Governor 169
Inward

1910
11th April

Last previous Paper.
4/AP/1910/630

Transmits

P. O.

Print the P. M. G's covering letter & Dr Ross's report, omitting pp 18-30, & pp 34 - 51. - & return to me.

at once.
L. S. R.
(5) IV.

Send 2 copies of the print to the Director of the S-S Bureau & Dr Sir Rickett respectively & the rest of the papers to Mr Keith to note that they are to be brought before the Advisory Ctee at their next meeting.

at once.
L. S. R.
1/IV.

S-R

Encl. 2 copies (By Govt Steamer) 6 June
A Proof in letter No 356. 17 June

Subsequent Paper.
AP
25122

pro

13516

PRINTED FOR PARLIAMENT
Cd 5514 July 1911

NATIONAL BACTERIOLOGICAL LABORATORY.

REPORT FOR THE YEAR 1909.

Governor 185
Bromhead

1910
7 April

Previous Papers

36530
9

Presents

P. S.

Print the P.M.O.'s covering letter & Dr Ross's report, omitting pp. 18-30 & pp. 34 - 51.

- & return to me.

at once.
L. J. R.

15/IV

Send 2 copies of the print of the Director of the S-S Bureau & Mr Guy Marshall respectively - & the rest of the papers to Mr Keith to note that they are to be brought before the Advisory Ctee at their next meeting.

at once.
L. J. R.
1/IV

S R

2 copies (Mr Guy Marshall) & all Proofs to Gen 356. 17 June

Subsequent Paper.

Dr
25122

GOVERNMENT HOUSE,
NAIROBI,
BRITISH EAST AFRICA.

April 11th 1910.

No.189
(Incl:2)

My Lord,

With reference to my despatch of the 14th of October last No.569 I have the honour to transmit herewith the report of the work done in the Kafiroi Laboratory for the ½ year ending the 31st of December 1909, together with a covering letter from the Principal Medical Officer.

I have the honour to be,

Your Lordship's humble,

obedient servant,

GOVERNOR.

The Right Honourable

The Earl of Crewe, K.G.,

Secretary of State for the Colonies,

Downing Street,

LONDON, S.W.

36530

— 4262-20

No. 41/10.

P.M.O's Office,
Nairobi,
29th March 1910.

Sir,

I have the honour to forward the Bi-annual Report on the work of the Nairobi Bacteriological Laboratory for the six months ending December 31st 1909.

Research work proper during this period has been much interrupted by two factors, a vastly increased demand for a free supply of vaccine owing to an outbreak of small pox which filtered through the country, which of a necessity took up a great deal of the time of Dr. Ross and his assistant, and the chemical examination of numerous water supplies.

Research work has been confined to confirming the results of Dr. Kleine's discovery - the length of time the tsetse fly Glossina Palpalis can retain its infectivity with the Trypanosome of Sleeping Sickness. These experiments are not yet completed. Dr. Ross's work on the leucocytozoon of the guinea fowl has been continued and would appear to confirm the work of Neave and Fenyon at Khartum on the same subject. As regards the disease O'Kabbe it will be noticed that he is not in agreement with the opinion expressed by Col. Sir David Bruce and Dr. Theiler, that this disease is identical with East Coast Fever.

The major portion of the report is taken up with an interesting discussion on the waters of East Africa, with a number of analyses appended.

I have the honour to be,

Sir,

Your obedient servant,

D. J. Mahoney

Principal Medical Officer

The Secretary,
to the Administration,
Nairobi.

SECOND REPORT

OF THE

Nairobi Bacteriological Laboratory

FOR THE YEAR

1909

BY

DR. P. H. ROSS.

Nairobi Laboratory Report, July 1 - Dec. 31 '09.

During the past six months the routine work of the Laboratory has very much increased, the total number of examinations made being nearly four times as grea as during the first six months of the year. The large number of water analysis that have had to be done and the greatly increased demand for vaccine lymph have made a large demand on one's time. Mr. Montgomery, the veterinary bacteriologist, arrived in August, but, his own laboratory not being ready, he has spent most of his time in the districts and the routine diagnostic veterinary work has still been done in this laboratory. Fortunately the veterinary laboratory assistant has become sufficient ly expert with the microscope to be able to do most of this work, referring to me when in doubt or when wanting confirmation of his diagnosis. But for this, the addition of some 1100 veterinary examinations to the increased medical work would have made it impossible to keep pace.

