

EAST AFRICA
No. 3827

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REC'D 50 JAN 07

Name of Institution

Name of Country

(Subject)

1907

Report on Sanitation of Nairobi

Year of issue

of previous issues

Transmit 2 copies of

(Minutes)

H. Johnston

In 1902 there was an outbreak of plague in the Indian bazaar (trading quarter) of Nairobi causing about 50 deaths. In order to stamp it out the bazaar was burnt down. The total expense entailed on the Government was £23,000.

In 1905-6 there were three outbreaks of the same disease resulting in 25 deaths. The Commissioner then asked us to send out a sanitary engineer to advise the Officer of the Local Government Board selected Mr. Williams to undertake this work. He returned on the 10th inst. about 4.30 p.m. and his report which strikes me as a clear and able judgment is before us.

X 5/11/07
H. Johnston

A summary of the recommendations is given
on pp. 88 & 89 of the Report.

The following are the following items:

Sewering	66,000
Drainage	18,400
Laying out New Roads & Park.	18,600
New Water Supply.	24,600
Other Works.	4,000

Total £115,000

This does not include anything for compensation for land and buildings taken over or in particular for the removal of the Indian Reserves for which no estimate is given. Mr. Williams considers that the cost of such compensation should be borne by the Protectorate Government as the municipality ought not to be saddled with the cost of past mistakes of the Government in laying out the town.

As regards the £115,000 Mr. Williams proposes that there should be spent in

1907	53,000
1908	50,000
1909	12,000

Total £115,000

This sum would have been supplied in the first place by the Protectorate Government, but Mr. Williams proposes to meet the greater part of these charges for the next few years from the revenues of the town.

With this we have proposed.

- (a) To rate Railway property in the town and estimate its annual value at £8000
- (b) To rate Government officials' houses at their full value instead of at preferential rates.
- (c) To surrender to the municipality the rents from Government workshops.
- (d) To give the water rates (enhanced owing to new supply) to the municipality.
- (e) To balance sheet of the town on these lines for 1910 is:-

Income	Expenditure
Rates 2,800	Conservancy & Sewerage
Fees, Licenses 1,000	Roads, Buildings, Drains, Waterworks
Rents 2,800	Scholarships Office Expenses 2,000
Deficit 1,385	Interest on loan 31,000
£10,385	Balance in 24 yrs. 2,385
	£10,385

He points out that this deficit might be converted into a balance if the rate were raised from 10 to 20. He deprecates this step, but I think there is something to be said for it. The white community is extremely expensive and at present contributes little or nothing in direct taxation to the central Government. I would also rate land as well as buildings in order to discourage speculators holding up land.

Mr Williams has stated that the rate should be 10 to 15 per cent.

He advises that the management of the town should be left to the Protectorate Government for practical purposes, but there is a subsidiary body should be handed over to a committee mainly consisting of British people who will manage the town until

It was for a representative of the Government and I understand that a Bill for this purpose has been drafted and is on the way to us.

If however, as I understand is the case, no large sum of money will be available this year (1907-8) for the sanitation of Nairobi, the discussion of the report is more or less academic.

It is right to point out that by declining to ask the Treasury for the sum Mr. Williams deems necessary we incur a considerable responsibility.

See p.92 of the report where Mr. Williams says "Plague has already made its appearance, there is no reason why the next epidemic should not be of a much more virulent and infectious type"

"If an epidemic of typhoid should break out the conditions lead one to suppose that there would be no limit to its ravages".

Without incurring any large expenditure new legislation for example emp. 25 to 28 might be brought into force. Also the Indian towns might be rendered much less insanitary by compelling the owners to provide large cess-pools, (See p. 145 & 17) and then regularly emptying them as in German towns by means of a portable engine which goes along the street and is provided with a pump which is connected with the various cess-pools by a flexible pipe carried through the house to the rear of the premises. Thus the cess-pools will be thoroughly evacuated with the least possible nuisance.

*an important
to refer to
in some
places
1/22*

(H.M.S. G.P.S.)

*In his memorial on the sanitation
(1196) Lord Byron wrote "Upon
not quite chary about the business"*

of Madeira - it is not satisfactory
 to find it contradictory when
 there is a growing white population
 Col. Sutter did not take any
 definite [objection] to the pro-
 posals above - with wh. I presume
 he was acquainted - but he evidently
 feels even less to at least make
 a beginning with the drainage
 scheme. If money cannot be
 found this year I think he
 might be advised to reserve his
 scheme with a view to a more
 adequate beginning next year.

M. G. J.

W. Patterson. See further remarks on the
 Journal Estimate. ($\frac{Ann}{1196} 106-7$)
 This is a excellent report & we
 ought to thank Mr. Williams, when not
 it is not. ~~And as the report is so good~~
~~and as the report is so good~~
~~and as the report is so good~~
 I talk with Col. Sutter & Mr. Williams with
 view to seeing how far the work can be
 carried out present or which portion of it
 is the most pressing. It seems clear that
 the work can be speed up 5 or 6 years &
 that the most pressing portions of it are
 the construction of the main drainage

in Appendix I

of the cost of the farm & estimated at
 about £12,000 (including the cost of
 detailed plans &c) & with another £5,000
 a beginning could be made with the removal
 of the Indian. Bagnard. At the same time
 the death-rate among the Europeans is only
 14.5 per 1000, among the Africans 25.4 per 1000
 & among the Quakers 29 per 1000. This is
 but a desperate state of affairs & I
 think that we might very well then
 for Col. Sutter the responsibility of paying
 whether £20,000 is more urgently required
 for the settlement of Madeira or the
 removal of the Indians & the debt to
 Madeira - See minutes - ~~11/10/18~~

H. G. J.

331

MR. GRANBY WILLIAMS
CIVIL ENGINEER
100, 100 WESTMINSTER.

39, VICTORIA STREET,
WESTMINSTER,

S.W.

January 29th 1907.

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

3327

JAN 30 1907

I have the honour to enclose
with two copies of my report on the
situation of Nairobi, and am sending under
separate cover two prints of each of the
drawings accompanying it.

I have the honour to be,

Sir,

Your obedient servant,

Granby Williams

3827

RECEIVED 30 JAN 07

BRITISH EAST AFRICA PROTECTORATE

REPORT

on the

SANITATION OF NAIROBI.

by

GEORGE BRANSHY WILLIAMS. A.M.I.C.E., A.M.I.N.E., A.M.I.E.E. &c.

Jan. 28th. 1907

THE SANITATION OF NAIROBI.

39, Victoria Street,

Westminster, S.W.

28th, January, 1907.

To the Right Honorable
The Earl of Elgin and Kincardine, K.G.
Secretary of State for the Colonies.

My Lord,

In accordance with instructions received from your Lordship to report on the sanitary condition of the town of Nairobi, in the British East Africa Protectorate, I left England on the 4th July last and arrived in Nairobi on the 31st. of that month.

On my arrival, the absence of any complete and accurate map of Nairobi necessitated my undertaking some extensive survey work in the town and its environs. The Native Authorities and the Survey Department further put themselves to provide me with a number of plans which formed the basis of this work; and the Survey Department further put themselves to considerable inconvenience in order to allow me to have the services of a competent surveyor, who undertook the work of surveying and leveling a large part of the town, and whose assistance was of the greatest value. The Public Works Surveyors also afforded me useful help.

These and other necessary preliminaries were completed by the middle of October. I then received instructions from H. M. Commissioner to make supplementary reports on the townships of Nairasha, Nakuru, and Kisumu. My visits to these places and finally a short stay at Mombasa, where a report was required on a proposal to drain the Kibungwe

and August 1895, necessitated by remaining an additional six weeks in East Africa, so that I did not return to England until the 1st. of January.

SECTION 14

INTRODUCTORY

GEOGRAPHICAL POSITION AND CLIMATE OF NAIROBI.

Geographical
Position of
Nairobi.

The town of Nairobi is situated on the Uganda Railway, 82 miles from Mombasa, and 257 miles from Kisumu the terminus of the railway on the Victoria Nyanza. The height above sea level is about 5000 feet, the highest levels within the township varying from 4900 feet to 5000 feet.

Climate.

The climate is suitable for Europeans. The maximum shade temperature in the day time hardly ever exceeds 65° F, and is seldom lower than 60°. The minimum night temperature is occasionally as low as 40° F, and very rarely 32° F, whilst in the warmest weather the night temperature of pure air is very uncommon. The average diurnal range of shade temperature is about 25° F - 30° F, but the average range in the Sun, which is very powerful at times, is much greater.

Statistics of the rainfall are given in appendix III. As far as can be judged from the comparatively short time during which the records have been kept, the mean annual rainfall is about 40 inches. It is not evenly distributed throughout the year. There is a short dry period at the commencement of the year and a longer one between June and

October. The heaviest rains take place between February and May and there is a second shorter wet season towards the close of the year.

EARLY HISTORY.

The town owes its existence to the fact that it is situated at the point where the Uganda Railway leaves the comparatively level Atai Plains and commences the long climb up the Kikuyu hills, and that it is approximately half way between Mombasa and the Victoria Nyanza. The site is a convenient one for railway buildings, work shops, sidings, etc., whilst hills adjacent suitable for the erection of bungalows for the railway officials, and is also central and well situated from the point of view of railway management; it was therefore early determined to make it the head quarters of the line. A commencement was made with the erection of the buildings as soon as the railhead arrived there, in June 1899. Directly afterwards the administration of the province of Ukamba was transferred from Machakos, so that the history of Nairobi may be considered to begin from that time.

The Railway Authorities proceeded to erect the Station, Workshops, Officials' bungalows and subordinates quarters on the sites they now occupy, whilst the original intention was to lay out the official portion of the town on the north bank of the river Nairobi. Some Government offices and the military lines were erected alongside the Ngara Road, but after the discovery of a large number of the larvae of Anopheles Mosquitoes in the swamp below, the site was pronounced unhealthy by the Medical Authorities.

Official
quarters
transferred
across the
river

Municipal
Committee
appointed

First Plague
Epidemic

Question of
Stability
of Site

Series of
Reports on
Site
Questions

4 336
It was in consequence decided by the Administration to emigrate across the river, and during 1900 a new town was laid out on the south-west side.

In 1901 the town was considered of sufficient importance to entitle it to a Municipal Committee; this was constituted and the administration of the town partially handed over to it by the ordinance of December 1st, 1901.

EPIDEMIC OF PLAGUE OF 1902.

At the commencement of 1902 an epidemic of plague broke out in the bazaar. There were apparently sixty-nine cases and, I am informed between fifty and sixty deaths. Energetic measures were taken to combat the disease, the whole of the Indian Bazaar being burnt down and the population removed to a plague quarantine camp. The epidemic was finally stamped out and the Government were left to pay of somewhat heavy bill for compensation and the other expenses amounting to about £25,000 in all.

REPORTS ON THE SITE OF THE TOWN BETWEEN 1902 AND 1906.

The occurrence of so severe an epidemic in a town just over two years old appears to have caused some misgivings in the minds of the authorities as to whether the site of the town had been wisely chosen.

Sir Charles Eliot, at that time the Commissioner, accordingly requested the five medical men then in Nairobi to report on the sanitary aspect of the site.

This report is the first of a series dealing with the question of the site of the town, and other sanitary matters, which made their appearance between April 1902 and March 1906. Your Lordship has had

copies of these reports sent you by His Excellency the Commissioner with his covering despatch dated May 18th. 1906. In this despatch the whole series is reviewed so fully that it is unnecessary for me to do more than refer to them very briefly.

Report of the Five Doctors.

The five doctors in their report unanimously condemned the site of the town and recommended its removal to the high ground behind the official quarters; they suggested a scheme of drainage as an alternative to the removal, stating at the same time that the alternative would not be in their opinion nearly so satisfactory.

Railway Authorities disagree with

Although these suggestions appear to have met with the approval of the Commissioner and other Protectorate Officials, they were not endorsed by the Railway Authorities. A large expenditure of money having been just previously made by them on the railways in the plain, it was perhaps not surprising that they objected to a fresh outlay on an extensive removal to a site which would, from their point of view, have been much less convenient.

Recommendation of Sites Board 1902.

The Railway Authorities appeared to have carried the day in the meeting of a board called together in May 1902, to consider the question of sites, for it was decided to let the Railway quarters remain where they were and to drain them. It was decided however to move the military lines to the site on the hill they now occupy and it was further announced that there was only one possible site for the bazaar. That site is nevertheless still occupied by the Government offices and the bazaar has been erected elsewhere. Other recommendations were also made, some of which have been carried out.

Medical Authorities un-
satisfactorily ac-
cording to post.

The subsequent reports show that the Medical Authorities continued to be dissatisfied with the site but

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Recommendation of the Five Doctors

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usually so
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by the middle of the year 1903 they appear to have accepted the fact that it was too late to move the town. In May of that year Dr. Moffat the P.M.O. submitted a report in which he made various recommendations with regard to the disposal of night soil and refuse, water supply, drainage, and other sanitary matters.

Major Pringle's report.

Major Pringle in his report of October 31st. 1903 on the Uganda Railway reopened the question of removal and recommended that a new site for a town should be selected from one to three miles from the present one; and that a gradual transfer should be made. In the meantime he recommended a scheme of drainage for the Railway subordinate quarters. He considered that a sum of 24,000 would be sufficient to cover these works; an exceedingly low estimate.

On the other hand Major (now Lieut. Col.) Will R. Moffat P.M.O. in 1904 reported on the town and gave as his opinion that it was too late to move it. He made certain recommendations with regard to drainage and other sanitary matters.

Mr. Currie the General Manager of the Uganda Railway reported at the same time; he recommended that the existing position of the town should be accepted, but that a site at end of Railway Hill should be reserved for additional houses, when required for those of the railway staff who could without inconvenience be put some distance from the rest.

The final report of the series is by Dr. A.D. Milne Acting P.M.O. which deals with the present condition of Nairobi. The writer appears to consider the question of removal as being practically settled and does not refer to it.

SCHEMES FOR REARRANGEMENT OF TOWN; PROPOSED NEW
EUROPEAN TOWNSHIP.

Want of a
definite
scheme for
laying out
the town-
ship.

It appears that since Major Pringle's report at the end of 1903, the official opinion has regarded the question of the removal of the whole of Nairobi town to another site as outside the bounds of practical politics, the intention being to endeavour to make the best of what has undoubtedly been considered to be a bad job. Although this has been the generally accepted view, there has been no agreement as to how the town should be laid out nor where the official and business quarters should be situated; whilst the question as to the best position for the new Government Offices has given rise to much difference of opinion.

Mr. Ross's
Scheme

The only comprehensive scheme for laying out the town, which, as far as I am aware, has been evolved by one, is that put forward by Mr. W.M. Ross, the Director of Public Works, in September of last year. The plan illustrating this scheme shows a town with a central boulevard of great width, and diagonal cross roads intersecting in piazzas. The scheme, which would have necessitated wholesale interference with private property, was not finally accepted by the Government.

Mr. Ross's
Views.

Mr. Ross took what was perhaps a somewhat exaggerated view of the defects in the present arrangement of Nairobi, and this led him to consider that he would not be justified in permitting money to be expended in making roads, drains, and other public works in the town until a commencement had been made to lay it out on more sanitary lines.

Condition of
streets in
last season.

This policy to some extent assisted in producing a most satisfactory state of things at Nairobi in the

300

earlier part of 1906. The rainfall was rather exceptionally heavy, and combined with the unrepaired condition of the roads, the lack of any proper drainage; the rapid growth of traffic, especially the increasing number of bullock waggons, carrying heavy loads on narrow tired wheels; and the nature of the soil and subsoil, made the streets practically impassable quagmires, so that people sank up to their knees in crossing the roads and vehicular traffic was almost stopped.

The wet weather also aggravated the unsanitary condition of the sewer and other parts of the town, and coincided with a second epidemic of plague, which although less serious than the epidemic of 1902 was still sufficiently so to cause considerable uneasiness.

Under these circumstances it is not surprising that an idea became to a certain extent prevalent that the present site of Nairobi was a hopelessly unsanitary one, and that even if it were too late to move the railway town and the town, it might still be advisable and even necessary to remove the European inhabitants to some site on the neighbouring hills.

At this time Mr. J. E. Hogan, who is a large landowner in the Protectorate and possesses an estate in the neighborhood of Nairobi came forward with a scheme for laying out a new European town on his land some two miles to the north west of the existing town, to which he proposed to attract the European inhabitants by offering a certain number of plots at very low or nominal rentals. He approached the government with a view to getting cooperation in his scheme, which appeared to him to offer the best way out of afflictions from which the inhabitants of the town were suffering.

On my arrival I found that the town had returned to its normal sanitary condition, but uncertainty existed as to the future and an opinion was still expressed in certain quarters that a removal of the white population offered the only possibility of a satisfactory solution of the various difficulties.

SECTION II

PRESENT SANITARY CONDITION OF NAIROBI

PRELIMINARY IMPRESSIONS

Accompanied by Dr. V.J. Radford, the Medical Officer of Health, I spent several days immediately after my arrival in making a detailed examination of every part of Nairobi. I found during my progress very little with which from a sanitary point of view, it is possible to express any qualified satisfaction, and that it is necessary to emphasize some things that can only be considered a danger to the health of the community.

In this part of my Report I intend to confine myself as far as possible to describing the condition of the town and its suburbs as it exists, reserving the question of remedies to a subsequent portion. I shall only refer except through the name of some letters which it will be more convenient to deal with fully at once, and which have little or no bearing on the larger questions discussed later.

AREA, POPULATION, & DENSITY RATE

The municipality of Nairobi is bounded by a imaginary circle of 1 1/2 miles radius, described from a centre in Dover Street Four opposite the Sub-Commissioner's Office. The area enclosed is 7 square miles but the suburbs extend in several directions outside the boundary; the total land covered would amply suffice for a town of 50,000 to 70,000 inhabitants and is far more than is likely to be required for many years.

The population of the municipal area was estimated at the time of my arrival at 4737, the number of Europeans and Europeans being supposed to be 347.

