. D. File (herewith [illegible]). It will be seen that this Officer took great pains over his investigations and proved that the low water flow averaged only [illegible] of [illegible] cubic feet per second. This would [illegible] more than [illegible] acres at the very outside, and without damming the River, the scheme as a combined Irrigation and Water Supply of Mombasa [illegible] Scheme would never pay. Even as inundation Scheme, that is one without storing water, would only bring in a revenue of about [illegible],20,000 rupees per annum gross revenue - were 60,000 acres commanded and under cultivation - and this would not justify an expenditure of more than say £.100,000, the Project would leave no water for Mombasa and it would be purely speculative. To take this water from the [illegible] River for the sole supply of Mombasa would be [illegible] out of the question, and as the Hon'ble the [illegible] Railway points out the major part of the [illegible] lost in evaporation and absorption before [illegible] the Service Reservoir for Mombasa - unless [illegible] were made to puddle the Canal and render it [illegible]tight. In my minute of 10/10/07 I went on the assumption that the flow of the river was nine [illegible] gallons per hour, which would have been a [illegible] than under [illegible] as measured by Mr. [illegible] and [illegible] time when [illegible] Years I hoped [illegible] find that the [illegible] discharge in [illegible] large river was more [illegible] million gallons. However [illegible] water [illegible] the [illegible] of the [illegible] in [illegible] of [illegible] fall to the ground, and I [illegible] no longer recommend the [illegible] of supply for Mombasa. This [illegible] would give but a fine.

the discharge of the river been larger.

I now come to a proposal, which I will call [illegible] which was suggested to me by Col. Owen Thomas and Mr. Hollyman late District Commissioner of Vanga. They told me that pure water was to be found in the hills [illegible] of Mombasa near Mwele and that it might be worth while to bring it into Mombasa. The Assistant Director informs me that no investigation has been made in these hills so one would be required before I could give an opinion on its merits.

(a) To sum up I [illegible] not in favour of any of the Schemes (1) (2) (4) (5) (6).

(b) I approve [illegible] of Scheme No. 7 as modified by Mr. Ham.

(c) If this is thrown out then I approve [illegible] Scheme No. 4.

(d) If a [illegible] [illegible] is required for Scheme No. [illegible] then I suggest securing the services of Mr. [illegible] (certificates attached). His father was in the [illegible] in Berar for several years with me, and bore an excellent character. [illegible] spent some time at the Thomason Engineering College Roorkee, has served on the Uganda Railway, passed in Kiswahili and Hindustani, been Town Engineer at [illegible] and is the kind of officer who would be able to [illegible] [illegible]. In my opinion this would be far preferable from [illegible] an Engineer out from England who [illegible] [illegible] this country, and as regards my own staff [illegible] [illegible] with reference to bringing an [illegible] out from home. This is unnecessary because Mr. Ham is quite capable of guiding the Engineer in charge, and I have had varied experience in the design, construction and maintenance of Water Works for many years [illegible] [illegible] [illegible] Mr. [illegible] for [illegible] a year [illegible] [illegible] [illegible] [illegible]

Temporary [illegible] [illegible] He sailed at [illegible] the other day from South Africa [illegible] has now gone to [illegible] to settle family affairs as [illegible] has lately died.

I am aware that pipe water supplies have waterlogged the soils of many Towns in India and that vast sums are being spent and will be spent in order to drain them, but with reference to the soil of Mombasa getting waterlogged I do not think this is likely because of the coral rock which dries quicker than any formation I ever saw, and absorbs impurities with avidity. On these points however the Hon'ble the Principal Medical Officer could give an opinion, if he has not already done so.

As regards private enterprize I think that it is utterly unsuitable to African Countries, and I should prefer the water supply being carried out by the [illegible] Municipality if one could be found. [illegible] regard [illegible] the present cost [illegible] is great, and the quality of [illegible] all the Races would gladly pay for pure water [illegible] no matter in what form the dues were levied. In the East a gravitation water supply is always a large source of revenue to a Town, and it would be a pity to throw away this income by allowing a Private Co. to enjoy it. I believe a private water supply was laid on at Bulawayo, but it proved a burden on the ratepayers and subsequently had to be bought out at great cost by the Municipality.

I regret the delay in answering His Excellency's minute of 10/4/08 [illegible] was due to my tour [illegible] the Secretary, [illegible]

[illegible]

DRAFT

F. N. Gibbs Esq.

MINUTE. 24/7

Mr Noall 27/7

Mr Read. 27/7

Mr Just.

Mr Antrobus.

Mr Cox.

Sir C. Lucas.

Sir F. Hopwood.

Mr Churchill.

The Earl of Elgin.

Sir,

I am d[illegible]

of Crewe t[illegible]

continuation [illegible]

this Office [illegible]

that a desk [illegible]

recd. from the [illegible] the

E.A. enclosing [illegible]

reports relating to the [illegible]

of the [illegible] supply for

[illegible]