Work has been continued with Glossina allidipes and Glossina fusca and various trypanosomes, but so far without result. Work with the Leucocytozoon of the Guinea fowl was interrupted by a constant succes ion of water analyses which rendered impossible continuous use of the microscope.

Blood examinations and Malaria.

Of 372 blood examinations, 49 showed malaria. Thirty of these were cases of sub-tertian, 14 of benign

benign tertian, and two were mixed infections, one of benign and sub tertian, and one of quartan and subtertian.

Out of 216 differential leucocyte counts, 24 showed an increase of large mononuclear leucocytes with the presence of pigment. These cases must also be regarded as malarial. The total result is that 19.6 of all bloods examined were malarial.

An increase of Eosinophiles is rather commonly seen, an increase above 5% being seen in 38 cases. Twenty four of these cases were Indians, only four being Europeans and six Africans.

Leprosy.

Two cases of leprosy were seen. The first was that of a native, and in this case scanty acid fast bacilli were found in the discharge from a sore.

The second case was that of an European. In this case attenpts were made to demonstrate the bacilli by the method of Marchoux and Borret. This method consists in taking blood smears from the neighbourhood of a leprous lesion, fixing by burning a drop or two of absolute alcohol on the slide, staining with warm carbol fuchsin, decolourising with 10% nitric acid, and counter staining for a second with borax blue to colour the leucocytes. The bacilli are looked for in the large mononuclear leucocytes where these are most numerous, that is to say, the sides and ends of the preparation. In the case tried, no bacilli were foundby this method, but it was probably not a fair test, as the case was one of almost pure anaesthetic leprosy. The bacilli were demonstrated in the nasal discharge and also

in

in scrapings from anaesthetic dry anaesthetic patches. It would be interesting to make a series of examinations by the method of the French writers on cases of nodular leprosy. If the method proves a success, it has the advantage of being simple, easily carried out, and of doing away with the exception that may be taken to the examination of the nasal discharge - that the bacilli found may be some other acid - fast bacilli and not the B. leprae at all.
Perhaps some medical officer who sees much of the disease would examine a series of cases, or would send smears from cases to the laboratory for examination.

Vaccine.

29430 tubes of vaccine have been issued, being sufficient for more than 100000 vaccinations. On the whole the results have been apparently good, the only complaints of failure having been received from Kisumu from Marsabit on the northern frontier and from an out station in Uganda. I am at a loss to explain the bad results with several issues of lymph to Kisumu. In one case, lymph from the same calf was used with success at the laboratory to vaccinate another calf at the time that the issue to Kisumu was made. In other cases I had no such control, but even the results of vaccinations at Kisumu were in some instances very contradictory. A possible explanation is that after a certain time in the ice chest the lymph is still active when used at once, but that it becomes less resistant to high temperatures, such as would be met with at Kisumu, when it has been some time removed from the ice, even though every

effort

effort may be made to keep it cool.
So far as concerns Marsabit and Uganda, prolonged sojourn in a hot post bag on the back of a porter in a blazing sun is sufficient to account for loss of activity in any glycerinated calf lymph. In the case of Marsabit, it takes a month for the post to arrive, and it would be surprising if any of the lymph were active at the end of such a journey. I hope that now I have the means of overcoming this difficulty by using the method, described by Ashalme and Marie Phisalix, of drying the lymph in vacuo and sealing in tubes, also in partial vacuo. If lymph so prepared keeps its activity in the manner described by these authors, I propose to make sufficient to issue to all out stations. Such lymph could then be kept in stock, and, in the case of an outbreak of small pox, would serve to vaccinate contacts and to carry on vaccination until further supplies of fresh lymph could be obtained from the laboratory. It could also be used as the usual supply for distant stations where the glycerinated lymph gives bad or no results. Two strains of lymph have been manufactured and issued. One was the strain derived from the Lister Institute, the other was that started by Dr. Small from cases of small pox There seems to be no difference between these two strains. Both have given usually good results, and, in the case of the bad results at Kisumu, both strain had been supplied.