Caucases 215, Indians 1710, and Africans 2246. I felt some doubt as to the accuracy of these figures for the number of Africans appeared to be small in proportion to the number of Europeans and Indians. My doubts were justified by the result of a census taken in November last.

1866

The figures for this census are given in Appendix I, Table E. The total population enumerated was 13374, the Europeans and Eurasians being 342, Gdangas 610, Indians 3071, and Africans 2951. This total included 2092 persons in the military lines which are not in the municipal area. On the other hand it is supposed that several hundred Indians and Africans escaped enumeration, owing to a well founded impression in the bazaar that the question of the serious overpricing there was likely to be taken in hand after the results of the census were known. Several hundreds of the inhabitants of that portion of the town are reported to have departed from the country for the night of the census, and not to have returned until the next day. It is probable that the actual population of the municipal area proper is about 12000 persons.

Table F.

The town would be, if given a fair chance, naturally a healthy one. In appendix II are given two tables showing the death rate for the first nine months of the year, the only period for which really reliable returns have so far been compiled. From these, which cover the most unhealthy season of the year, it appears that the deaths amongst the whole population were at the rate of 22.0 per 1000 per annum. Amongst Indians the rate was 29.0 Africans 26.4 Europeans 14.8. It is of course necessary to take into consideration the fact that the number of young

children and old people is proportionately small, on the other hand many deaths occurred amongst persons who had contracted diseases in other, more unhealthy parts of the Protectorate, and had been sent to the Hospital in Nairobi.

During the early part of the year there was an epidemic of plague, which accounted for 26 deaths. On the whole the returns may, under the circumstances, be considered fairly satisfactory.

SANITARY CONDITION OF CENTRAL AREA.

The main street of the town is a long straggling road commencing at the railway station and leading to the Ainsworth Bridge on the north side of the town, continuing thence into the suburb of Parklands.

Station Road forms the first portion and Government Road the further portion of this main street. A new street runs parallel with Station Road for a distance of some 500 yards, finally bending round and forming a junction with it at the point where Government Road commences. Some cross roads branch off on the north east side of Victoria Street and Government Road and lead to the first end of the Bascooree Bridge over the River, one of these being Market Road. The branch roads are for the most part still unmetalled, but small houses are rapidly springing up alongside them. These streets form with the Indian bazaar, which is situated on the south west side of Government Road opposite the junction of Market Road, the business quarter of Nairobi.

The present temporary Government Offices, Police Lines and Gaol, the Civil Hospital, the Town Hall, the

... principal hotels
 ... Government
 ... office with some shops and
 ... Victoria Street, the National
 Bank of India occupies a site between Station Road
 and Victoria Street.

Generally speaking the buildings are of an inferior
 description, the majority being of the corrugated iron
 type. Of late there
 has been in some cases an improvement in the architectur-
 al quality, and one of two buildings, notably the new
 ... are well and substantially built
 of stone with tiled roofs.

The several temporary Government offices are for
 the most part the most decrepit looking structures

possible. The Sub-commissioner of Uganda
 District, the District Collector and Sub-collector of Masobi
 District, the District Veterinary Officer, the Commissioner
 of Lands, the District Surveyor, the Land Officer, the
 District Officer, and the Government Bacteriologist, with
 their whole staff of clerks and subordinates carry on their
 work in these corrugated iron sheds, which appear to be
 overcrowded and as inconveniently arranged as possible.
 The sanitary arrangements are very defective. At the time
 of my visit I inspected one block reserved for the offi-
 cials in the whole of the offices, about 30 in number, one
 for 10 or 20 clerks, and one for a large number of native
 orderlies, porters, police, etc.

These animals are brought daily for inspection to the
 District Veterinary Officer's Yard, which is unpaved and ungrain-
 ed. At the back of his office are a number of cages in-
 which animals are confined suffering from various diseases.

Police Lines

of disease, either inoculated or natural. The Police Lines and Gaol are shortly to be removed from their present site in Government Road to a position near the new native location. In the meantime their condition is highly unsanitary. The only drainage consists of badly dug trenches which after following tortuous courses finally discharge latrine effluent and slop water into the roadway at the back and on to the land near the Telegraph Store. Most offensive pools are formed in both places. The latrine accommodation is insufficient both for the police and for the gaol. There is no guttering or downspouting of the buildings, and the unpaved central square, which must be in a fearful condition in wet weather, is kept wet and muddy even in the dry season by the water continually running from the stand pipe to the centre.

Civil Native Hospital

The Civil Native Hospital is on the opposite side of the road. The main buildings are constructed with galvanized corrugated iron walls and roofs, and wooden floors, the whole being raised some 2 or 3 feet above the ground on wooden posts.

The ward in which I was informed plague patients had been treated is only thinly partitioned from the receiving room. The rain water from the roof and the effluent from the latrines is conveyed by a cement channel to a point at the back where it discharges into the open, about 30 yards from the irrigation channel, which at this place runs parallel to Government Road. Into this channel the drainage finally soaks. The post mortem room has no drainage of any kind.

The hospital was constructed some three or four years ago and was condemned from the outset by the medical authorities.

14

authorities as being hopelessly insanitary.

Some distance along Government Road in the direction of Parklands from the civil hospital, on the same side of the road, is the Norfolk Hotel, the chief hotel of the town. It is a one storied stone building with round an internal courtyard, the latrines, urinals and bath rooms being at the end of this courtyard furthest from the road. There is no proper outlet for the drainage from the hotel; the latrine and bath room effluent runs along a stone channel until they find their way into a pool of foul smelling liquid. The drain from the kitchen after passing under the windows of several bedrooms ends in a similar manner.

Extensive clothes washing operations appear to go on at the back and aggravate the surrounding insanitary conditions. The irrigation canal is the final recipient of all the drainage from the hotel which is not evaporated or absorbed on the way.

Generally speaking the sanitary arrangements in the houses in Government Road are very unsatisfactory; there are no drains in the back streets behind them, the slop water and roof water are in some cases conveyed by open channels discharging into the side drains in the main street, but in others the drainage simply flows on to the ground adjoining. House refuse of all kinds is scattered about and lies in unwholesome festering heaps.

The houses in the Victoria Street district are also defective from a sanitary point of view. Several of the plots seem to be almost entirely built over, much too little internal courtyard space being left in consequence. A stone drain runs down the back street and carries away the effluent from the latrines and the bathrooms.

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15

The drains along Government Road and Victoria Street were constructed some three or four years ago. It was apparently impossible at that time to obtain the assistance of any engineer to design them or to superintend their construction, and the amount of money allowed was altogether inadequate. The result is that the drains are badly designed, badly constructed of inferior material, and laid to insufficient gradients. The shape of the cross section is wrong, being rectangular with a flat invert, they are incapable of carrying off the storm water in wet weather or of giving anything like a sufficient velocity to the sewage in dry weather. In fact they are worse than useless except as instructive examples of the results of false economy in engineering work.

At the time of my arrival the drain on the south west side of Government Road had no real outlet at all, but discharged on to a small piece of land between Station Road and Victoria Street. The drain on the opposite side of the Road ended in a small open marshy ditch, whence the water slowly made its way into the drain along Victoria Street; the latter discharges into the main outlet drain from the railway subordinate quarters.

After my arrival a connection was made between the Government Road drain and the railway drain along Station Road, and a relief drain is now in course of construction down the cross road leading from the bank towards the river. These works will make the flooding of the houses between Victoria Street and Station Road less inevitable than it would have been under the old arrangement.

INDIAN BAZAAR.

The Indian bazaar covers an area of land of nine acres on the west side of Government Road. There is one central main street and two back streets; a cross road roughly parallel

111 of Government Road forms the west boundary of the main part of the bazaar. A few off-shoots in the shape of some tumble-down shops, a few warehouses and a mosque have extended beyond these limits.

The shops, which are in the main street, the cross road, and along one side of the back street facing the gardens, are one storied buildings either built of brick or of corrugated iron, erected upon stone plinths raised some two or three feet above the ground. They are of the type common to Indian shops in the Protectorate, with open fronts, and are built in blocks of two or three with sanitary passages between each block. The fronts of the roofs are provided with guttering and downspout but the backs have none.

The back quarters of the bazaar consist of wretched buildings, chiefly of corrugated iron, intersected by labyrinthine lanes, passages and alleys. They constitute the most overcrowded, and unsanitary portion of the town; the Indian inhabitants having succeeded in reproducing here many of the features of the overcrowded and filthy of ancient oriental towns.

The courtyards and alleys are all unaved and are muddy on every possible occasion; the soil has doubtless been the recipient of filth and disease germs of various kinds. The back rooms are occupied by awlages and ledgers and are fearfully overcrowded, whilst the latrines, washing places, and kitchens, are filthy and unsanitary. The latrine accommodation is insufficient and the capacity of the buckets in them is too small to take the night soil, which owing to the custom of washing after defaecation instead of using paper, common amongst Asiatics, is generally largely diluted with water. The buckets overflow and the effluent goes out at the back in an offensive manner.

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The sewage from the houses consists of latrine effluent, slop water, water from the washing places, and in wet weather the rain water; it flows in some instances directly into the drains along the back streets, in others it is conveyed to them by connecting channels running down the passages between the plots; in a third method the latrines, kitchens, etc., discharge into open cemented cesspools. These cesspools are generally circular, of an average diameter of three feet, and a depth of about 3 feet 6 inches. They are too small to hold even the liquids flowing into them in dry weather, and in wet weather they overflow and flood the neighbouring properties with their noxious contents.

The main drains are of a slightly better type than those in Government Road but they are by no means satisfactory, have insufficient fall and can only be kept open by constant sweeping and flushing.

The main outfall drain flows along the South side of the Bazaar and, after crossing Government Road, crosses the main street, crosses Market Road and finally discharges into the irrigation canal.

Behind the Indian Bazaar is the Jevanias Market. This edifice is a pretentious terry-built imposture, which will probably collapse, or be blown down, in the course of a few years. The building is constructed of corrugated iron on a wooden framework, the paved stone floor being raised some feet above the ground. There is no guttaring, downspouting, or provision for removing the water which pours off the roof into the interior courtyard. As far as I could see little effort is being made by anyone to maintain the building in a state of repair, possibly because it is not considered worth the expense. The market, which is apparently larger than is required for present needs, contains stalls there meat and vegetables are sold. There are some stalls in the street in front of the market.

discharge into two small cesspools. One of these cesspools has an overflow into a neighbouring ditch. The other has no outlet at all and when full overflows on to the adjoining waste land where it forms a foul quagmire.

RAILWAY QUARTERS.

The railway subordinate quarters are situated on an area of between 40 and 50 acres between Station Road and the railway. The land has given much trouble owing to its waterlogged condition in the wet seasons. The bungalows are arranged in 6 rows with roads between; they are of unpainted corrugated iron, the general effect being by no means attractive. The plots have so far not been fenced off in any way and the occupiers of the houses have consequently taken very little interest in their gardens, the resulting general untidiness increasing the difficulty of draining the site properly. I am informed by the Manager of the railway that the work of fencing off the plots will shortly be taken in hand; this will certainly effect a very desirable improvement.

Each bungalow has its own kitchen and latrine. The latter have mud floors and are in many cases by no means as sanitary as they might be, the floors being frequently lower than the surrounding ground and impregnated with urine, while the buckets are surrounded by broken bottles and refuse of various kinds. A row of latrines of the Indian trough pattern were particularly filthy at the time of my visit. This type has been unsatisfactory in every example that I have examined and needs constant attention, which these were certainly not getting. In many of the houses the inmates appear to make use of inside night composts; a system which tends to

self to great abuse, especially in the smaller class-
es of houses.

A system of surface water drains is being construc-
ted in the subordinate quarters. The drains are V-
shaped, with masonry sides and cemented inverts. The
in some cases is not more than 1 in 400 which, although
enough to produce self cleansing velocities in wet wea-
ther, is insufficient in dry weather unless the drains
are frequently flushed and cleaned out.

The main outfall drain from the railway quarters runs
along the west side of Station Road then turns at
right angles and passing the end of Victoria Street fi-
nally ends in a swamp near the railway landfills. This
drain is of insufficient size to take the whole of the wa-
ter discharged by the drains from the railway quarters, so
that a portion of Station Road is liable to be flooded
during heavy rains.

The railway landfills are long corrugated iron
buildings built in two rows between the railway line and
the river. Their condition has been from time to time
the subject of discussion between the administration,
the railway and the medical authorities and various refer-
ences are made to them in the medical reports. A new
system of lime concrete drains has just been completed for
these landfills.

Concrete drains were constructed last year to re-
move the surface water from the railway station yard
and workshops and they appear to have successfully ac-
chieved their object.

DHOBI QUARTERS AND SLAUGHTER HOUSE.

The municipal dhobi quarters are situated on the
north east side of the river near the Nagalla Road.
The dhobis or washmen occupy the premises Government

self to great extent, especially in the smaller classes of houses.

A system of surface water drains is being constructed in the subordinate quarters. The drains are V-shaped, with masonry sides and cemented inverts. The slope in some cases is not more than 1 in 400 which, although enough to produce self-cleansing velocities in wet weather, is insufficient in dry weather unless the drains are frequently flushed and cleaned out.

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CHOBHI QUARTERS AND SLAUGHTER HOUSE.

The municipal Chobhi quarters are situated on the north-east side of the river near the Nagera Road.

The Chobhi or warehouses occupy the original Government

20
102
offices, constructed here before it was decided to move the town to the opposite side of the river; the old offices have been transferred into 24 one room dwellings for them. The buildings are in a dilapidated condition.

This place is a constant menace to the health of the town and has been condemned by the medical officers of health since 1901. The inhabitants appear to be unhealthy; deaths from pneumonia or malaria are frequent, and there has been at least one death from plague this year. The clothes are washed in an irrigation canal which is becoming increasingly liable to sewage contamination, the clean and dirty clothes are kept in the roads, and the inhabitants live, eat, and sleep amongst them, apparently occasionally making use of the clean clothes as bedding.

The rents paid for these rooms are high, and the dhobis have to pay for a license.

In the official Gazette of June 1st 1906 a set of rules for the regulations of laundries of all kinds was published. Several of these are being obviously and flagrantly transgressed in these municipal dhobi quarters.

The Slaughter House is on the same side of the river near the race course road. It is a small building and is only used for killing sheep, bullocks being slaughtered in the open. At the time of my visit it was in a clean and sanitary state. It is intended to construct a new slaughterhouse as soon as possible of sufficient size to enable both sheep and bullocks to be slaughtered.

21

NAIROBI SWAMP.

The low lying land between Ngara Road on the north east side of the river and the slopes below Government Road and Market Road on the south west side, was originally for the greater part a large papyrus swamp. This swamp was at first the cause for the first intended site of the official quarters being condemned as unhealthy. Since that time a policy has been adopted of letting the land on a lease under a condition that the papyrus should be cleared and the whole drained and cultivated as market gardens (or shambas as they are locally called). The result has been satisfactory. A fresh channel has been dug for the river in places, and irrigation channels have been formed along the slopes on the east side from which water is taken when required for the shambas below. There are two portions of the original papyrus swamp which are still uncleared, one near the race-course bridge, and the other near the Sub-commissioner's house. I understand that these swamps are both included in the land leased and the conditions prescribing their clearance and drainage should be strictly enforced.

That this has been done the shambas will not in my opinion constitute any great danger to the health of the town. The river for the greater part of the distance between Aikworths Bridge and Race Course Bridge flows with good velocity, although in a curiously irregular course, between banks several feet in depth. The gardens appear to be well and diligently cultivated and to yield good crops, and the irrigation is worked in such a manner as not to leave stagnant pools in which mosquitoes can breed. In the wet season the state of the water is probably

N A I R O B I S W A M P .

The low lying land between Ngara Road on the north east side of the River and the slopes below Government Road and Market Road on the south west side, was originally for the greater part a large papyrus swamp. This swamp was in fact the cause for the first intended site of the official quarters being condemned as unhealthy. Since that time a policy has been adopted of letting the land on a lease under a condition that the papyrus should be cleared and the whole drained and cultivated as market gardens (or shambas as they are locally called). The result has been satisfactory. A fresh channel has been dug for the river in places, and irrigation channels have been formed along the slopes on the east side from which water is taken when required for the shambas below. There are two portions of the original papyrus swamp which are still uncleared, one near the race-course bridge and the other near the Sub-commissioner's house. I understand that these swamps are both included in the land leased and the conditions prescribing their clearance and drainage should be strictly enforced. When this has been done the shambas will not in my opinion constitute any great danger to the health of the town. The river for the greater part of the distance between Ainsworths Bridge and Race Course Bridge flows with good velocity, although in a curiously irregular course, between banks several feet in depth. The gardens appear to be well and diligently cultivated and to yield good crops, and the irrigation is worked in such a manner as not to leave stagnant pools in which mosquitoes can breed. During the wet season the water on the shambas is probably

not so satisfactory, but I saw nothing during my stay in Nairobi which made me consider that it would be worth while at the present time reacquiring this land and embarking on a somewhat expensive scheme of forming a channel down the centre sufficiently large to carry away the river water in times of flood.

WESTERN VALLEY.

On the west side of the railway line there is a large area of waste land extending to the foot of the Nairobi and Protectorate hills, forming a shallow valley, through which a stream flows in general direction parallel to the Nairobi river. I have called this land the western valley as the stream flowing through it does not seem to have a name. During the wet season it is all one large impassable swamp, for the greater part of the year it is hard and dry, but there is always a flow of water in the stream, which forms several marshes and pools in which anopheles mosquito larvae can be found.

The stream is thus a distinctly greater danger to the health of the town, especially to the residential quarter on the adjoining hills, than the Nairobi river. It is formed by the junction of several small streams which flow down the valleys intersecting the hills on which the western suburbs are built.

SUBURBAN DISTRICTS.

The suburbs on the western hills contain the hangers on of most of the officials living in Nairobi. The soil is shallow and rock appears on the surface in many places (but trees grow well and gardens can be had).