Plague.

No cases of plague occurred in Nairobi, but infected rats were sent from Nakuru for examination.

Smears from the sputum of a case of pneumonic plague were also sent from Nakuru.

Dr. Arthur, of the Scotch mission at Kikuyu, sent smears made from the puncture of buboes in two cases, and, in these, bacteria morphologically indistinguishable from the B. pestis were found.

In the spleens of two cases which died in the Native hospital, Nairobi, bacteria resembling the B.pestis were found. Cultures were made, and the growths resembled those of plague bacilli, except that no stalactite formation could be got. Involution forms on salt agar were obtained. The cutaneous reaction on a Guinea pig was tried, but without result. In both cases, some time had elapsed between death and the carrying out of the post mortem examination, so that it is probable that the bipolar bacilli met with were only putrefactive organisms.

Koch-Week's bacillus.

In smears from the discharge in a case of conjunctivities, bacteria were found indistinguishable from the Koch-Week's bacillus (B.aegyptiacum).

Search for Malta fever among goats.

Thanks to the kindness of Sir David Bruce, the laboratory became possessed of a strain of Micrococcus melitensis. I have examined many goats for an agglutinative reaction with this strain. The sanitary inspector in charge of the slaughter house kindly took a tube of blood from every goat slaughtered, and these blood were tested in a dilution of 1-20. No reaction was found in 263 goats examined. The work was interrupted by water analysis, but the

fact

fact that the question has been frame in Uganda makes it appear worth while to continue the search in this protectorate. I do not think that goats' milk is much used by white people in this country, but any one using it would be well advised to boil such milk before use, as a precautionary measures.

Various work.

Among the miscellaneous work brought to the laboratory there have been such things as the weighing of coins for the Treasury, and the estimation of acidity in fruit. The fruit was a species of Flacourtia very common in the Kavirondo country, and the question was its suitability for coagulating rubber. When the fruit reached the laboratory, it was somewhat fermented. The juice was expressed by squeezing through cloth, and the acidity of the juice determined. One kilo of the fruit yielded 700 c.c. of juice, which showed an acidity equal to 4 c.c. of glacial acetic acid in 100 c.c. of juice. If this is a sufficient degree of acidity for the purpose, the fruit should be a cheap substitute for lemons and oranges. If the acidity is insufficient, it might be worth while trying whether the acidity could be increased by fermentation, without damage to its coagulating properties A slight degree of fermentation, such as the sample sent showed, would probably make the expression of the juice easier.

Trypanosomiasis.

Experiments have been begun with T. gambiense and a trypanosome from a mule and Gl. fusca and Glossina

Glossina palpalis on the lines of Kleine's experiments. Unfortunately up to the present, the experiments have been abortive, owing to the premature death of the experimental animals, but the experiments are still going on in such numbers as the supply of experimental animals will allow.

In these experiments, made with captured flies, the most important consideration is the exclusion of naturally infected flies. To ensure this, two animals are used for the flies to feed on before the experiment proper begins. The first animal is used to feed flies until a sufficient number have been collected for the experiment. These flies are then fed on another animal for from 18 days to three weeks, then starved for four days, fed on an infected animal for four days, again starved for four days and then fed on the experimental animal.

For the second time, the animal on which the flies were fed when first brought to the laboratory has become infected and again the infective fly has been the G. palpalis. The previous case was in 1904 when the feeding of 85 flies during a period of 60 days resulted in the infection of the animal 70 days after feeding had been begun. In this last case 209 flies were fed between July 15 and December 10. The animal died on January 11 and it was only after death that trypanosomes were found. Inoculation of blood from the dead monkey into a fresh monkey resulted in infection, but inoculation of a dog at the same time failed. In this case infection was suspected nine days after feeding began, but repeated examinations of the blood during five months were

were always negative. The monkey became very thin, and had all the appearance of a trypanosome infected monkey, and the temperature chart was also very suggestive of trypanosomiasi. The trypanosomes found in this animal were 17 - 18 micron in length, including a short free flagellum, and had rather a blunt posterior end.

Another trypanosome met with was found in a mule which had been recently imported from the north. This trypanosome closely resembled morphologically T. nanum, but it is distinguished from it and from T. vivax and T. cazalboui, the group as described by Montgomery and Kinghorn, by the fact that it is extremely fatal to dogs, which die about a fortnight after inoculation with it. There is therefore a dif a difference between this trypanosome and the one conveyed by Gl. pallidipes from Kitwezi.

Blood parasites of the Guinea fowl and Spur fowl. In my report for 1908 I described and figured what I called Leucocytozoa in the Guinea fowl and Spur fowl I find that similar, if not identical, parasites have been described by Neave and Nenyon in the reports of the Khartum laboratory. During the past six months I have had several Guinea fowl infected with this parasite in the laboratory, in hopes of being able to work at the life history. All that has been possible, however, has been to observe the parasites in fresh and stained specimens, and I find that Wenyon's account is so full that there

is

is little to add. The point on which I am still unconvinced is his contention that the host cell is an erythrocyte. There certainly are large greenish oval cells in birds' blood, which may very likely be altered red cells, but I find that the nucleus of the host cell in this disease is very often larger than any nucleus I have seen in these presumably altered red cells. In my guinea fowl, even when showing a very high infection, I have found very little variation in the size of the parasites, but, in a spur fowl which showed numbers of parasites indistinguishable from those of guinea fowl. I have also seen many smaller forms, and it is the appearance of these latter forms which makes me doubtful as to the identity of the host cell.

In these smaller forms the picture usually consists entirely of parasite and nucleus of host cell. The latter is varying in size, but is always larger than the nucleus of a normal erythrocyte, and usually larger than the nucleus of one of these abnormal red cells. Further, it is often very irregular in outline, being indented by the parasite or folded round it. But in these smaller forms there is seldom any trace of host cell, apart from the nucleus, whereas, were this cell one of the altered erythrocytes, one might expect to see at any rate a small portion of the cell not yet filled with the parasite, as is the case with Halteridium. When any unoccupied portion of the host cell is visible, it stains a pale blue as would the protoplasm of a leucocyte.

One must further presuppose that these altered red cells

cells are entirely deprived of haemoglobin to account for the absence of pigment or other debris the result of destruction of haemoglobin.

The infected Guinea fowl I have been observing have also had a high infection of Halteridium, which promptly flagellated when the blood was drawn, but the leucocytozoon were also present in large numbers. After a copule of hours, the free flagella were usually no longer visible, while the changes that I observed in the leucocytozoon often did not take place till the blood had been drawn for a considerable time.

In the case which showed the highest infection with leucocytozoa, four or five parasites could often be seen in one field. No locomotion was ever observed on the slide, but in some of the parasites there was a kind of peristaltic movement. The most noticeable thing about the movement was the slow flowing of the refractile granules within the parasite. These were usually grouped at the two ends of the parasite, but were sometimes seen to gradually move, first towards one end and then towards the other. At the same time, close observation showed that a kind of peristaltic wave kept passing from one end of the parasite to the other, and then back again. Wenyon describes this movement, and also the appearance of protruberances, not large enough to be called pseudopodia, from the side of the parasite. I have found that the peristaltic movement, with the [illegible] of the granules, can be observed in many of the parasites, but by no means in all, whilst the appearance of

of a projection on the surface is much more rarely seen, and is the precursory of further changes, which result in the escape of the parasite from the host cell. This escape I have observed several times, but not nearly so often as one would expect, considering the numbers of parasites that have been watched. I soon found that what looked like a large, and therefore probably full grown parasite, might be watched for hours, that the granules would continue moving, but that no further change took place unless the parasite had also exhibited the formation of these slight projections when first taken under observation.