In my opinion this district would certainly be the healthiest part of Nairobi if the mosquito breeding swamps below were got rid of.

On the north east side of the town there is a large suburban district of Parklands covering a series of small well-wooded hills and valleys, and consisting of bungalows generally surrounded by several acres of land each.

For towns of the age and size of Nairobi have suburbs naturally so pleasantly situated. There are not many either, in which the suburban houses are scattered about in such an irregular manner, extending over so large an area of land.

The uncertainty as to where Nairobi would be finally centered to some extent assisted in bringing this state of things about, for speculators have taken the opportunity of large suburban areas being left open, to purchase leases at low prices, in the hope that the centre of gravity of the town would finally move in their direction and increase the value of their holdings. Some leases have built houses on their land, but no sign is apparent of any attempt to build on many of the plots. There are thus suburban bungalows scattered about over several square miles. The result is a singularly inconvenient town and also an uneconomical one from the municipal point of view, for the cost of road making, water supply, and drainage is more than it would be if the population were more concentrated.

MILITARY LINES.

The military lines, although not within the municipal area, are to all intents and purposes part of the

town. The lines are built in a healthy situation on the southern end of the summit of Nairobi Hill. The 3rd. Battalion King's African Rifles occupy the permanent lines near the Dagoretti road whilst the 1st. Battalion occupy temporary lines further down the hill.

Lines of the 1st. Battalion K. A. R.

These latter consist of rows of round mud huts framed in jungle wood, built by the men themselves, whilst the officers quarters are of corrugated iron, and are in fact the same buildings which were first erected at Maseru, and subsequently removed.

The temporary lines are on a good slope and little difficulty should be experienced in keeping them sanitary during the next twelve months, which I understand is to be the period for which this Regiment is to remain in Nairobi. The latrines are open trenches on the opposite side of a small valley below the lines.

Third Battalion K. A. R.

The lines of the third K.A.R. consist of corrugated iron buildings placed round four sides of a square parade ground; on one side are the offices and behind these are the officers quarters and mess; the opposite side is taken up by the clerks quarters, hospital, and canteen, the two remaining sides being formed by the rows of long one-storied corrugated iron barracks.

Sanitary Arrangements

The sanitary arrangements are most unsatisfactory. The men's latrines are placed along the fence on the east side of the lines and the effluent flows into open trenches just outside it, where it stagnates and becomes an intolerable nuisance, whilst the ground near the trenches is becoming impregnated with decomposing filth. Rough trenches have been dug round the parade ground, with little or no fall; into these the waste water from several standpipes is discharged, forming at each place a puddle, which is replenished daily by the constant washing of clothes and utensils which takes place.

25

I was asked by Colonel Harrison D.S.O. officer commanding the 3rd King's African Rifles to make some suggestions as to measures for mitigating as far as possible the worst of the existing evils. I did so in a letter to him written on the 5th October last. The Public Works Department are now engaged in constructing a cemented drain to take the effluent from the latrines, which should improve matters at that end of the parade ground.

A complete system of cemented drains is necessary for the lines, including the officers' quarters and mess, where at present the slop water and bath water is stagnating in pools in a manner calculated to be both offensive and unhealthy. I suggested to Colonel Harrison that the whole of the sewage might be discharged into the gullies which run along the west side of the lines, but added that if this was done conditions might subsequently arise which would necessitate the military authorities purifying their sewage before discharging it into the stream. At the present time however there is no necessity for this, providing that the outfall is sufficiently far removed from the lines and a place is chosen for it where the flow of the stream is rapid.

INFLUENCE OF SOIL AND SUBSOIL ON THE SANITARY
CONDITIONS.

Even if Nairobi were singularly well situated with regard to the soil, subsoil, and natural drainage channels, the undrained and overcrowded conditions of parts of the town could not fail to make those districts unsanitary. As far as the central area is concerned, far from being well situated in these respects the town is in fact very unfavorably placed.

Geological formation

The geological substrata underlying Nairobi are in common with the greater part of East Africa, of volcanic origin, consisting of a series of tuff, lavas, and basalt, apparently lying directly on the archaean gneiss and schists which form the floor of the whole country.

Soil.

The subsoil in many places is formed by what is locally called *muram*, a compact concretionary iron-stone. In places the hard rocks come within a few inches of the surface of the ground, but in the western valley there is over a small area a depth of at least 16 feet of yellow clay.

Black Cotton Soil

The soil covering the whole of the plain is the "black cotton soil" frequently referred to in other reports. The term together with the name *muram* are both of Indian origin, but I do not know if they represent precisely the same formations as in that country or not. When dry this soil presents the appearance of a black friable loam, but it has some of the characteristics of both clay and peat, and great capacity for absorbing and retaining moisture.

Forest

The black cotton soil ends with singular abruptness at the foot of the suburban hills and its place is taken by the red *kikuyu* soil, which covers the whole of the forest area above Nairobi, and occasionally attains a thickness of many feet. The surface is generally covered with trees in places with dense forests and undergrowth. Its general appearance is that of a very fertile soil but I am informed by agricultural experts that it is somewhat deficient in phosphates.

The red soil is less retentive of moisture and drains more easily than the black cotton soil. There is no

21
doubt that it is a more healthy soil to live on than the latter.

The black cotton soil under the business and railway quarters varies in thickness from a few inches to three or four feet. It lies over a practically impervious subsoil and rock which offer little facilities for natural drainage of the subsoil water. Such drainage as there is however, together with the processes of evaporation and absorption, are sufficient in the course of the dry season to completely dry the soil, and large cracks then form which apparently extend down to the rock or mud below. When the rainy season commences the water flows down through these cracks and is absorbed by the soil, which thus forms a large reservoir and gradually fills up from below. In this way at the end of one or two weeks continuous rain the whole of the soil on the plains becomes a wet spongy boggy mass, across which it is impossible to walk.

It is at this part of the year that the conditions are most favourable to the outbreak of disease. A soil and subsoil in which the level of the surface of saturation is liable to considerable variation are more dangerous to health than if they were constantly waterlogged up to the same level. In the Nairobi soil there are great variations in the position of the surface of saturation, and this fact makes the outbreak of an epidemic in the badly drained insanitary areas more probable in the wet season than the dry.

The suburbs are better situated. Their natural drainage channels are well defined and the houses are for the greater part built on the sides of hills and on the red soil. The consequence is that although in wet weather the suburban roads are frequently very wet and muddy

the inconvenience never approaches that experienced by the inhabitants of the lower portion of the town.

EXISTING DRAINAGE AND SANITATION.

The drains in the various parts of the town have been described separately. With the exception of those constructed by the Railway Authorities it is hardly possible to retain any of them as part of a comprehensive and permanent scheme of drainage. It is only by frequent sweeping and flushing and constant supervision that most of the drains that do exist are prevented from becoming an intolerable nuisance to the houses which they are supposed to drain.

The conservancy of the town appears to be thoroughly carried out and causes very little offence to the inhabitants. The contents of the buckets in the latrines are emptied into closed wrought iron single or waggon; each cart containing about 70 gallons. The buckets are disinfected with Jeyes' fluid before being replaced in the latrines, and emptying is done between 4 P.M. and 6 A.M.

The night soil trenches are about a mile away from the nearest part of the town, on the south west side. The natural soil is a thin layer of black cotton soil overlying hard rock. The night soil was for some time buried in deep trenches, but this system has been abandoned and the trenches now dug are only about 9 inches deep. This is certainly the better method, but the night soil still decomposes with extraordinary slowness; I found in some of the trenches night soil which was still very offensive after being buried in this way for

very north. On the other hand, I was struck on my visit to the night soil trenches of the 3rd K.A.B. who bury their night soil in a separate place in the red Mikuyu loam, with the great rapidity with which it there lost its offensiveness.

Recommendations for improvement of night soil disposal.

I consider that the condition of the night soil trenches could be improved in the following manner. A top dressing of 5 to 9 inches of red soil should be spread over 5 or 6 acres of the present site. Arrangements could probably be made with the Railway authorities to allow the soil to be brought down by ballast trains from the hills and tipped alongside the line at the nearest point to the trenches. The soil would then be dug or ploughed into the ground and the whole area afterwards systematically trenched in succession; the night soil being tipped into shallow trenches, and a fresh trench opened adjacent and parallel to the one previously used as soon as that has been filled up. The ground should be subsequently cropped with suitable crops. I do not recommend that vegetables for human consumption should be grown on this land.

Recommendation for the use of night soil.

It was suggested to me that instead of turning the night soil it might be tipped into a septic tank and the effluent turned into the trenches. My experience of septic tanks leads me to suppose that in a remarkable short space of time the tank would be a solid mass of decomposing filth. I certainly do not recommend any such scheme being seriously considered.

Refuse.

The refuse is collected in open carts and deposited in large heaps near the night soil trenches; as much of the refuse as is easily combustible is burned and the

many months. On the other hand I was struck on my visit to the night soil trenches of the 3rd K.A.R. who bury their night soil in a separate place in the red Sikuyu loam, with the great rapidity with which it there lost its offensiveness.

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Septic tank
 for night soil

It was suggested to me that if possible even the night soil it might be tipped into a septic tank and the effluent turned into the trenches. My experience of septic tanks leads me to suppose that in a remarkably short space of time the tank would be a solid mass of decomposing filth. I certainly do not recommend any such scheme being seriously considered.

The refuse is collected in open carts and deposited in large heaps near the night soil trenches; as much as the refuse as is easily combustible is burned and the

rest accumulates. The refuse heap is in the direction of a prevailing wind and some complaints have been received of a nuisance being caused to the residential quarters, but I was unable to detect any during my stay in Nairobi. The quantity of refuse removed is said to be 14 tons per day. This figure is arrived at by taking the number of cart loads and assuming each load to be 10 cwt. I should say that this was possibly an excessive estimate but there is no question as to the amount removed being considerable. 14 tons a day is about one ton per 1000 inhabitants, which is above the average of an English town; three quarters of a ton being nearer the usual amount.

It has been proposed that a refuse destructor should be provided, and the idea appears to be that the refuse could be used for generating electricity. Before embarking on any such scheme it would be well to have an analysis of the Nairobi refuse in order to discover what the calorific value is. Of the average refuse from an English town over 50% is half burnt rubbish, breeze, and ashes, ingredients which are entirely absent from the refuse of Nairobi. It is questionable if the latter will be found of much value for the purpose suggested, and I do not consider it would be worth while installing an electric power generating plant to deal with the present amount of refuse. On the other hand if the quantity increases very much it may be found possible to do so in the future.

I recommend that the question of constructing a refuse destructor should be left in abeyance for the next two or three years for the following reasons.

(1). No serious nuisance or damage to health is being caused by the present method:

(2). The cost of refuse destructor is not

31

the present needs would probably not be the type that would be chosen for a town of 25,000 - 30,000 inhabitants.

(3). The next two or three years will give some idea as to how the town is going to develop and it will therefore at the end of that time be easier to estimate the advantages of trying to combine the destruction of refuse with the generation of electricity.

In making this recommendation I do not wish to suggest that the destruction of refuse would even now not be some benefit, whilst in future it may possibly become absolutely necessary.

The cost of the conservancy, removal of refuse, street cleaning, and scavenging is about £1200. per annum, including the salary of the sanitary inspector. For this sum in addition to the 14 tons of refuse of per day, the night soil is removed from 1033 buckets and 50 cesspits. The comparatively high cost, in comparison to that of similar work done in other towns is put down by the town clerk to a variety of causes, chief amongst which is the disproportionate area of the town to the number of inhabitants and the consequent distances that have to be traversed by the night soil carts. There is no doubt that this makes the work of conservancy much more expensive than it otherwise would be.

WATER SUPPLY.

Nairobi, compared with other places in the Protectorate is well situated so far as water supply is concerned. The water comes from some springs near Kikuyu Station, 13 miles away, which form one of the sources of the Nairobi river. They flow from the hill side at the bottom of a spur, about half a mile below the

31

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In making this recommendation I do not wish to suggest that the destruction of refuse would even now not be some benefit, whilst in future it may possibly become absolutely necessary.

Conservancy.
The cost of the conservancy, removal of refuse, street cleaning, and scavenging is about £1200. per annum, including the salary of the sanitary inspector. For this sum in addition to the 14 tons of refuse of per day, the night soil is removed from 1053 buckets and 50 cesspits. The comparatively high cost, in comparison to that of similar work done in other towns, is put down by the town clerk to a variety of causes, among which is the disproportionate area of the town to the number of inhabitants and the consequent distances that have to be traversed by the night soil carts. There is no doubt that this makes the cost of conservancy much more expensive than it otherwise would be.

WATER SUPPLY.

Water.
Nairobi, compared with other places in the Protectorate is well situated so far as water supply is concerned. The water comes from some springs near Rikuyu Station, 13 miles away, which form one of the sources of the Nairobi river. They flow from the hill side at the bottom of a rocky valley about half a mile below the

Station. The waterworks were constructed and are managed by the railway engineers. A small reservoir has been formed just below the spring by building a concrete dam across the valley; the supply main passes through the dam, provision being made for laying a second main when required.

The spring appears to have a deep seated origin and the flow is, I am informed, fairly constant throughout the year. I gauged this flow and found that at the time of my visit the total quantity of water coming from the spring was just under 1,000,000 gallons a day. This was after 3 months dry weather. I am of opinion that a supply of 800,000 gallons a day may be safely calculated on even in the driest years.

The level of the intake at Kikuyu reservoir is 6644 feet above sea level. The water is conveyed from here by a 5 inch pipe for a distance of 3 miles, at the end of this length the hydraulic gradient becomes steeper and the diameter of the main is reduced to 4 inches; the pipes are laid for the greater part of the way alongside the railway, and finally end at the service tank, situated on a hill placed on the summit of the hill near the railway lines, the top water level being 5891 feet above the sea. The main service tank is circular, 20 feet high and holds about 20,000 gallons. In addition there are four supplementary tanks in connection with the plant for a very elaborate system of water filtration, which holds about 40,000 gallons between

One history of this purification plant is rather curious. It was originally ordered on the strength of

analyses made by Messrs. Stanger & Mount, who described the water as being exceptionally impure. The plant has however never been used.

Subsequent analyses have given much better results. Two out of three samples submitted to Dr. Dupree were favourably reported on by him, the third having been apparently contaminated by an unclean cork. At a later date, Dr. P. W. Ross the Government Bacteriologist analysed the water with satisfactory results. In Appendix IV, the results are given of analyses of this water made for us by Mr. J. H. C. Johnson, which confirm the results previously obtained by Dr. Dupree and Dr. Ross. Dr. Johnson also analysed the water bacteriologically and was unable to find any bacteria of a harmful or suspicious nature. The results of these analyses leave little doubt that the Nairobi water is of a very fair quality, indeed, judging by the standard of a tropical country, a very good water, and certainly better than any other I have found in the Protectorate.

Quantity of water delivered to Nairobi.

When the main was first laid it had an overflow tank at Nairobi, a tank fixed about half way between the reservoir and Nairobi. The upper portion of the main as far as the tank having a much steeper hydraulic gradient than the lower nearer the town, was able to discharge much more water, so that about half the water brought down to the tank ran to waste there. A quantity of 77,000 gallons a day was delivered in Nairobi by this arrangement. The overflow has now been closed and the quantity delivered increased to about 150,000 gallons a day. It has hitherto not been possible to give the town the benefit of the whole of this water because the size of the distributing pipes, 24 inches for the most part, are much too small. During the day time the outflow from the service tanks

34
This water overflows and runs to waste.

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The railway authorities are now laying two new 4 inch distributing pipes to the town. When this is done the quantity of water obtained during the daytime will be increased, but the total supply will at the best be insufficient for present needs, and further works will be necessary to provide an increased supply. I will describe the works which I recommend should be undertaken in the next part of the report.

SUMMARY

Generally it may be said that the present town has grown up haphazard and that the arrangement of districts and streets has not been planned on any definite system. The population is not properly distributed and convenience of access from one part of the town to another has not been considered. The Indian bazaar is in an unsanitary state as to be a constant menace to the health of the public; and other parts of the town are in a very unsatisfactory condition; on the other hand the death rate is somewhat lower than might be expected. The soil on the plain is liable to be saturated with water in the wet season and when in that condition is a source of danger to the health of the town and as at times runs to waste almost invariably. The suburbs are better situated on a more healthy soil and are not so liable to be saturated with water. The drainage channels.

The climate is suitable for Europeans and malaria is not common but may become fatal unless some of the marshes are drained. The present system of drainage is to a large extent useless but the work of conservancy is well and thoroughly carried out, as is also the work of refuse removal and scavenging. A supply of pure water has been obtained, but an insufficient quantity is delivered in the town although a much larger quantity is obtainable at the source. There are other abuses which have been referred to and should be remedied as soon as possible.

SECTION III.

REMOVAL MEASURES AND NEW WORK

looked at from a purely sanitary point of view there is no doubt that more desirable sites for the town of Waipahi than the present one could have been chosen, but a number of shops and houses have now been erected and any extensive removal of the inhabitants could only be undertaken at great cost.

In order to justify reopening the question of removal, which during the last year or two has been considered settled by the large majority of the inhabitants some very serious reason must be shown.

It would undoubtedly be sufficient if it could be proved as has been suggested that the present town is in so hopelessly unsanitary a position and so badly laid out that nothing short of removal can ever put things right. An equally good reason for removal would be the discovery that the cost of draining the town and laying it out in a proper manner would be so great as to exceed the possible expenditure on removal and direct and indirect losses caused by leaving the present site. A third reason might be found if some financial advantage would be obtained by going elsewhere, sufficient to compensate for these expenditures and losses.

In my opinion there are no reasons sufficient to justify the question of even a partial removal being seriously considered, and I am convinced that the cost of any such proceeding at this stage would far outweigh any possible advantage that could be obtained.

Although from a sanitary point of view the position of the town in many ways leaves much to be desired, in this respect it still compares favourably with many towns throughout the world. There is in fact hardly

any example of the choice of a site for an important business centre being guided solely by sanitary reasons. Many such towns are situated in what are naturally most unhealthy places, in hollows, on the banks of sluggish rivers, on the sites of old marshes or below sea level, when other and healthier sites could be obtained in the neighbourhood. By proper drainage and sanitation these towns have been made healthy and the same process must be gone through at Nairobi.

The site in this case, like that of other towns was chosen for business reasons. The railway authorities selected it to suit their own convenience, because from their point of view it was a good site. The administration followed them because it was more convenient to be at the headquarters of the railway than 20 or 30 miles from the line. The business community preferred sites near the station to others two miles away on the top of a hill. Thus the town was developed on its present site in a perfectly natural manner.

The whole town can be drained by gravitation in such a way as to get rid of the present troubles. Apart from the difficulty of the subsoil and the large area over which the town has spread, it is an easy one to drain. That this is an advantage will be apparent on consideration of the very large number of towns that have to get rid of their sewage by pumping.

A misconception exists with regard to the town in this respect. It is often spoken of as being on an absolutely flat plain. This is by no means the case; every portion of the town has a sufficient fall for drainage purposes and it is only flat by comparison with the hill sides surrounding it.

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There is therefore no particular difficulty in reaching the present site; on the other hand I do not know of any place to which the town could be moved that would not require some form of drainage. If therefore, as has been proposed, the European temporarily were induced to emigrate and to build a new town elsewhere, the second town would require a drainage system, in addition to that necessary for the Indian and African inhabitants remaining on the present site. No possible economy could result from the substitution of two schemes of drainage for one, even supposing the cost of removing the inhabitants were nil. But the cost of removal would on the contrary be very large, unless the inhabitants could be induced to go voluntarily, a highly improbable contingency.

There is no doubt that it will be cheaper to drain the present town than to move its inhabitants. In addition the removal would entail other and heavier losses on the government in another way. The latter owns the whole of the land in the municipal area. Parts of it are already let, but the greater portion is still unlet. If the unlet land is gradually developed as a building estate and the town continues to increase in anything like the proportion it has done in the past, it will in a few years be a very valuable property. To destroy the future value of this land, or actually expending large sums of money in order to induce people to migrate on to the estates of neighbouring landowners, would be an extraordinary proceeding. I can only say that I can see absolutely no reason at the present time for such a move.

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Necessary future expenditure on public works

A considerable sum of money will undoubtedly have to be spent on public works in Nairobi in the near future. It has grown from nothing to a town of 12,000 inhabitants in seven years. It is still growing rapidly and is looked upon as the natural future capital, and the centre of the white population of the Protectorate. The money expended upon public works in the past has been altogether insufficient. The whole of the existing drains in the town outside the railway property appear to have cost only £1102 so that it is not surprising that they do not answer their purpose very well. Much leeway has to be left and still more provision made for future needs. As far as possible this expenditure should be arranged so that it not only improves the health and prosperity of the town but also increases the income derived by the government from direct and indirect sources.

SCHEME OF REARRANGEMENT FOR THE TOWN

Location of site of new Government offices referred to p. 39.

Immediately after my arrival in Nairobi, His Excellency the Commissioner informed me that the question of new Government offices was becoming acute and that the work of the Protectorate was being carried on under great inconvenience, owing to the lack of a proper accommodation. He requested me to let him know at the earliest moment, what I considered from an engineering and sanitary point of view would be the best site for the new offices which it was proposed to build.

Memorandum on a proposal for rearranging the

On the 1st of September I addressed a memorandum to the Commissioner of Lands in which I dealt with the whole question of the re-arrangement of the town and the site which it was proposed to

Government offices. The plan which is described has been subjected to some modification in order to suit objections on the part of the acting manager of the railway, but in most respects the arrangement shows the plan of the railwaying the Memorandum is practically identical with that of the plan attached. Drawing 1.

In Appendix 1. tables are given showing total population according to the census of the end of 1906, the increase in the population during the years 1904 - 1906, and the estimated future population at the end of each five year period from 1906 to 1926.

I estimate that the total population of the town in the latter year (exclusive of the military) will be 28,000. This figure is naturally to some extent a guess, for there are not sufficient statistics available to enable me to make an estimate based entirely on previous increases. Moreover the conditions may entirely alter in the future and it would not be possible to rely on figures obtained from previous years even if they were available.

The estimate of a population of 28,000 in 20 years time of whom 4800 are to be Europeans and Eurasians, is by no means an extravagant one. Nairobi is to be the centre of administration and the chief European town in a prosperous agricultural country.

For purposes of comparison I give some figures showing the population in other African towns. The population of Bloemfontein was given in 1905 as 2077 whites and 1302 natives or 3379 together. In 1905 the population was 45012 whites and 3,487 natives, and 48,500 natives or 52,000

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Memorandum with
plans attached
Nairobi &
elsewhere.

together and 28,545 without the troops. The population of Pretoria in 1904 was 36,700, 21,161 being whites; whilst Bulawayo mustered in 1904 a population of 3840 whites or only 1000 less than have given to Nairobi in 20 years time.

It is necessary to take some standard for the works I am about to recommend and for this purpose I have adopted the above estimate of the population in 20 years time. I consider this a sufficient length of time to look ahead in such a new country as British East Africa. The township shown on the plan is accordingly made out for a civilian population of 20,000 and there are directions in which expansion can easily take place should that number be exceeded. It is advantageous with a mixed population of Europeans, Africans, & Asiatics to segregate the different races in different quarters of the town as far as possible. Table A Appendix 1. shows a distribution of the various races making up the estimated 20,000 which is based to some extent on the number living in the various parts of the present town. This hypothetical distribution forms the basis of the plan of the proposed arrangement of the township, and the intention has been to arrange the town in such a way as to necessitate the minimum interference with land already leased to private owners.

The central idea is that the new Government offices should be placed in a park of about 150 acres formed by draining and planting the waste open spaces in the western valley referred to in Section II of the report.

The advantages of putting the offices in this position are many, amongst others:-

- (1). The land is under present conditions

useless and not likely to be required for building for many years.

(2). The streams and marshes in this area should be drained in any case on account of their effect on the health of the town, and the additional cost of draining the new main roads and the buildings will not be very great.

(3). By forming the land into a park and planting the greater part with gum trees, which grow very rapidly and abstract large quantities of water from the ground, the soil will be improved and dried to a great extent even without any drainage; it is obviously easier to plant trees than to make a large number of drains.

(4). The Government buildings will form a focus round which the business, official and mercantile offices and houses will group themselves, and because being in a convenient place, will cause considerable areas of unlet government land to greatly increase in value.

(5). There will be a tendency for the population to concentrate within reasonable distance of Government offices, thus an influence will be introduced tending to counteract the centrifugal forces, which have hitherto caused the suburbs to extend all over the country, and a more convenient and economical town will be formed. The position chosen gives the best opportunity for this influence to have full effect.

(6). The Government offices and park will form a great addition to the appearance of Nairobi, whilst the park will add to the healthiness of the town and will be a central lung on which private buildings will never be erected.

The soil here is the black cotton soil, the thickness being about 5 feet; the subsoil is yellow

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clay to a depth of at least 15 feet. Although this clay is a better foundation than is often available for buildings in other towns it is not so good as the rock or the muram which approach within a few feet of the surface of the ground in other parts of Nairobi. The concrete foundations will have to be somewhat broader and deeper than would have been the case if either of the other foundations had been build upon, and the cost of the buildings will be somewhat greater, but this disadvantage is outweighed by the other advantages of the site.

The Government offices are intended to be on the north side of a central square which is to be approached from the town side through a crescent with gardens on each side. The square is intersected at right angles by two main avenues 100 feet wide; diagonal roads 50 feet wide branch out from the western angles.

The street. The avenue crossing the park from west to east is continued across the railway line and then in the same straight line to Government Road, which it joins opposite the Town Hall. The part east of the railway will be the main street of the town, and the building sites along it will be exceptionally valuable. The new post office will be in this main street near the railway, and if thought fit, sites might be reserved in the square half way between the railway and Government Road for the library and assembly rooms which it is intended eventually to build.

Conditions as to building. I venture to suggest that it would be advisable to insert conditions into the leases of all lands let in this district insisting on the erection of good and substantial buildings of approved design and a certain value. It will certainly in the long run to do this even at the risk of a small

loss of income for a year or two for the best business firms who in the end be more willing to pay high rents and to erect good buildings if there is a certainty that their effect will not be subsequently spoiled by jerry built structures next door.

New European Business Quarter.

The land between Government Road and the railway will be cut up into blocks by wide cross streets and will become the chief European business quarter. Further sites will also be available between the cross avenue on the east side of the railway and the railway line which would be suitable for offices and banks. All this land should be covered of tiles of concrete tiles, etc.

SUGGESTED REMOVAL OF THE INDIAN BAZAAR

Recommend removal of the Indian Bazaar.

In order to make room for the European business quarter I strongly recommend that the Indian Bazaar should be moved to another site. I make this recommendation not only for sanitary reasons but because I consider that it would be a short sighted policy to allow the bazaar to remain where it is. I have already described the sanitary condition. How far the existing buildings have been built with the sanction of the authorities is not quite certain. There is no doubt that for some of the buildings at all events were sanctioned by the Sub-commissioner, but I do not find any evidence that permission was ever given for the greater part of the buildings at the bazaar which are such a nuisance at the present time.

Existing buildings should be pulled down and to

If the bazaar were to be allowed to remain as it is, certain sanitary works would have to be

and some necessary measures would have to be taken at the earliest opportunity to put a stop to the worst of the nuisance.

The following would be absolutely necessary:

- (1) - The insanitary back premises would have to be condemned and demolished.
- (2) - The present excessive over-crowding would have to be put a stop to.
- (3) - The courts and back areas would have to be paved.
- (4) - New and sufficient latrine accommodation would have to be provided in all the houses.
- (5) - A set system of drains would have to be laid. They would partly deep level sewers and the house connections which would have to be properly trapped & ventilated, would be expensive.

The cost of these works would be difficult to allocate between the Government and the Lessees and sublessors, probably some part would fall on each, but in what proportion it is not easy to say, having regard to the somewhat peculiar circumstances. It is certain that if the bazaar is to continue in the present position a considerable sum of money must be spent on it. Whatever amount would necessarily come out of the pockets of the owners should in all fairness be taken into consideration in assessing the compensation to be paid if the bazaar is compulsory acquired. On the other hand by acquiring the bazaar at once the government will save any outlay that they themselves would have had to make in making it less unsanitary.

It will be much cheaper in the long run to acquire the bazaar now than to allow it to remain where it is for the present and then to have to acquire it when a large sum of money has been spent on it, and the ground it stands on has been used in value.

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I believe that this time will certainly come, for not only does the bazaar occupy land that will be badly wanted for the European business quarter as the town increases, but as long as it remains where it is it will exercise a depreciating influence on the neighbouring land. In fact it will be quite impossible to erect a good class of houses on the property adjoining.

I suggest that a new Indian bazaar should be laid out on the land behind Victoria Street, between the buildings already erected there and the railway landings, extending on the north side to the new road from the bank to the race course bridge. The site offers advantages both from the sanitary and business point of view. The Government, with the exception of a small triangular strip in the centre, which would have to be acquired, and it can be easily drained.

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available

On the plan accompanying my original Memorandum I showed an area of 43 acres somewhat reduced. The railway authorities wished to keep the portion nearest the railway line in their hands for the construction of sidings, and I subsequently discovered that sanction had been given for the erection of a Goanese Institute, which has since been built on a strip of land at the northwest corner. This piece of land was not shown in the land office plans as having been alienated as I included it in my original plan of the new bazaar. The area available is now only 30 acres but this should be sufficient for the bazaar for many years, providing that it is confined to the legitimate occupants and not made a common lodging place for half the floating population of the island as at the present time.

part of a
committee
my proposals.

I recommend this course of acquiring the present bazaar and removing it to the new site in my memorandum of the 1st of September. A small committee was appointed to consider the financial aspect of this and other of my proposals. Unfortunately, owing presumably to my not having made myself sufficiently clear, the committee failed to understand certain parts of my memorandum, and their report therefore loses the value it might otherwise have had; they made a valuation of the Indian Bazaar and the estimate of the net cost of moving it. In my opinion this estimate is too low.

alternative
plans.

Whilst I feel strongly that it will be consequently much regretted if the present estimate of acquiring the bazaar is lost, I am aware that the opposite opinion is held by others that on account of the cost of acquiring it it will be better to put up with the nuisance of having it in its present position and to endeavour to make it as sanitary as possible.

Your Lordship may possibly decide that this is the better course, and much as I should regret such a decision, I am not prepared to say that the removal is an absolutely vital necessity to the existence of Nairobi. I have accordingly prepared a second plan (Drawing 2) showing an alternative arrangement of the town with the Indian bazaar on its present site.

No further expansion would in any case be allowed beyond its existing limits, so that a new Indian bazaar could still have to be laid out on the site already described. The hope in this case would be that the inconvenience of having two Indian bazaars would be more than counterbalanced by the advantages of the old bazaar. The hope in this case would be that the present course of the city might be preserved.

one, giving opportunity for the erection of a better class of house on the present site.

PROPOSED ARRANGEMENT OF NEW BAZAAR.

On Drawing 3 a plan shows a suggested arrangement of the buildings in the new bazaar. The plots are 90 feet by 54 feet with sanitary passages 8 feet between each. The plots are subdivided into half plots, on each of which a house, either one or two stories high would be erected. The ground floor of each house would be divided up into one large front-room to be used as a shop and two smaller back rooms. The upstairs rooms would be a chamber with a passage 4 feet wide between. Access would be obtained to the upper floor by an outside staircase behind. No room should be smaller than 10 feet by 10 feet by 8 feet high and the number of persons allowed to live in each room should be strictly limited.

The courtyards at the back should be entirely paved and cemented, and provided with proper drainage channels. There should in every case be a courtyard space free from any buildings or obstructions of not less than 300 square feet with a minimum width from the back of the buildings to the boundary fence of not less than 20 feet. No building used for sleeping in at night should be allowed in the courtyard.

The kitchens could be built in the centre of the yards, the latrines and washing places being placed at the angles of the fence. There should be one latrine for each family, and the buckets should be of a large square pattern. The ordinary pail is of quite insufficient capacity for the wants of an Indian family. The wooden seat is also quite unsuitable and quick to get impregnated with water. It would not be difficult to design a type of latrine which would be much more suitable and suitable for the Indian habits than those now used.

Attachment
of the
drawing

Fig.

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and which should not be very expensive.

The houses are shown fronting a main street with a 30 feet back street behind. Down the centre of this back street the foul water sewer is laid; a cast iron pipe is in my opinion necessary for this purpose. The house connections would consist of open channels running down the centre of the sanitary passages to an intercepting chamber, with which would be connected a ventilating shaft fixed to the side of the adjoining fence, carried up above the level of the highest window in the neighbourhood.

In every passage a water tap is fixed which can if necessary be used for washing down and sweeping from time to time.

At the head of each pipe sewer an automatic floating tank is fixed to hold two gallons, arranged to discharge two or three times a day. In the first instance there will be only two pipe sewers in the new bazaar so that the total quantity of water used by the tanks will only be 1200 gallons per day. This, together with the small quantity required for cleansing the sanitary passages can I think be spared even from the present water supply, in fact there is no question that it can be done if someone else goes short.

The foul water sewers will take its main water from the back yards, as well as the effluent from the latrines and washing places, and the slop water from the kitchens. The down spouting connecting the roof is connected with the surface water drainage in the middle of the main streets.

The houses themselves should be well built and would be far better if they could be all of stone and I think that all possible inducements should be put in the way of the owners to do so not only by giving them longer leases, as in

and even by raising the rent for a few years when stone houses are built. The masonry might be laid in mortar made of lime and red earth or even red mud alone providing the stones are properly dressed, bedded and bopped in, and that in the latter case the outside face is raked out and pointed in cement mortar, whilst the inside face could be either treated in the same way or properly plastered and lime washed. In my opinion it is far better to build the masonry properly in and in this way than to build in the usual manner in Nairobi. The Indian masons frequently dress the building stones wedge shape in such a manner that there is a great thickness of mortar filled in with a few spalls. Walls built in this way sometimes show signs of failure soon after they are finished, and there are many opportunities for internal flat runs.

Whatever the superstructure of the buildings, it is most important that the plinth should be well built. A badly constructed plinth is simply an invitation to rats to come in in numbers. The floor should be paved with stones, grouted in with cement mortar after the buildings are finished.

The stringent conditions attached to the construction of buildings in the bazaar may possibly have the effect of causing the income from rents from it to be somewhat reduced. The sanitary condition of the bazaar is of such importance to the town that there can be no question that such a sacrifice is amply justified.

At the same time thus many of the conditions I have suggested should I think be enforced in the case of all new buildings.

The first portion of the new bazaar should be erected on each side of the main thoroughfare, which it is intended should lead to the native location. Three rows of shops should be quite sufficient for present needs and a smaller number will be required in the first instance if it is decided to leave the existing bazaar where it is.

NATIVE LOCATION, INDIAN LANTERNS ETC.

The site of the new native location has been decided upon by the Sites Committee and has shown it in a position chosen. It is necessary that the land should be drained before any buildings are put upon it, for it is as wet as a sponge the wet season as it is possible to be. It is not quite clear who it is intended should erect the buildings in which the natives are to be housed, whether each department is to provide for its own natives or if the whole cost is to come upon the public works. There are in addition a number of natives in private employ for whom accommodation will have to be found. In the first instance buildings will have to be put up sufficient to house 5000 persons. I have not included any sum in my estimates either for these buildings or for the drainage and gas, but I understand that the Public Works Department had already gone into these questions before my arrival.

In my opinion the class of latrine required for the natives in the location is of the simplest form possible. A row of buckets in a concrete trench, which can be readily flushed from end to end, with arrangements for squatting on each side of the buckets would be quite sufficient, and would be far better than any attempt to imitate the European pattern. The native does not understand the latter

a road to the native village.