The projection usually occurred a little to one side of the middle of the parasite on the side opposite the nucleus of the host cell. Very slight at first, it kept disappearing and appearing, getting gradually larger. When it reached a size that stood out as a distinct projection, it became permanent, getting a little smaller but not entirely disappearing. At this stage it could be observed that the granules were flowing in and out of the projection. The projection increased in size till it formed three parts of a circle, when it gradually became constricted at its base, and finally, when all the granules had flowed into it, it appeared to become entirely separate from the rest of the cell, or, at most, joined to the cell by the thinnest of thin threads. After this had occurred, no further change was seen even when the parasite was watched for several hours. Several of the preparations were carefully smeared off the blood allowed to dry, and then stained with

In the stained specimen many unaltered parasites were seen as well as a few which had apparently undergone the change described. In these latter, the nucleus of the host cell could be clearly made out, and round it could be seen the envelope of the host cell, looking like a burst bladder. The parasite lay beside the remnants of the host cell, sometimes apparently free, sometimes connected to the remains of the cell by a faint thread.

In all the fresh preparations examined there was no variation in shape in the parasites. They were always definitely spindle shaped, and the only variation was in size, and, even in this, the variation was small.

In the stained specimens, however, there were very marked variations in shape, which must have been the result of spreading the smear. Two types, as described by Neave and Wenyon - the deeply stained very grandular female and the lighter stained less granular male - were quite obvious, but in all, comparing them with the fresh specimens, there was an evident flattening of the parasite. Judging by the very uniform appearance of the fresh specimens, practically all the variations in shape seen in the stained specimens must be attributed to the spreadin of the film preparatory to staining.

Smears were made from the internal organs of one infected Guinea fowl which died. In both fresh and stained preparations, the parasites were found, usually showing no difference from the forms seen during life, but there was a large proportion of fre

parasites.

Many of these were apparently still contained in the host cell, others were closely applied to the remains of the cell, and only in a very few could no trace of the cell be seen. When free of close outside the host cell, the parasite appeared as an irregular oval-the usual shape when still within the host cell- or as a circular body resembling the escaped parasite as seen in a fresh preparation when the escape of the parasite has been observed. In the Guinea fowl which showed the highest infection of Leucocytozoa there was also a very high infection of Halteridium. The latter flagellated as soon as the blood was drawn, and the most obvious thing seen in a fresh preparation was the violent agitation of the pigment in the parasites which had already become spherical. In a few minutes several flagella would be protruded; when all were protruded, the interior of the cell came to rest, but the cell itself would then be violently agitated by the lashing movements of the flagella. Gradually the flagella would escape and then the picture was that of an intense trypanosome infection. For an hour or more, the flagella could be seen actively moving about the field, often several being seen attacking the red blood corpuscles. But, though carefully watched, no flagellum was ever seen to attack a cell infected with Halteridium. The most marked thing about the free flagella was their dextrotropism. Any air bubble in the preparation was surrounded by numbers of flagella, all in active movement. Occasionally flagella could be seen attacking a Leucocytozoon, but this was very rare, and the

flagellum

flagellum was never seen to penetrate, whereas, in the case of red cells, flagella could frequently be seen, which had either penetrated the cell, or were so closely applied to it as to appear as if they had penetrated. One of Wenyon's figures (No 27 Plate XVIThird report Wellcome Laboratory) resembles what I have seen in stained specimens from this doubly infected bird when the blood had been kept for some time, either under a cover glass or in a damp cell before being spread; but I have never seen any sign of flagellation occurring in the leucocytozoa, nor indeed of any further change than that described above as extrusion of the parasite from the host cell.

M'Kebbe.

In my report for the year 1906, I described under the name of "M'Kebbe" a disease which appear to be common among calves throughout the country. As the Sleeping Sickness Commission in Uganda and Dr. Theiler, who recently passed through the country have come to the conclusion that this disease is neither more nor less than East Coast Fever, it would seem worth while to reprint that part of my 1906 report, which was the first account of the disease. I add this as an appendix.