Indian Workman's
dwelling

Between the native location and the railway pro-
port. I have shown an area occupied by Indian workman's
dwellings or huts. It is very necessary, for almost all the skilled and partially
skilled labour in Nairobi is performed by Indians, and
these men are for the greater part now crowded together
in the bazaar. The erection of these buildings could
be left to private enterprise, being only permitted
under stringent conditions of the case of the bazaar.
The land is a profitable investment, as the
land is rather willing and the rent is good
being rather better than in any part of the
town. The land in this position is not very valuable
for any other class of buildings and could be let on
a cooperative, low rental for the purpose.

Police House

At the request of the Commissioners of Lands I have
shown a site for a Police house near the native location.
The Police lines and gaol are also to be built in this
district. The Police authorities consider the neigh-
bourhood of the native location to be the natural site
for their headquarters.

Highway

Several new roads are shown in the suburbs of
Nairobi and Protectorate hills. The roads are
built in line and generally following the natural
direction of the contours or along the valleys. The
most important of these is a new road to be laid down the
valley from the Hill station to the end of the main
road across the park. This will be a very useful
road and will be a valuable building land
and will constitute a much better gradient and
slope to the road from Ngongo and Bag-
erini for the purpose.

Other Sites

The remainder of the plan showing the proposed arrangement of the town does not need any special comment. Sites have been shown for various buildings, some of which will be required shortly, but others not for several years or possibly not at all; it will be well to reserve land for them whilst opportunities offer. These include a fire station, tramway depot, drill hall etc.

Municipal Reserve

An area of 200 acres below the town between the Jalrobi river and the railway is shown as municipal reserve. I understand that it is already decided to set apart 100 acres of land for this purpose. It only remains to fix the position and boundaries. The land shown on the plan will include the sewage outfall, night soil trenches, refuse heap, and includes also that can be set apart for future disposal works, refuse destructors, and other municipal buildings if required.

Government Subordinates

A site has also been set aside for government subordinate bungalows. The accommodation for the government subordinates is at present exceedingly limited and fresh bungalows are badly needed.

Government House

The new Government House has already been partly built. It will be conveniently situated with regard to the new Government offices and will be in a park of great natural beauty. Portions of the land will require such drainage and I am of opinion that it might be advisable to form the whole of the park land into ridges and furrows, the furrows running in the direction of the natural fall, with intercepting drains where required.

As I have stated in other parts of this report a system of drainage is absolutely necessary for Nairobi town. The sewers and drains should be capable of removing, as far as is practicable, the sewage, the surface water and the subsoil water.

In a tropical climate where the dry seasons alternate with the rainy seasons in more or less clearly defined periods, so that at one part of the year there are months with practically no rain, and in another frequent heavy downpours, there has been mention that if a town is to be properly drained it should be served on the separate system; that is, there should be a complete system of drains to take away the surface and subsoil water and another complete system to deal with the sewage proper. The size of the drains required to remove the surface water during the heavy rain of the wet season is so large that in dry weather the comparatively very small quantity of sewage, if conveyed through the same drains, would flow with such a low velocity that solids would be deposited, which unless they were constantly flushed away, would putrefy and become a nuisance.

In Nairobi a separate drainage system would be the ideal one, but the expense of laying two sets of drains would at the present time be prohibitive. It is however possible that the time may come when this more perfect method of drainage will be adopted. The drains, which I recommend should be constructed in the immediate future are arranged so that they can at a later time form part of a more complete system.

I propose that in the first instance arrangements should be made to remove the sewage in the surface water drains, and to overcome the trouble caused by the

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small flow in dry weather by allowing a certain quantity of flushing water to constantly run through them, diluting the sewage and increasing the quantity and consequently the velocity of the dry weather flow to such an extent as to prevent the deposit of solids.

The quantity of the dry weather sewage depends on the amount of water supplied to the parts of the town which are drained. In Nairobi the total consumption of water and consequently total daily volume of the sewage varies little from day to day throughout the dry season, but the actual rate of flow varies very considerably at different hours of the day, the greatest rate being probably soon after a rain storm. To judge the average flow the fresh flow hours, which is the middle of the night the flow is practically nil. Considering the water now wasted from the service tanks and that supplied to suburban houses, which would not be connected to the main drains, the daily quantity of sewage which it would be necessary to remove would not at the present time probably average more than 50,000 gallons per day at the outside, and the maximum flow would be at the rate of 80,000 gallons per day. There will however be a very large increase when an adequate water supply is laid on.

CHANGE IN
COMPOSITION
OF SEWAGE

The night soil is collected and removed separately, the sewage remaining to be dealt with is the slop water, which is derived from latrines, water from baths and washing places, and water which has been used for washing clothes and utensils.

Sewage of this nature can be run down open drains without causing any appreciable nuisance provided the volume is comparatively large, the sewage fairly dilute, and the velocity in the drains sufficient to keep them self cleansing. On the other hand open drains in the streets are quite unsuitable for drainage from water closets. At the present time there are no such

things as water closets in Nairobi, it is probable that the present system of conservancy will not be continued indefinitely, at any event in the central portion of the town, and there is little doubt that when the water supply is increased the better class of houses will prefer to adopt the water closets where possible. If the house connections are properly made and ventilated and the sewers well designed and constructed, the water closet system in a town of any size is the best, most economical, and the healthiest.

There may be three stages in the development of the sewerage system of Nairobi. First the disposal of night soil by the present system of conservancy—the liquid sewage being removed in the surface water drains and diluted by the flushing water. Secondly the provision in certain places of sewers to take the foul water only (including drainage from water closets) which for the time being will be connected to the main arterial surface water drains. Thirdly the completion of the system by the provision of main foul water sewers throughout the town of sufficient capacity in every case to not less than eight times the maximum flow. These sewers to be connected to the main surface water drains or overflow in suitable places. By the time the third stage is reached it may be necessary to purify the sewage before turning it into the river. It is probable that this sewage is so good that any such treatment will be unnecessary.

How quickly these stages will follow each other will depend on the rapidity with which the population of Nairobi increases; stage No. 3. is still remote. At any rate before that time comes Nairobi will be able to collect and will pay for its own sewerage system. It is only necessary to lay down sewers and manholes required in the first stage, making provision for connecting the sewers required in stage No. 2.

Plan of
Sewage
System

Stages of
Sewerage
System

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The size of the drains required in the first instance depends therefore on the maximum quantity of surface water it will be necessary to remove in a given time. This depends in the maximum rate of rainfall that may be reasonably provided for and the proportion which will find its way into the sewers.

In Appendix III tables are given showing the rainfall in Nairobi during the 6 years 1900 - 1905. The period is too short to give an accurate figure for the mean annual rainfall but the average for the 6 years may be assumed to be within 15% of the actual mean. For the 6 years the average is 40.47 inches, the greatest rainfall in any year was 47.32 inches in 1903 and the least 33.12 inches in 1904.

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In tables 2 and 3 the number of days in each year on which rain fell, are tabulated according to the number of inches which fell during the 24 hours. From the summary in Table 3 it appears that the number of days in the year on which more than one inch fell averaged weekly 24, and that the average number on which more than 1 1/2 inches fell was only 3.3. The maximum recorded during the 24 hours is 6 inches.

The rainfall for short periods is often very heavy although not quite so much so as in some other places in East Africa. The records with regard to heavy falls in short periods are very scanty; I have been able to get a one or two instances of 1 1/2 inches in an hour and a few of between 3/4 inch and 1 inch. On the whole the evidence seems to show that the number of occasions on which more than 1/2 of an inch falls during one hour are few, probably not averaging more than one or two in a year, but it is probable that this rate is often reached for shorter periods of time than an hour.

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In my opinion the surface water drains will be of sufficient size if they are capable of removing as much

of the rainwater when falling at the rate of 2 inches per hour as can reach them during that time.

The proportion flowing off into the sewers depends on the nature of the surface on which it falls. From land which has been or is likely to be entirely built over, practically the whole of the rain must be allowed for; where there are gardens and open spaces an allowance of 75% is sufficient, whilst in some places if the drains are capable of removing 60% of the maximum rainfall the allowance will be large enough.

This is the basis on which I propose that the sizes of the drains and of the drops in the drains should be calculated. There will undoubtedly be times of exceptional rainfall, but it is not possible to design a system of removing the water so rapidly as it falls. No system could be designed which would deal with every conceivable downpour of rain except at a prohibitive cost; in any case if there is flooding it will be no worse than a temporary inconvenience occurring rarely and for a short time.

The surface water drains should collect as much subsoil water as it is possible by simple and inexpensive means to get into them. The soil and subsoil are absolutely saturated a portion of the year, but after the wet season the soil is completely saturated. Any system of separate subsoil drains which would remove the water rapidly would have to be very closely spaced together, would be costly, and owing to the nature of the soil very liable to choke up.

I do not recommend that any attempt should be made to lay such a complete system of subsoil drains, for as the town increases these drains will become more and more unnecessary. Every year the latter portion of the town will become more covered with buildings, paved yards, and macadamised roads, so that the rainwater will be more intercepted before it reaches the soil at all. It is

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of the rainwater when falling at the rate of 1 inch per hour as can reach them during that time.

The proportion flowing off into the sewers depends on the nature of the surface on which it falls. From land which has been or is likely to be entirely built over, practically the whole of the rain must be allowed for, where there are gardens and open spaces an allowance of 25% is sufficient, whilst in some places if the drains are capable of removing 50% of the maximum rainfall they will be large enough.

This is the basis on which I propose that the inclinations of the drains in Nantwich should be maintained. They will undoubtedly be tired of inspection and they will be unable to remove the water as rapidly as it falls. No system could be designed which would deal with every conceivable downpour of rain except at a prohibitive cost; in any case if there is flooding it will be no more than a temporary inconvenience occurring rarely and for a short time.

The surface water drains should collect as much subsoil water as it is possible by simple and inexpensive means to get into them. The soil and subsoil are absolutely dry for a portion of the year, but after the wet season the water is completely saturated. Any system of separate subsoil drains which would remove the water rapidly would have to be very closely spaced together, would be costly, and owing to the nature of the soil very liable to choke up.

I do not recommend that any attempt should be made to lay such a complete system of subsoil drains, for as the town increases these drains will become more and more unnecessary. Every year the flatter portion of the town will become more covered with buildings, paved yards, and macadamised roads, so that the water will be more intercepted before it reaches the soil at all. It is

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and only a comparatively small quantity...
downwards. Owing to the configuration of the ground the central
portion of Nairobi is not troubled by the underground drainage
from elsewhere; the subsoil water which causes the trouble
comes directly from the heavens above it.

There will always be some subsoil water and I propose that
small openings should be left at intervals in the sides of the
open drains, to take in as much as can make its way there,
unless special arrangements should be made in the case of deeper
sewers. A series of subsoil drains on a limited scale might be
used in some places, for instance round the site of the new
government buildings.

The accompanying plan of Nairobi (Sheet 1) shows a line
of all the proposed new main drains and sewers. Sheet 2
shows the modifications which would be necessary if it were
finally decided to leave the Indian Bazaar where it is.

The portion of the town most urgently requiring drainage is
the triangular area enclosed between the railway and the river,
together with the land east apart for the native location, Indian
landlines police lines, and such. In this are included almost
the whole of the present and probable future business quarters;
and on the almost entirely on the watershed draining directly into
the river Nairobi.

I have shown a main intercepting sewer commencing at its
lower end at a point near the railway landlines, the line of the
sewer being along the south side of the proposed new Indian Bazaar
along the continuation of First Market, turning as far as
Station Road, turning at right angles the corner with the
Station Road, where it will connect at various points with the
drains now or to be constructed on the railway and elsewhere and
and finally along Government Road, the upper end being opposite
the centre of the new central street.

Sheet 2B gives the longitudinal section of this sewer.
The lower portion has a gradient of 1 in 325, the middle 1 in 100
and the upper 1 in 100. The sewer will be a circular concrete
culvert varying in diameter from 6 to 3 feet.

The gradients and distances will give velocities of from 1
to 3 feet per second with a dry weather flow at the rate of
250,000 gallons per day and a velocity of 10 ft per second

and this comparatively small quantity will flow downwards. Owing to the configuration of the ground the central portion of Wairoa is not troubled by the underground drainage from elsewhere; the subsoil water which causes the trouble comes directly from the heavens above it.

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There will always be some subsoil water and I propose that small openings should be left at intervals in the sides of the open drains, to take in as much as can make its way there. Extra special arrangements should be made in the case of deeper sewers. A series of subsoil drains on a limited scale might be useful in some places, for instance round the site of the new government buildings.

The accompanying plan of Wairoa (showing 1) shows the line of all the proposed new/main drains and sewers. It is to be noted that the underground lines which would be necessary if it were finally decided to leave the Indian Bazaar where it is.

The portion of the town most urgently requiring drainage is the triangular area enclosed between the railway and the river, together with the land set apart for the native location, Indian landlines police lines, and so on. In this are included almost the whole of the present and probable future business quarters; and on it almost entirely on the watershed draining directly into the river.

I have shown a main intercepting sewer commencing at its lower end at a point near the railway landlines, the line of the sewer being along the south side of the proposed new Indian Bazaar along the continuation of First Market, across as far as Station Road, turning at right angles the sewer will be along Station Road, where it will connect at various points with the drains to be constructed on the railway subordinate quarters and finally along Government Road, the upper end being opposite the centre of the new central street.

Drawing 222 gives the longitudinal section of this sewer. The lower portion has a gradient of 1 in 325, the middle 1 in 100 and the upper 1 in 100. The sewer will be a circular concrete culvert varying in diameter from 3 to 5 feet.

The gradients and diameter will give velocities of from 3 to 5 feet per second with a dry weather flow at the rate of 250,000 gallons per day and a velocity of 10 feet per second with a heavy rain flow at the rate of 500,000 gallons per day and a velocity of 15 feet per second with a very heavy rain flow at the rate of 1,000,000 gallons per day.

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flowing full at least 5 feet per second. The concrete of which the sewer is made is to be composed of sand, and broken stone, and the interior half is to be plastered on the inside with rendering made of a mixture of cement and sand.

Manholes are to be built at frequent intervals, ventilating shafts are to be connected to them and wherever required pipes should be built into the manholes for possible future connections with the foul water sewers.

This main sewer with its tributary drains will take the surface water and sewage from the greater part of the area between the railway and the station.

A second circular sewer, however, will be a junction with the main sewer in the manhole at the lower end and will follow the line of Market Road to the point where it joins Government Road. The diameter varies from 2 feet 6 inches to 2 feet 8 inches.

This sewer is to take the sewage and surface water from Market Road, the upper end of Government Road, including the Norfolk Hotel, Civil Hospital, Public Gardens, and the site of the present Indian Bazaar.

In the Indian Bazaar the sewers should be stoneware pipes with cement joints; with these exceptions all the surface drains in the town will in the first instance be open masonry channels along the sides of the roads. The drains should be V shaped with semicircular inverts, the upper portion being formed of dressed local stone and the lower of cement concrete with a plaster of cement rendering. The thickness and depth of the concrete will require to be varied in accordance with the nature of the ground, the drains laid in good ground to be of less thickness than those in rotten soil. The type of drain is very similar to those already constructed by the Railway authorities but it is recommended that a modification of their design be adopted, the side

with somewhat less batter, should use less stonework and more concrete, and should plaster the interior with a greater thickness of rendering.

I propose to put a layer of broken stones each side along the top of the haunches of the large concrete circular sewers so as to form a drain for the subsoil water. At regular intervals inlets would be made through the arch so that the water could make its way into the sewer. A similar arrangement would be made in the open channels, a lining of broken stones being packed outside the drains, and holes left for the same object. This would not be a very perfect method of draining away the subsoil water, but it will be very useful, and will assist matters to some extent.

From the masonry which forms the tunnel at the lower end of the two concrete sewers, an overflow is to be arranged in the shape of a 3 feet in diameter, which eventually delivers into an open channel the latter in turn finally discharging into the river below. The overflow is intended to take all sewage beyond a quantity of 42 million gallons per day which is equal to ten times the dry weather flow of 4,200,000 gallons per head from 2000 persons.

The residue is conveyed by a line of stoneware pipes to the sea, either by an open concrete channel or an outfall into the river below the town.

The main outfall drain from the native location (where this concrete channel about 500 yards above the outfall). The area to be drained here is very considerable amounting in all to more than 200 acres, but the drains need not be capable of carrying away so large a portion of the rainwater as those in the town. An occasional flooding of the ground in the native location will be of less importance than in the business quarter. I therefore propose that these drains should be of

and it is probable that it will be necessary to allow for a
margin of 25% of the total rain falling.

413

On the eastern side of the river a number of houses
are being built. There are also the dhoobi quarter,
the slaughter house, and the new native market. It will
be necessary to drain a part of the Kikuyu Caravan Road
and off the Niagara Road. I have suggested that the whole
of the drainage should be brought down to a point on the
Race Course Road; from this point a 2 inch diameter stone-
ware pipe sewer will carry sewage at the rate of 600,000
gallons per day along the eastern bank of the river
and finally across the valley by an inverted siphon, the
river being crossed by 9 inch cast iron pipes laid on
piles. These pipes will finally discharge into the
common outfall channel. When the flow is at a greater
rate than 600,000 gallons per day the surplus storm
water will be discharged into the river by means of a
dedicated overflow channel.

The trouble arising in large storm water sewers
when they are made use of to carry the comparatively very
small amount of dry weather sewage has already been
referred to. The liability to deposit solids will
probably be somewhat greater here than in the case of
sewers from an entirely European population, on account
of the habits and food which finds its way into the
sewers; but also due to the habit amongst Indians and
natives of cleaning their cooking utensils with sand and
earth when washing them. The flushing water which I
propose to add should be sufficient to give a velocity
during the dry weather of nearly 3 feet a second in
every main drain, at all events during some part of the
day. This will prevent any large deposit taking
place, but it will also be advisable to have detritus
chambers on the main sewers and catchpits in places where

the branch drains connect, in order to intercept as much of the silt as possible. The chambers and catchpits will need cleaning out from time to time.

In order to discover how much water can be spared from the river Nairobi for flushing purposes I had the river gauged towards the end of last dry season, when there had been a drought of about 4 months. I found that there was a daily flow of 50 million gallons.

Half of this, or 25 million gallons is taken by the irrigation canals for irrigating the shambas on each side of the river but most of this water is not actually used, and is returned to the river near the course bridge.

I understand that in very dry seasons the river is lower, but I think it is quite safe to estimate that a quantity of 400,000 gallons per day can always be obtained for flushing purposes without interfering with anyone, even under the most unfavourable circumstances.

I recommend that a 9 inch diameter pipe should be laid from a point on the Nairobi river about half a mile above the Ainsworth Bridge to a point near the present police lines. It is easy to arrange a hydraulic gradient such that the quantity of 400,000 gallons per day will be discharged. The termination of this pipe is the summit of the system of sewers, and water delivered here can be made to flow through any of the new main drains and sewers. By means of sluices fixed at convenient points the flow of water will be so regulated that a velocity of nearly 3 feet per second can be obtained in almost all the sewers. As an additional assistance special flushing sluices should be fixed in certain places.

The result of the works which I have described will be that in wet weather a maximum quantity of about 6 million gallons per day, which is equal to 10 times the dry weather flow at 20 gallons per day from 30,000 persons will be conveyed from the town.

It is also well to mention that the object of treating sewage is generally to produce an effluent which when turned into a non-drinking water stream will not cause nuisance, but that no ordinary form of treatment of sewage produces an effluent which it is safe to turn into a drinking water stream; in order to do so it would be necessary to go through additional expense, and after going through these ordinary processes pass the final effluent through said filters.

It will be the same here as in the question of any form of treatment of sewage in the case of Nairobi, the increase in the volume of the sewage and the number of settlers in the river below are sufficient to make 15 necessary.

I consider that a warning should be issued to all settlers on the river below not to drink the water if other is available, and in no case to do so without filtration and boiling.

Before leaving the question of treatment it is necessary to refer to the possibility of applying the sewage to land. In a country like East Africa where irrigation is so much required this would at first sight appear to be the natural method of purification.

I have carefully examined the land near Nairobi to which it would be possible to gravitate the sewage and have been unable to find any in the least degree suitable. A thin layer of a soil which combines the disadvantages of clay and peat overlying an impervious volcanic rock is the worst combination possible for this purpose.

DRAINAGE OF THE WASTEWATER

WALLEY.

The Cream-Glitch flows down the eastern valley of a tributary of the Ngando river. It has a cultivated area above the bridge near St. Andrew's Church of 1257 acres and its volume in times of heavy rain is large.

It is also well to mention that the object of the treatment is generally to produce an effluent which when turned into a non-drinking water stream will not cause a nuisance, but that no ordinary form of treatment of sewage produces an effluent which it is safe to turn into a drinking water stream; in order to do so it would be necessary to incur additional expenses, and after going through the ordinary processes pass the final effluent through sand filters.

It will be time enough to consider the question of any form of treatment when the growth of the population of Nairobi, the increase in the volume of the sewage and the number of settlers in the river valley are sufficient to make it necessary.

I consider that a warning should be issued to all settlers on the river ^{below} not to drink the water if other is available, and in no case to do so without filtration and boiling.

Before leaving the question of treatment it is necessary to refer to the possibility of applying the sewage to land. In a country like East Africa where irrigation is so much required this would at first sight appear to be the natural method of purification.

I have carefully examined the land near Nairobi to which it would be possible to gravitate the sewage and have been unable to find any in the least degree suitable. A thin layer of a soil which combines the disadvantages of clay and peat over a very impervious volcanic rock is the best combination possible for this purpose.

DRAINAGE OF THE WESTERN VALLEY.

The stream which flows down the western valley is a tributary of the Ngando river. It has a watershed area above the bridge near St. Andrew's Church of 1287 acres and its volume in times of heavy rain is large.

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A properly graded channel with sloping sides, pitched with stones, should be formed for the stream. It will be necessary to concrete the bottom for the velocity is rapid and in times of flood would wear out the natural clay bottom.

Channels should also be formed for the tributary streams which flow down the valley intersecting the Nairobi and Procter's hills. They could for the greater part be roadside drains and would form the natural outlet for the surface water from a large part of the suburbs on these hills.

The main roads and avenues through the town will require drainage, the drains being of the type already described. The outlet will be into the main channel. A connection can be made between the flushing water main and the drains alongside the main cross avenue so that if necessary they can be flushed out. The foul water drainage from the government buildings will probably sooner or later be conveyed by a separate sewer to the main outfall, but for the present charge down the surface water drains.

SUBURBAN DISTRICTS.

No other drains in the suburbs are included in the scheme, either for Parklands or for Nairobi Hill. The greater part of Parklands is not on the watershed of the Nairobi river but on a tributary of the Masari river. The natural outlet for its drainage is really in that direction although it could be arranged if necessary to bring it round to the main outfall. I do not think that, considering the area of land round most of the houses, and the sewerage facilities which many of the owners have for disposing of their sewage, that there is any likelihood of extensive drainage works being undertaken for a long time.

The western suburbs are somewhat different. I

rapid increase in the population in this district is likely as soon as the new government offices are built, and the houses will probably have smaller plots of land round them than those in Parklands. The time may come when a system of sewers will be necessary, at all events for the better part of this district. The outfall sewer could be taken across the plain, past the native location, to the main outfall. The time when this will be necessary is still so remote that no account need be taken of the cost of this work in the present estimates.

STATION

The general health of the natives is poor, and it is considered that the natives should be encouraged to improve their dwellings. It is suggested that the natives should be encouraged to improve their dwellings.

The kitchens, servants' quarters, and servants' latrines are frequently very filthy. No attempt is made to form any drains to remove the slop water from the kitchen, whilst the bath water is discharged directly under the house. Night soil is used in very general use. In houses where a sweeper is constantly in attendance, so that the contents are always removed at once, this system is efficient but expensive, in houses where this is not the case the system is highly unsatisfactory.

In the better class of houses and especially those on the red soil, drains could be laid from the bath room and kitchen to good sized closed and properly ventilated cesspits, the contents of which could be emptied at frequent intervals on to the gardens. This arrangement would certainly be better than allowing the slop water to be thrown out through the kitchen doors to stagnate outside.

The ground round the water standpipes should also have some sort of drains. The usual addition of things is that a small permanent pool of water lies round the standpipes offering opportunity for mosquitoes.

rapid increase in the population in this district is likely as soon as the new government offices are built, and the houses will probably have smaller plots of land round them than those in Parklands. The time may come when a system of sewers will be necessary, at all events for parts of this district. The outfall sewer could be taken across the plain, past the native location, to the main outfall. The time when this will be necessary is still so remote that no account need be taken of the cost of this work in the present estimates.

The general of houses in the suburbs standing in good sites, natives might consider in the meantime if they could not do more in the way of private sanitary work than they do.

The *litiliana*, servant's quarters, and servant's latrines are frequently very filthy. No attempt is made to form any drains to receive the slop water from the kitchen, whilst the bath water is discharged directly under the house. Night commodes are in very general use in the house when a sleeper is constant. In the absence, so that the contents are always removed at once, this system is efficient but expensive, in houses where this is not the case the system is highly unsatisfactory.

In the better class of houses and especially those on the red soil, drains could be laid from the bath room and kitchens to good sized closed and properly ventilated cesspits, the contents of which could be emptied at frequent intervals on to the gardens. This arrangement would certainly be better than allowing the slop water to be thrown out through the kitchen door to stagnate outside.

The ground round the water standpipes should also have some sort of drains. The usual objection of things is that a small permanent pool of water lies round the standpipes offering opportunities for breeding mosquitoes

to bread.

MATERIALS FOR SEWERS.

The material which I recommend should be most largely used in constructing the sewers and drains is cement concrete. The local turfs and lavas which form the building stone used in the town are generally light and porous with a large capacity for absorbing water. They are not capable of bearing any great compressive stress and are not suitable for any of the work except for the upper portions of the surface drains and the lining of the upper part of the sewers.

It should be possible to make a good concrete of the basalt, of which there is an abundant outcrop south of Nairobi, broken up to a suitable size, and mixed with sand. The broken stone might also be a mixture of basalt and lava, or one of the limestones found near the railway in various places. There is good sand in some of the river beds, and also, I am informed, in the direction of Fort Hall. The quality discovered so far has not been very great, but further search will probably disclose other sources of sand. It was not able to discover amongst the transformations and granitic rocks, which would, when broken up, form a better material for concrete, but it is possible that some may exist.

The local lime is not in any way hydraulic and is not suitable for sewer work. The drains in the native location may be partly constructed of lime mortar, but I believe that cement mortar should be used elsewhere.

WATER SUPPLY

The existing water main delivers about 1,000,000 gallons per day in Nairobi. The resident population supplied is not less than 14,000 giving a daily quantity of 6.3 gallons per head. In addition to the resident population there is a daily influx of natives, probably not less than 6000 and the average native of whom consume a certain quantity of water during their stay in the town. The actual quantity available to the resident population if it were all utilized would be less than 6 gallons per head. This is such a small supply and allows very little water for flushing drains, which would be available for trade purposes if wanted.

I am not aware of any important town where the quantity supplied per head is so small. The number of gallons supplied per head per day varies in towns throughout the world from 12 to 15 gallons per head in a small English town to 125 gallons in Washington. Having regard to the climate and the nature of the population supplied I am of opinion that Nairobi should have a supply of 16 gallons per day per head of the resident population including all sales.

In Table 3 appendix 3 the estimated population of Nairobi at the end of 10 years from the present time is given as 22,000; in 20 years as 28,000. These figures do not include the military, who although outside the municipal area, are supplied with water. They add an additional 2,000 persons and the total becomes approximately 24,000 and 30,000 respectively.

at 16 gallons per head per day (the quantity

required would be 350,000 gallons in 1910 and 540,000 gallons in 1920.

The existing main conveys a quantity of 130,000 gallons, so that an extra 220,000 gallons will be required in 1910 and 410,000 gallons in 1920. This quantity of at least 500,000 gallons appears to be always available at the springs, so that it is really a question of laying an additional main.

Reservoir.

In order to bring down 220,000 gallons at the reservoir the gradient being the distance from the reservoir to Nairobi it would be necessary to lay a 7 inch diameter pipe for the first three miles and a 6 inch diameter pipe for the remainder of the distance to deliver 410,000 gallons per day at Nairobi and a 7 inch would be required. The difference in cost is not very great and I recommend that the larger size pipe be laid in the first instance so that the full quantity can be brought down at once.

Distribution.

In addition to obtaining the extra supply from the springs, it will be necessary to lay new lines of larger sized pipes in the town in order that it may be properly distributed. The use and for water in a town fluctuates greatly during the day, the rate of supply during the hours of maximum draught being as much as twice the average for the 24 hours. In European countries the rate of consumption also varies in different seasons of the year, the demand in the summer being sometimes as high as 30 to 40 per cent above the average. The distributing mains are accordingly made large enough to deliver 2 1/2 to 3 times the daily average quantity.

The seasonal fluctuations may be almost neglected in Nairobi because the variation in the temperature is comparatively small. The distributing mains

required would be 200,000 gallons in 1915 and 340,000 gallons in 1920.

The existing main conveys a quantity of 130,000 gallons, so that an extra 206,000 gallons will be required in 1915 and 410,000 gallons in 1920. A daily quantity of at least 600,000 gallons appears to be always available at the springs, so that it is only a question of laying an additional main.

In order to bring down 900,000 gallons, the hydraulic gradient with the discharge to the reservoir at Malboro' it would be necessary to lay a 12 inch diameter pipe for the first three miles and a 6 inch diameter pipe for the remainder of the distance to deliver 410,000 gallons per day and a 12 inch pipe would be required. The difference in cost is not very great and I recommend that the larger pipe be installed at the first instance so that the full supply may be brought down at once.

In addition to obtaining the extra supply from the springs it will be necessary to lay new lines of larger sized pipe in the town in order that it may be properly distributed. The demand for water in a town fluctuates greatly during the day, the rate of supply during the hours of maximum draught being as much as twice the average for the 24 hours. In European countries the rate of consumption also varies in different seasons of the year, the demand in the summer being sometimes as much as 50% to 40% more than the average. The distributing mains are accordingly made large enough to deliver 2 1/2 to 3 times the daily average quantity.

The seasonal fluctuations may be almost neglected in Malboro' because the variation in the temperature throughout the year is comparatively small. The distributing mains

need only be large enough to deliver twice the average daily requirements.

The distributing pipes from the reservoir will thus have to be large enough to deliver together at the rate of 92,000 per day in 1916 and 1,080,000 gallons in 1921. The pipes which the railway engineering department are now laying will when completed only be capable of delivering 100,000 gallons per day so they are clearly much too small.

A 6 inch pipe will be laid from the service reservoir to the Government Road and at this point a 4 inch branch will be required with a 2 inch branch through the proposed new Indian bazaar, continuing as a 4 inch pipe to the native location. Another 3 inch branch should cross the river to the new bazaar to the east side. An additional 2 inch pipe will be required along the hills near Government house to Parklands, but the necessity for this is not so great as for the town mains.

If the system of water mains had been planned and laid out as a whole in the first instance it would have been better to have divided the town into zones of high and low pressure, and have put a reducing valve on the low pressure main. Considerable trouble and expense in leaks and bursts would have been saved by this arrangement.

In order to cope with the maximum daily rate of consumption a new service reservoir will eventually be required. The present storage is only 60,000 gallons and this will clearly not be of much use when the daily supply from the reservoir is 540,000 gallons per day and the maximum draught at the rate of 1,000,000 gallons. The quantity delivered by the proposed 6 inch pipes together with the existing ones will be at present quite double the average demand, so the new

need only be large enough to deliver twice the average daily requirements.

The distributing pipes from the reservoir will thus have to be large enough to deliver together at the rate of 792,000 per day in 1916 and 1,080,000 gallons in 1921. The pipes which the railway engineering department are now laying when completed only be capable of delivering 180,000 gallons per day and they are clearly much too small.

A 6 inch pipe should be laid from the service reservoir to supply the town hall, from this point a 6 inch Government Road and a 4 inch pipe will be required, with a 4 inch branch through the proposed new Indian bazaar, continuing as a 4 inch pipe to the native location. Another 6 inch branch should cross the river to the new bazaar. An additional main will probably be required down the hills near Government house to Parklands, but the necessity for this is not so great as for the town mains.

If the system of water mains had been planned and laid out as a whole in the first instance it would have been better to have divided the town into zones of high and low pressure, and have put a reducing valve on the low pressure side. Considerable trouble and expense in leaks and bursts would have been saved by this arrangement.

In order to cope with the maximum daily rate of consumption a new service reservoir will eventually be required. The present storage is only 60,000 gallons and this will clearly not be of much use when the daily supply from the reservoir is 540,000 gallons per day and the maximum draught at the rate of 1,000,000 gallons. The quantity delivered by the proposed new main, together with the existing one will be at first quite double the average demand, so the new

Service
reservoir.

reservoir will not be required for some years.

It is quite clear that the railway authorities are not the proper persons to have charge of the water supply of the town. There is absolutely no reason why they should, for this supply does not even feed their locomotive tanks and workshops, a separate pipe from the river brings enough for this purpose. They would probably be glad to be relieved of the trouble caused by having to look after the water mains and reservoirs, which should undoubtedly be handed over to the municipal authorities.

OTHER NEW WORKS

The present condition of the Dheol quarters is a public danger and calls for immediate relief. New Dheol quarters should be erected as soon as possible. The shortage of water is a hindrance to the provision of a large supply of good washing water, but two or three thousand gallons a day would wash a very fair number of clothes, and it would be possible to obtain that amount.

A new civil hospital is undoubtedly required for the present one is certainly not satisfactory. Other Public Buildings are I understand being proposed. The new slaughter house and a fire station appear to be the most necessary; but in case of a large fire, a supply of water to put it out is even more important than the fire station.

It will be found economical in the long run if the foundations of the new roads are properly made from the beginning. The following method would I think ensure a good road where it has to be made on the black cotton soil.

The foundations should be excavated to a depth of about a foot and the bottom covered over with 6 inches

of red Kikuyu soil. On this hand packed stones should be laid to a depth of at least 9 inches. The top metalling should be basalt broken to one inch cube and the binding material muram. The surface should be watered and rolled; the camber in a 40 foot road should be 9 inches; the sides being made to a slope of about 1 in 25. Trees should be planted in all wide roads for shade and ornament, and also as a protection against vehicles and animals falling into the deep drains. In the case of narrow roads it would be better to put the drains inside the footpaths and not outside. In all main roads, a stone tabling should be laid along the edge of the metalled portion communicating at frequent intervals with the side drains by gutters. The side walks can be made 6 or 8 feet wide with a fall towards the drain of 3 inches.

SECTION IV

FINANCIAL

ESTIMATED COST OF WORKS

I estimate the cost of the various works I have recommended as follows:-

(1). Main Drainage Scheme

Main intercepting sewer.....	21,000
Branch sewers and drains on west side of river.....	13,800
Branch drains on east side of river.....	3,500
Outfall sewer west side.....	2,750
Outfall sewer east side.....	1,500
Overflows.....	5,000
Flushing Water main.....	2,100
Drains in native locations.....	11,000
	<hr/>
	50,450
Add for contingencies 10%	5,045
Total	55,495

of red Kikuyu soil. On this hard packed stones should be laid to a depth of at least 9 inches. The top metalling should be basalt broken to one inch cube and the binding material maram. The surface should be watered and rolled; the camber in a 40 foot road should be 9 inches; the sides being made to a slope of about 1 in 25. Trees should be planted in all wide roads for shade and ornament, and also as a protection against vehicles and animals falling into the deep drains. In the case of roads too narrow for trees it would be better to put the drains inside the footpaths and not outside. In all main roads a stone tabling should be laid along the edge of the metalled portion communicating at frequent intervals with the side drains by gutters. The side walks can be made 6 or 8 feet wide with a fall towards the drain of 3 inches.