It is, of course, possible that the Commission and Dr. Theiler have had to do with a different disease from the one I described four years ago, but I am quite clear that the cases I then saw were not Coast fever. I first met cases of Coast fever in 1904, and came across the "blue body" in November of

of that year, and looked for it and found it in ever case of the disease that I saw after that date. I also found, during the year 1906 in the cases that I described as M'Kebbe, peculiar bodies in the peripheral blood and in the glands by puncture during life, and in the liver, spleen and lung, post mortem. Yet I saw or reason to consider that the diseases were really one and the same. One point of difference was that M'Kebbe was a wasting disease, the carcase after death being distinctly emaciated. In Coast fever, on the other hand, the animal is usually in good condition and may look well till a day or two before death. As regards the blue bodies, the appearance in fresh specimens was distinctly different. The M'Kebbe body was hard to see and the most remarkable thing about it was the active dancing movements of the granules. In Coast fever the granules are larger in size, and have not got this dancing movement.

In the stained specimen the Coast fever body is a much more prominent object than the M'Kebbe body. The masses of chromatin are larger, and often more numerous, and the protoplasm takes on a much darker blue than does the protoplasm of the M'Kebbe body. As regards occurrence in the various organs both bodies are found in glands and the inner organs, but I have not seen the M'Kebbe body in anything like the numbers in which the Coast fever usually occurs. Infarction is much less marked in M'Kebbe than in Coast fever. Further, the M'Kebbe body can, by long search, be found in the peripheral circulation. In the hundreds- probably thousands - of Coast fever

slides

slides that I have examined since 1904, I have only three times seen the blue body in the peripheral blo blood, and those three cases the bodies were so distinctly Coast fever bodies that I should probably haveexcluded M'Kebbe even without the high infection of ring and rod parasites. The absence of ring and rod intracorpuscular parasites in my cases of M'Kebbe was another point of difference. In the prolonged search through blood smears to find the M'Kebbe bodi one must certainly have found these intracorpuscular forms had they been present, especially as I was then very familiar with their appearance, and always on the look out for them, in order to find out if Coast fever were spreading.

Another point against the identity of the two diseases is, that if they are one and the same, the country round Nairobi, and possibly the whole protectorate, must be an endemic centre of Coast fever. M'Kebbe was known to Mr. Sturdy some years before Coast fever was discovered here, and, since its discovery, the spread has been followed. It is certainly true that there have been cases which seemed to show that the local cattle had some degree of immunity, but, on the other hand, the mortality has been very much higher than one would expect from an endemic disease, immunity to which was due to previous attack and recovery. The wholesale destruction of cattle by Rinderpest between eleven and twelve years ago should have left large areas destocked for long enough for them to become clean. Even though the cattle brought in from surrounding countries might

might have been immune, they would have been unable to reinfect such country as had become clean, and until the disease was reintroduced, the only immunity would be that of the imported cattle and a possible hereditary immunity in their progeny.

'91

Meteorology.

The shelter and enclosure for the Meteorological instruments have not yet been put up, but I have kept the Stevenson screen with self recording thermometer under the verandah of the laboratory. Barometer thermometer and rainfall records have been kept for the last three months. Having no mercurity barometer, I do not know if the self recording instrument is corrected. It shows clearly, however, the two daily rises reaching the highest point between 10 a.m. and midday and between 10 p.m. and midnight. The two lowest points are at about 4 p.m. and 4 a.m. The range is very small seldom amounting to .15 of an inch. The thermometer also shows a very regular daily curve the maximum being reached about 3 p.m. and the minimum at about 6 a.m.

Water.

To the end of the year 1909, 105 samples of water had been completely analysed, and on a certain number less complete analyses have been carried out. Fourty four of these analyses have been done since September 11 last

From this large amount of material it is more possible to draw conclusions likely to be correct than it has ever been before. The addition of the number added during the past four months largely removes the objection that one was generalising from too small a number of observations, and also, during these months, many samples have been taken with one definite object in view, and much fuller particulars have accompanied the samples.

The value of such particulars as those asked for in Medical form XXIX must always be considerable in helping the analyst to give an opinion on a water sample, although in this country the lack of these particulars in the past has hardly been felt, owing to the great majority of the samples forwarded being so chemically foul as to leave no possible doubt in the mind of the analyst.