SECTION IV

FINANCIAL

ESTIMATED COST OF WORKS

I estimate the cost of the various works I have recommended as follows:-

(1). Main Drainage Scheme.

Intercepting sewer.....	£11,000
Branch sewers and drains on west side of river.....	13,800
Branch drains on east side of river.....	3,500
Outfall sewer west side.....	2,750
Outfall sewer east side.....	1,300
Overflows.....	5,000
Flushing Water main.....	2,100
Drains in native localities.....	11,000
	<hr/>
	50,450
Add for contingencies 10%.....	5,045
<u>Total</u>	<u>£55,495</u>

Western Valley Drainage.

(2). Drainage of the Western Valley.

New Main Channel.....	£5,500
Branch Channels.....	4,500
Roadside drains etc.....	5,700
Drains in park.....	1,000
<u>Total.</u>	<u>16,700</u>

Add for contingencies 10% say 1,700

Total

(3). Laying out new Roads, Parks etc.

New Roads, Squares etc.....	£11,000
Laying out and planting park etc.....	1,300
<u>Total</u>	<u>12,300</u>

Add for contingencies 10% say 1,200

Total..... £13,500

New Water

(4). New Water Supply.

Main from Kikuyu to Nairobi	16,500
Distribution Mains.....	6,000
<u>Total</u>	<u>22,500</u>

Add for contingencies 10% say..... 2,100

Total..... £24,600

(5). Other Municipal Work

New Dhobi Quarters etc., say £4,000

The total cost of the works will therefore be:-

Main drainage.....	£5,500
Drainage of Western Valley.....	18,400
Laying out new roads, streets, etc.....	13,500
Water supply.....	24,600
Other municipal work.....	4,000

£65,000

Expenditure during the years 1908-1909.

This expenditure can be spread over three years in the following proportions:-

1907.....	58,000
1908.....	50,000
1909.....	12,000

Total: £ 115,000

Cost of draining native location.

The estimate of the cost of draining the native location includes the total cost of draining the whole area set apart for the natives, including workmen and police lines. In a preliminary estimate supplied to His Excellency the Commissioner I subtracted from the total a sum of £3,500 for works which I did not consider would be required within the next three years. The result of the census in Nairobi subsequently proved that there were so many more natives than had been previously supposed that I have now included the whole amount, and have assumed that the sum of £3,500 will be spent in the year 1909.

Municipal works.

The sum of £4,000 to cover other municipal works is only intended as an approximate figure. I have not got any accurate data on which to base an estimate.

Cost of land and buildings not included.

The above total does not include anything for the cost of acquiring land and buildings. I do not agree with the estimate prepared by the Committee who went into this question, but for obvious reasons it would not be advisable to give any exact figures.

After 1909 further expenditure will be required from time to time for extensions of the drainage, and roads, etc. but the sum required for this work should not be very large for a number of years.

Expenditure during the years 1908, 1909.

This expenditure can be spread over three years in the following proportions:-

1907.....	83,000
1908.....	50,000
1909.....	12,000
	<hr/>
Total	£ 115,000
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Cost of Drainage Native Location

The estimate of the cost of draining the native location includes the total cost of draining the whole area set apart for the natives, including workmen and police lines. In a preliminary estimate supplied to His Excellency the Commissioner I subtracted from the total a sum of £3,500 for works which I did not consider would be required within the next three years. The result of the census in Nairobi subsequently proved that there were so many more natives than had been previously supposed that I have now included the whole amount and have assumed that the sum of £3,000 will be spent in the year 1909.

Municipal works.

The sum of £4,000 for other municipal works is only intended as an approximate figure. I have not got any accurate date on which to base an estimate.

Cost of land and buildings not included.

The above total does not include anything for the cost of acquiring land and buildings. I do not agree with the estimate prepared by the Committee who went into this question, but for obvious reasons it would not be advisable to give any exact figures.

After 1909 further expenditure will be required from time to time for extensions of the drainage, new roads, etc. but the sum estimated for this work should not be very large for a number of years.

Profit
included in
estimates.

In these estimates I have not included anything for profit on the carriage of materials by rail. It is the habit of the Railway authorities to charge the Public works department prices for freight which not only cover the actual cost of carrying the material but an additional percentage for profit as well. I wish to give the actual amount which in my opinion the works will cost the Government, as I have endeavored to eliminate all such percentages which simply means money transferred by the Government from one pocket to the other.

Income
Expenditure

PRESENT FINANCIAL POSITION OF NAIROBI.

The financial position of the town, as set forth in the last annual balance sheet, would at first sight hardly seem to justify so large an expenditure of money as £115,000. The townships' estimate for 1906 (which are the 1st figures that I have been able to obtain) provided for a total income and expenditure of Rs. 51,141 or £342,415 0. Out of the Income Rs. 14,277 or £1069 3 0 comes under the heading of grants from the Protectorate and the Railway Department. The total income derived from rates is Rs. 15,250 representing a 10% on Rs 152,500, or a rateable value of £2,150.

These figures are however in themselves quite misleading and moreover they do not include the income from water rates nor the rents from the land that has been reserved. Of the sum of £115,000, £23,000 is to be spent on new water works and a large part of the remainder on works which will improve the value of the building estate; so in any review of the financial prospects it is necessary to take account of these two sources of income.

ESTIMATE OF INCOME FROM RATES

able value

The figures given for rateable value do not

represent the true rateable value at all. All government and Railway lands and buildings are exempt from rates whilst their houses and bungalows are rated much below their proper value. Rates of Rs 2, Rs 3, or Rs 4 per month are paid on these bungalows according to the official position of the Government. Railway bungalows are not rated at all. The Railway pays a lump sum of Rs 1,000 per month for bungalows used by an official. The Government might possibly claim exemption from rates on the same principle that buildings in England in the occupation of the Crown are exempt. But there is no apparent reason why the Official bungalows should not be rated at their proper value. The Government could then pay the whole or part of the rates if they considered it necessary to do so. The actual rateable value of the official bungalows is estimated by the Town Clerk at Rs 30,000 or Rs 43,700.

The railway with the station, shops and buildings should be also properly assessed. In England the railways pay 1/3 of the local taxation of the country. I do not know of any reason why the Uganda Railway should not pay its share in Nairobi. The original capital outlay on the railway, official bungalows, subordinate quarters, workshops, station buildings and landties, was over £200,000. This does not include the cost of the railway line and sidings, the permanent way or the machinery in the workshops. The usual methods of rating railways are very complicated but it is probable that whatever system was adopted the rateable value of Railway property in Nairobi would not be less than £8,000.

On the above basis of calculation the rateable value of Nairobi at the present time should be about £80,000.

Estimated Rateable
Value in 1910

Between 1901 and 1906 the value of property rated increased by nearly 200% between 1906 and 1908 the increase was 50%. The development of Nairobi has been somewhat hindered during the last year or two by the various causes I have referred to. The effect of carrying out the new works should be to cause the increase during the next five years to be at all events equal to that of the last five years. It should be quite safe to assume that the assessable value of property in Nairobi in 1910 will be £50,000.

Water rate

A water rate of 1/6 per gallon for every stand pipe is charged by the railway and is collected for them by the Municipality. This brings in a net income of £380 per annum. By increasing the supply a much larger annual sum will be obtained.

LAND FROM LAND.

The Government is the absolute landlord over the whole of the municipal area. Nearly 1000 acres have already been let on leases of various lengths bringing in a total annual rent of about £1000.

There has been a continuous increase in the value of building land in Nairobi; the premiums paid for leasehold plots fronting the main streets have consistently represented together with the capitalised ground rent a freehold value of £1700 per acre. The value of good sites in Government roadways certainly be taken at £1000 to £1200 per acre; the freehold value of land in other parts of Nairobi varies from £30 to £50 per acre in the suburbs, to prices anywhere between £200 and £800 per acre in the centre of the town.

The land fronting the new main street should even in the presentment be more valuable than any previously let in Nairobi and good rents should be obtained.

Estimated Rateable Between 1901 and 1906 the value of property rated increased by nearly 200% between 1905 and 1906 the increase was 50%. The development of Nairobi has been somewhat hindered during the last year or two by the various causes I have referred to. The effect of carrying out the new works should be to cause the increase during the next few years to be at all events equal to the previous years. It should be quite safe to assume that the assessable value of property in Nairobi in 1910 will be 250,000.

Water Rate A water rate of Rs. per month for every 100 ft. pipe is charged by the waterworks and is collected for them by the Municipality. The charge for a net of 100 ft. is Rs. 200 per annum. By increasing the supply a much larger annual sum will be obtained.

RENTS FROM LAND.

The Government is the ground landlord over the whole of the municipal area. Nearly 1000 acres have already been let on leases of various lengths bringing in a total annual rent of about 25000.

There has been a continuous increase in the value of building land in Nairobi; the premiums paid for leasehold plots fronting the main streets have correspondingly represented together with the capitalised ground rent a freehold value of 21700 per acre. The value of good sites in Government Road may certainly be taken at 21000 to 21300 per acre; the freehold value of land in other parts of Nairobi varies from 220 to 250 per acre in the suburbs, to prices anywhere between 2200 and 2800 per acre in the centre of the town.

The land fronting the new main street should even in the commencement be more valuable than any previously let in Nairobi and good rents should be obtained.

For it. Some of the other land opened up by the new streets will also be of considerable value.

INCOME AND EXPENDITURE IN 1910

By the time the works recommended have been carried out, in the year 1910, the total annual income derived from general and sanitary rates (including rates on railway property) and the value rates obtainable on the property of the municipality would be £3,600, and the income from fees, licenses etc. would produce £1,000, will be not less than £4,600.

The total income from all sources would thus be £4,600.

On the other hand the expenditure on conservancy, scavenging, lighting, maintenance of roads, buildings, drains and water works, and officials' salaries, may be taken as £5,000. In addition there must be included the interest payable on the £115,000 spent on public works in the municipality, and a sinking fund for the repayment of the capital, for this is clearly capital expenditure and should be treated as such. Supposing to be considered this sum as a government loan at 4% repayable in 25 years, the total annual sum required for interest and capital would be £635 per annum.

The balance sheet for 1910 would then be approximately as follows:-

<u>Income</u>		<u>Expenditure</u>	
Rates	£4,500	Conservancy, Scavenging, Maintenance of Roads	
Fees Licenses etc	£1,000	Building, Drains, Water Works, Salaries Office Expenses etc.	£5,000
Rents	£3,600	Interest on and Repayment of Loan	£635
Balance	£1,385		£5,635
	<u>£10,385</u>		<u>£10,385</u>

Nothing is allowed in these figures for compensation for acquisition of land and building. This will

be almost entirely expended in moving the Indian Bazaar and it hardly seems reasonable to saddle the town of Nairobi with the financial responsibility for mistakes previously made by the Protectorate Government. I have therefore supposed that any part of this expenditure, not recouped in the end by the increased value of the land on which the bazaar now stands and that adjoining it will be considered a dead loss by the Government. Supposing that the money for these works is provided as above I have suggested there would be a deficit of £1365 in 1919 and the Government would have to forego a part of the interest or the £114,000 for the year unless the general rate is to be increased beyond 10% or 2/- in the pound. It would be better that the Government should make this sacrifice than that the town should be burdened with heavy rates at so early a period of its history. The amount of the Government loan, which should never amount to a large sum, would decrease each year, and within 5 or 6 years from the present time the direct income obtained from the town should be sufficient to pay for the whole of the sinking fund and the interest on the money expended as well as to provide for the ordinary annual expenditure.

SECTION V.

MUNICIPAL ADMINISTRATION
Present System of Administration

The present Municipal Committee came into existence under the ordinance of December 1st, 1901, and for some time consisted of two Railway officials one Protectorate official, and three local merchants with the Sub-Commissioner as chairman. They had the power to make by-laws for the preservation of public health and order with the approval of the Commissioner, and to levy

rates, which were to be exclusively expended upon
public lighting, and cleansing the town. The Sub-
Commissioner was to submit in December of each year
an estimate of the cost of these works to the Committee,
and, after the estimate had been approved, a rate might
be levied.

These rules were repealed by the Ordinance of Sep-
tember 1904. A new set of rules was made and
remained in force until amended rules were published.
The revised rules made
their appearance in due course in the Gazette of June
1st 1904. The Committee was now to consist of the
Collector as chairman, one other Protectorate official,
two Railway officials, two European residents and two
resident Indian traders. The duty of preparing the
estimates was transferred from the Sub-commissioner to
the Collector; the estimates were afterwards to be sub-
mitted by the Sub-Commissioner to the Commissioner for
his approval. In practice the estimates were forwarded
by the Committee to the Sub-commissioner, who proceeded
to alter them and then submitted them to the Commissioner
without referring them back to the Committee, who had no
opportunity of seeing them in their final form.

By the ordinance of February 14th 1905 another
change was made to the constitution of the Committee,
who were to consist of the Collector, three other Pro-
tectorate officials, three railway officials, four
European residents and two Indian traders with the
Medical Officer of Health and Town Clerk as ex officio
members. These latter soon afterwards ceased to be
members, and with this exception the constitution is
still the same.

Their powers and responsibilities were defined in
November 1905 by the acting Commissioner, who decided that

they have no power to hold moveable or immovable property except as the Commissioner's agent, or to expend money except in accordance with the sanctioned estimates. They are a body nominated to do certain duties mostly discharged by the collector in other townships.

It is clear that they are merely an advisory body and in no wise representative. The management of municipal affairs in fact hitherto been entirely in the hands of the Protectorate Government.

PROPOSED ADMINISTRATIVE BODY

From a business point of view the most satisfactory arrangement would be for a body of financial and administrative experts to take over the entire management of Nairobi; their object would be to put the town on its legs as quickly as possible so that it may become self-supporting and that the administration can then be handed over to a properly elected Town Council.

The best arrangement which would be to delegate the entire management of municipal affairs to an Improvement Commission, consisting of five or six members (not necessarily all officials) selected for their knowledge of financial questions or experience of administration. The chairman could be the Commissioner of lands. The Commission would be a Government body appointed for the definite purpose of administering Nairobi until the works of drainage, water supply etc, have been carried out, and the time is ripe for a proper representative municipal body.

The Improvement Commission would take over the functions of the existing Municipal Committee, the

Land Office (as far as the land inside the municipal area is concerned) and the existing Sites Committee.

They would have power to make bye-laws, subject to the sanction of U.M. Commissioner; and would have the responsibility for the expenditure on the various public works needed; would take over the waterworks, lay out streets, and would arrange for the lighting, cleansing, scavenging, and sanitation of the town; the maintenance of all public works, roads, government buildings, and parks, and have control of the municipal police. All Government land within the municipal area would be temporarily vested in the Commissioners who would be responsible for leases and sales of land.

The boundaries of the municipality should be rectified so as to include the whole of Parklands and the new native location.

The commission would require the services of a medical officer, land officer, treasurer, clerk, sanitary inspectors and an engineer who should be skilled in carrying out works of water supply and drainage.

I have not included anything in my estimates of municipal expenditure for police. I have assumed that the whole cost of the police would for the next few years at all events be defrayed from the Protectorate funds.

When the time comes for the transfer of the administration to a Town Council, a portion of the crown lands will clearly have to be made over to the Municipality if the new Council are to become responsible for the municipal debt. One of the advantages of keeping the municipal administration entirely in the hands of

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ials.

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the Government until the time comes is that the
latter, ^{will} have a perfectly free hand to make any financial
arrangements with the elected body that may seem to
them at the time to be satisfactory. If the Govern-
ment lack the responsibility of furnishing the money
required for the necessary public works in the first
instance, they should if possible have some benefit
from the improved value of land later. Any premature
arrangement such as has been suggested for handing
over ^{to} a body nominally representing the ratepayers,
the whole or part of the Crown lands before they are
developed, and then providing that money required for
their development, would be, from a business point of
view an exceedingly unsatisfactory proceeding.

EXISTING ORDINANCES.

The regulations for the preservation of the public health are contained in a series of rules and ordinances issued by the Commissioner and published in the Official Gazette from time to time.

Certain special orders issued to Nairobi have also been issued but these have generally been all superseded by subsequent regulations.

The most important sets of rules are those contained in the Gazette of June 1st, 1904, Oct. 15th, 1905 and June 1st, 1906. The first represents a sort of Public Health Act for the whole country, and contains regulations with regard to assessment, streets, roads, and erection of buildings, sanitary matters, slaughter houses, bakeries, markets, lodging houses, preservation of order and many other matters. The two latter ordinances refer only to Nairobi. The rules of October 1905, relating chiefly to sanitary matters whilst those of June 1906 are concerned entirely with the shops.

These various ordinances contain many useful regulations, many on the other hand are vague and difficult to follow, and some that are absolutely useless. Their greatest defect is that they contain no instructions with regard to legal proceedings, and in practice they appear to be almost dead letters.

Cases have occurred in Nairobi of houses being built without the plans having been submitted to any authority. The penalty imposed for the offence has been usually a fine of 15 rupees, so that under the existing laws, it is impossible to erect almost any kind of building for a merely nominal fine. The

Municipal Authority has no power to pull down buildings erected without their sanction and this power they certainly should have.

462

NEW LEGISLATION.

In my opinion the existing legislation should be repealed and a complete set of new public health rules issued to include the whole Protectorate. A set of by-laws for Nairobi could also be published and these could afterwards be used as a model by-laws for other towns.

Amongst matters requiring legislation the following deserve special notice.

The construction of the new sewers raises the question of the cost of house connections and the party on whom this is to fall. In England the owner or occupier is bound to connect to any sewer within 100 feet of his property, and the local authority has the power to do the work necessary if the owner refuses, and to recover the cost from him subsequently.

On the other hand it appears as if it was the custom in India for the Municipal Authority to lay the connecting pipe as far as the boundary of the street, the house owner constructing the drain inside his property with the inspection chamber, trap and ventilating pipe.

The house connections in Nairobi have not so far been very expensive works; but the cost of making a number of connections to a deep sewer would be considerable, and I do not think that it is a cost which should rightly fall upon the Municipality.

Some definite regulations are necessary on the question of the sewerage, paving, and metalling of streets and roads on private property. Under the present ordinances there seems to be no obligation

148

On owners to do anything of this kind before the roads are handed over to the authorities to be maintained at the public cost.

The principles of the Private Streets Act 1892 might well be applied. By this Act it is provided that an urban authority may sewer, level, pave, metal, flag, channel, or make good, or provide proper means for lighting, a private street, or part of a street, and may apportion the expenses incurred in so doing to the owners of the premises, fronting or abutting. They may also include any premises to which access is obtained from the street which in their opinion will be benefited by the works.

Objections to the proposals are heard before a court of summary jurisdiction; expense can also be recovered in this court.

After the streets have been sewered, paved and metalled they become, on the application of the greater part of the owners, highways, repairable by the inhabitants at large.

The list of nuisances given in the ordinance of October 1905 is a fairly complete one, but the machinery for the enforcement of the abatement appears to be insufficient. The overcrowding in the bazaar is notorious and appalling but the Medical Officer failed to get a conviction in a particularly bad case just before my departure from Nairobi.

The regulations with regard to the milk supply do not appear to give sufficient power of inspection. This is a serious matter on account of the possibility of disseminating disease by means of milk. The native milk is nearly always adulterated to some extent with the urine of the cow; the natives prefer it flavoured in this way. The European milk supply comes from farms of white settlers but it is not free from danger.

for in case of an attack of infectious disease in one of these farms there does not seem to be any means of prohibiting the milk from being sold in Nairobi.

The regulations with regard to new buildings require several additions. The conditions laid down on the subject of air space round the buildings are altogether insufficient. Clause 35 of the Ordinance of June 1904 specifies that one side of the living room shall either be an exterior wall or abut on an open air space. As nothing is said about any opening between the room and the open space either by a door or window this regulation is useless.

Every building should have an open space in front not less than 24 ft. wide throughout the whole line of its frontage and a court-yard of not less than 250 sq ft; the distance across this open space to be not less than 15 ft. in the case of one storied buildings and 20 ft. in the case of two storied buildings. Habitable rooms should have at least one window opening directly into the open air, the total window area to be not less than one tenth of the floor space, and one half of the window at least to be able to be opened.

A regulation enforcing the laying of a proper damp proof course in all masonry buildings is also needed.

In Nairobi the nature of the black cotton soil and the tendency for epidemics of plague to occur, makes it essential that there should be power to insist on the paving of back yards when necessary. In the Indian bazaar and the business quarters all back yards without exception should be properly paved or cemented.

There are certain districts in Nairobi which are in a very unsanitary condition and this is not only due to the lack of proper sanitary arrangements but also to the habits of the inhabitants. I am convinced that the ideas of the Asiatics in the Protectorate on this

subject of cleanliness are so far removed from those usually held among civilised people, that no matter how perfect the system of drainage may be, or how well the houses are built, they will succeed in making their dwellings thoroughly unsanitary unless they are under constant supervision.

It is not reasonable to expect the community as a whole to pay for the cost of work necessitated by unsanitary habits of a class. I therefore recommend that power be given to the Municipal Authority to levy, with the sanction of H. M. Commissioner, a special sanitary rate on any district, wherever they may consider it necessary to do so. This rate is to be expended in providing a special sanitary gang, under an Assistant Sanitary Inspector, whose sole duties would be to sweep out, cleanse and scavage in this district. Power should also be given to the Authority for their proper officials to visit the back premises of any house in the prescribed district, or giving proper notice, and, if any of these back premises, should be found in an unsanitary condition, to cleanse them and to recover the cost of so doing from the occupier or owner.

SECTION VII. Conclusion.

Summary of Proposals.

In conclusion I will summarise as briefly as possible the proposals which I have the honour to submit in this report for your Lordship's consideration.

I recommend that the position of Nairobi should be accepted as the final one, that the plan on which the town is to be laid out should be decided on at once, and that the work of laying out the necessary roads, streets, etc., should be commenced without delay.

The arrangement of the town which appears to me to offer more advantages than any other is shown in the accompanying plan (Drawing 1.) The scheme is essential

Summary of
Proposals for
the
Laying out and
Management of
Nairobi Town.

889 179
the removal of the Indian bazaar.

If this proposal is not accepted, the next best but a distinctly inferior solution of the difficulty will be to lay ^{out} the town as shown on Drawing 2.

The central portion of the municipal area on both banks of the river shall be drained as soon as possible. The course of procedure which will be most economical, will be to lay ^{out} separate drains of surface water drains arranging for the time being to convey the sewage into these drains, and to insure their being kept free of deposit by admitting a comparatively large volume of flushing water daily, in order to maintain sufficient velocity in the sewers to keep them self-cleansing.

The dry weather sewage ^{from the town} up to 6,000,000 gallons per day is to be discharged into the River Nairobi about a mile below the town. In wet weather the excess beyond this quantity will pass into the river by shorter routes through storm water overflows.

In the subsequent development of the sewage system there will probably be a period when separate sewers for foul water alone will be laid on some of the streets and the time may be reached when the whole town is sewered on the separate system; the sewage proper being removed to the main outfall, and possibly purified, before being turned into the river; whilst the surface water drains will discharge directly into the river.

No treatment of the sewage will be necessary in the first instances, or for a number of years. A site is however reserved for the disposal works if they should become necessary.

The new native location will be drained to the main outfall. The western valley should be drained by forming a main channel down the centre with branch drains up the valleys intersecting Nairobi and Protectorate hills. The other drains need be constructed in the suburbs in the first instance, and necessary foul water sewers

889 171
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The central portion of the municipal area on both banks of the river shall be drained as soon as possible. The course of procedure which will be most economical, will be to lay a separate system of surface water drains arranging for the time being to convey the sewage into these drains, and to insure their being kept free of deposit by admitting a comparatively large volume of flushing water daily, in order to maintain sufficient velocity in the sewers to keep them self-cleansing.

The dry weather sewage, ^{from the town,} up to 8,000,000 gallons per day is to be discharged into the River Nairobi about a mile below the town. In wet weather the excess beyond this quantity will pass into the river by shorter routes through storm water overflows.

In the subsequent development of the sewage system there will probably be a period when separate sewers for foul water alone will be laid in some of the streets and the time may be reached when the whole town is sewer-ed on the separate system; the sewage proper being re-moved to the main outfall, and possibly purified, before being turned into the river; whilst the surface water drains will discharge directly into the river.

No treatment of the sewage will be necessary in the first instances, or for a number of years. A site is however reserved for the disposal works if they should become necessary.

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the removal of the Indian bazaar

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The central portion of the municipal area on both banks of the river shall be drained as soon as possible. The course of procedure which will be most economical, will be to lay a complete system of ~~sewers~~ drains arranging for the line being to convey the sewage in these drains, and to insure their being kept free of deposit by admitting a comparatively large volume of flushing water daily, in order to maintain sufficient velocity in the sewers to keep them self-cleansing.

The dry weather ^{from the town} sewage up to 3,000,000 gallons per day is to be discharged into the River Nairobi about a mile below the town. In wet weather the excess beyond this quantity will pass into the river by shorter routes through storm water overflows.

In the subsequent development of the sewage system there will probably be a period when separate sewers for foul water alone will be laid in some of the streets and the time may be reached when the whole town is sewer-ed on the separate system; the sewage proper being removed to the main outfall, and possibly purified, before being turned into the river; whilst the surface water drains will discharge directly into the river.

No treatment of the sewage will be necessary in the first instance, or for a number of years. A site is however reserved for the disposal works if they should become necessary.

The new native location will be drained to the main outfall. The western valley should be drained by forming a main channel down the centre with branch drains up the valleys intersecting Nairobi and Protectorate hills. No other drains need be constructed in the suburbs in the first instance. All necessary foul water sewers

can be subsequently laid from the suburban districts to the main outfall and disposal works.

Improvements are desirable in the methods of burying the night soil. The present method of disposing of the refuse can be continued for some time, but the erection of a refuse destructor will probably become necessary later.

An additional water supply main from the reservoir should be laid into the town, and a set of larger distributing pipes in the town itself.

Dhobi quarters. New dhobi quarters are necessary and should be built at the earliest opportunity.

The total estimate cost of the above works including some minor municipal works, is £115,000, which does not include the compensation to be paid for acquisition of land and buildings. This expenditure is to be spread over the next three years, £53,000 being spent in 1907, £50,000 in 1908, and £12,000 in 1909.

Health Improvement. I further suggest that the administration of Nairobi should be delegated to an Improvements Commission who would on behalf of the Government control the expenditure on these works, and administer the town with the object of making it self-governing, so that at the earliest possible moment their place could be taken by a properly elected Town Council.

Municipal debt. The sum spent of these works would be looked upon as a Government Loan to Nairobi and interest and repayment of capital by a sinking fund would be charged in the annual municipal budget.

Public Health. I recommend that the present Public Health Ordinances should be repealed and that fresh legislation should be promulgated, which would include regulations on many subjects either omitted from or insufficiently dealt with in the existing Ordinances.

Expenditure
of unduly large

I venture to think that your Lordship will not consider the expenditure I have recommended an unduly large one under the circumstances.

English town

The state of things which exists in Nairobi would not be tolerated in an English town. If the drainage of a town of 14000 inhabitants in this country were a condition, as is at the present the case in Nairobi, the householders would demand proper drains and sewers, the Local Government Board would undoubtedly insist on the defaulting local authority providing proper drainage. Your Lordship will doubtless desire that in Nairobi, where the Government have absolute control of Municipal affairs there should be no delay in doing works so absolutely necessary.

of
supply

There can be no question about the inadequacy of the present water supply and the consequent necessity for larger water works.

acts of
Nairobi

The prospects of Nairobi are such that there is a likelihood of money spent now being a profitable investment. A country so favoured by nature as the British East African Protectorate may reasonably be expected in the future, even if it does not equal the prosperity of some other colonies, at all events to be quietly progressive.

In my estimate of the future population, taxable value and rental I have calculated on Nairobi being the centre of administration and chief European town in an agricultural country with a population of some thousands of settlers; the head quarters of the railway and the junction with an important branch line. The figures given are certainly not extravagantly optimistic and may easily be exceeded.

An increase in the trade or prosperity of any part of the Protectorate must have its effect on the capital

92

town; on the other hand the larger the population of the town the better will be the prospects of farming in the country round.

Nairobi has now reached a crisis in its history. In spite of the natural defects of the site it is possible to transform it into a well-built, well drained and healthy town laid out on modern lines with good roads and an ample supply of pure water.

Unless the present state of things continues there can be no question that epidemics must visit the town. Plague has already made its appearance; there is no reason why the next epidemic should not be more of a such, more virulent and infectious type than the previous visitations. There has so far been an immunity from typhoid fever, the typhoid germs never having had the opportunity of getting into the soil. It would however be a very optimistic person who would expect the community to continue for any length of time; if an epidemic of typhoid should break out in Nairobi, the conditions there lead one to suppose that there would be no limit to its ravages.

I therefore venture to make these recommendations in the full expectation that your Lordship will agree the works I have described and the measures I have suggested, are not only necessary, but eminently desirable not only from the point of view of Nairobi itself but also of the Protectorate as a whole.

I have the honour to be my Lord,

Your Lordship's most humble and
obedient servant,

Robert G. ...

THE STATISTICS OF NAIROBI

Results Census of Nairobi Township and Military Lines Nov 2nd 1906

	Adults	Children	Total
Europeans	469	110	579
Asiatics	38	25	63
Africans	433	77	510
Military Lines	2962	203	3165
	37	134	171
	11745	1769	13514

Note: - This includes 2002 persons in the Military Lines

TABLE 2

Estimated Population of Nairobi Township only in the years 1904, 1905, 1906

Year	Europeans	Asiatics	Africans	Total
1904	162	1836		
1905	306	2141	765	
1906	559	3383	673	7371

* Including Eurasians and Goanese.

† No reliable figures available.

TABLE 3

Estimated future population of Nairobi Township at the end of each 5 years period from 1906 to 1936

Year	Europeans	Asiatics	Goanese	Indians	Africans	Total
1906	559	63	409	5030	7371	11222
1911	1100	90	650	4000	10000	15840
1916	2000	120	700	4800	12400	20100
1921	3200	160	900	5500	16400	24100
1926	4200	200	1000	6200	20000	28400

Distribution of population of ... 1929

District	European	Chinese	Japanese	Indians	Africans	Total
Business quarter	2300	60	800	450	2200	4210
Industrial quarter			30	3000	500	3530
Public location					4000	4000
Suburban					100	100
Business quarter	10	50	200	70	200	430
Suburban	2030	30	350	300	2000	4710
Industrial quarter	80	50	100	150	500	820
Business and South			60	300	600	960
Industrial quarter			30	250	500	780
Total	4100	200	1000	6200	16000	28000
Military zone	25		25	50	1900	2000
Total	4625	200	1025	6250	17900	30000

APPENDIX II

TABLE I

occurring within the Township area
 Jan 1st 1906 Sept 30th 1906

	Estimated average population	No of deaths	Deaths per 1000 per annum
DEATHS	460	5	10.5
	5500	64	20.4
	2800	61	29.0
	400	3	10.0
Total	10460	173	22.0

TABLE 2

occurring within the Township area Jan 1st 1906 Sept 30th 1906
 according to diseases

Disease	No of deaths	Deaths per 1000 per annum
Typhoid	6	3.3
Diphtheria	18	2.20
Scarlet fever	2	0.4
Cholera	20	2.55
Typhus	12	1.53
Smallpox	1	.13
Other general diseases	44	1.78
Measles	8	.77
Scarlet fever	2	.25
Whooping sickness	2	.25
Scarlet fever	2	.25
Respiratory system	6	.77
Respiratory system	47	6.04
Digestion	7	.89
Injuries	7	.89
Poison	1	.13
Total	173	22.05

TABLE 1

Summary of Nairobi for the 6 years 1900-1905

1900	1901	1902	1903	1904	1905	TOTAL	Average
Inches of rain	Inches of rain	Inches of rain	Inches of rain	Inches of rain	Inches of rain	Inches of rain	Inches of rain
8.39	3.00	3.20	6.25	1.42	3.10	21.55	3.59
11.74	9.57	8.23	7.02	3.86	7.28	56.72	9.45
10.68	11.22	6.12	4.26	8.75	8.13	56.63	9.44
13.59	19.24	8.87	12.48	14.36	14.41	90.90	15.15
6.25	11.49	9.46	7.54	4.35	12.81	63.77	10.63
5.12	2.19	5.99	6.30	12.41	5.16	43.60	7.27
1.21	3.13	6.88	7.88	7.46	5.22	38.52	6.42
2.24	1.70	2.10	2.10	2.02	6.15	3.57	5.95
0.00	0.43	2.26	10.79	1.12	4.02	18.92	3.15
7.77	1.20	4.24	8.33	8.15	6.09	45.93	7.66
5.39	13.68	3.22	9.32	5.60	6.19	53.61	8.94
8.13	3.18	9.45	12.29	8.15	5.48	60.78	10.13
7.34	42.18	82.43	100.39	100.27	100.47	507.28	84.55
4.76	3.54	6.38	6.29	8.33	8.66	53.99	8.99

1900

1901

1902

1903

1904

1905

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1900												
1901												
1902												
1903												
1904												
1905												

179

TABLE 3

Summary of Table 2

Number of rainy days during the seasons 1890-1895

1890	272	23	27	24	20	4	4						
1891	289	20	23	19	13	7	1	1	1				
1892	241	16	19	15	20	3	1						
1893	248	26	22	17	12	7	1	1					
1894	232	22	22	23	9	2		1					
1895	220	20	20	18	11	8	2	1	2	1			
1896	218	129	86	31	8	4	3	2					
1897	240	125	215	143	51	10	6	5					

16.18 per 100 000

Origin of Sample	Date 1906	Total Solids	Ammonia		Oxygen absorbed in 3 hours at 80°	Hardness			Chlorine	Total Sulphate Solids	Remarks
			Free	Albumenoid		Total	Temporary	Permanent			
1919 Lake Kikuyu Reservoir	Aug 8	28.0	0.0007	0.0016	nil	8.0	2.0	6.0	6.0	0.06	The results of the high level examination, the water with the chemical analysis the water table of substantially quality for drinking
1919 Lake Kikuyu Reservoir	Aug 9 th	24.0	0.001	0.004	0.068	5.5	1.0	4.5	5.0	0.06	do
1919 Lake Kikuyu Reservoir	Sept 22	not given	0.004	0.016	0.368	7.0	2.0	5.0		0.05	
1919 Lake Kikuyu Reservoir	Sept 25	not given	0.005	0.034	0.338	8.0	2.0	6.0		0.04	
1919 Lake Kikuyu Reservoir	Sept 26	not given	0.003	0.015	0.120	8.0	1.0	7.0		0.04	The results of the high level examination, the water with the chemical analysis the water table of substantially quality for drinking

DRAFT

C. Agate

C. Agate

MINUTE.

- Mr. *W. H. C. 2/3*
- Mr. ~~Andrews.~~
- Mr. ~~Cox.~~
- Mr. ~~Lucas.~~
- Mr. ~~Graham.~~
- Mr. ~~M. Osmanney.~~
- Mr. ~~Churchill.~~
- The Earl of ~~Elgin.~~

undated notes

Specimen of report of H. C. (P.R.)

circulate from file

2^d March 1907

gentlemen
by the last of these to
transmit to you the
accompanying copy of
a report by Mr. G. B.
Nuttall on the surren-
der of Nairobi & to
request that you will
have 50 copies printed,
with reproductions of the
3 photos showing the
route to the base of
the G. R. P.

The document is of confidential nature.

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