The danger arising from the lack of this particulars is, that a chance sample might be sufficiently pure to pass the tests on a given day and never be pure enough to pass again. Such an occurrence is by no means impossible. At the beginning of either the large or small rains there is often a heavy downpour lasting a few days. This downpour may be so heavy that the soil cannot absorb all the rain as it falls,

and

and a great deal of water flows straight into the nearest stream, carrying with it all the filth which has been accumulating on the surface in native villages, cultivated land, native washing places and watering places for both game and domestic stock. If, after this downpour, there come a few dry days, as is often the case, a sample of water taken now might be pure enough to pass the tests. The rain that had soaked in would not have had time to reach the stream as subsoil water carrying with it the filth which had soaked into the soil sufficiently not to be carried off by the surface water, and the surface filth would have been washed away by the firs downpour. If the particulars sent with the sample showed such conditions, the analyst would at once ask for further samples when the conditions were more near the normal.

The various samples of water examined may be grouped under three heads. 1 springs, 2. rivers and 3. coast wells.

1. Springs

Good samples of spring waters have been sent from Kiambu, Fumias, Limoru and Nairobi. Other spring waters, such as that from Fort Hall and from a spring near Punda Milla, are apparently merely subsoil water made up largely of drainage from the neighbourhood of native villages.

2. Rivers.

Apart from the few large rivers in the country, most of the streams are no more than creeks with a fair volume of water during the rains, but drying up to what may become a mere trickle after a short drought

These streams that dry up completely may be disregarded when one is considering water supply, and, in the case of many of the smaller streams, it would be better from an hygienic point of view if the settlers through whose farms these streams run would be regard them more as open drains than as sources of supply for drinking water. Taking the streams with which I am acquainted as samples showing the conditions commonly met with throughout the country, I should say that the water of no one of them should be drunk without boiling, except by the man on whose farms the stream risen, and then only by him if he can protect the source from contamination. It is, of course, possible that water might be drunk from these streams for years without harm resulting, but no one can tell when he may be caught. A very good example of this occurred two or three years ago, when a small epidemic of typhoid was clearly traced to the use of water from the old Nairobi supply, when the new supply was cut off during a great part of the day owing to drought. The old supply is taken from the Nairobi river at the French Mission, and, until the installation of the new supply, had been used with apparent impunity by every body. But, some months before this epidemic, cases of typhoid had occurred some miles above Nairobi in the drainage area of the river. Then came the drought, shortage of water for the new supply, and the use of the old one, which had presumably been effected by cases of typhoid along the river above the intake. When it is remembered that, in the last few years, it has been shown that a person who has recovered from typhoid and is apparently perfectly well, may harbour

harbour the typhoid bacilli for many years (some say " once a typhoid carrier, always a carrier") and continue to discharge virulent bacilli all the time, it must be admitted that these small streams are dangerous. Most of them have collections of natives living near their banks, and the water is liable to fouling directly by the natives and less directly by filth finding its way into the stream, or being washed into it by the rain. It is very unlikely that the cases of typhoid seen among natives were the only ones; it is much more probable that the disease is widespread among them. The streams, then, are liable to infection by the sick, including ambulatory cases, and by recovered cases which act as " carriers". I think, therefore, that the wise men will take the extra trouble necessary to have his drinking water boiled.

The larger the volume of water in the stream, the greater the dilute pollutionand the less the danger to the drinker. But when it is considered that such an authority as Sir Edward Frankland holds that " it would be safer to infer that there is no river in the United Kingdom long enough to effect the destruction of sewage oxidation" it would appear reasonable to hold that, in considering water supply in this country, one may leave out of one's consideration the possibility of the small streams ever being able to purify themselves. Nearly all the examinations of water, made so far, strongly support this point. The few exceptions may probably be

classed

classed with the possible exception mentioned above. The local streams are probably at their worst at the end of a drought and just after the first downpour of rain, and it is then that samples of water should be collected for analyses. Samples taken after several weeks of rain are not only valueless, but are likely to be deceptive.

It is not only the pollution that has to be considered. Many of the streams contain Magnesium salts in varying quantities. In the wet season, these salts would probably be so diluted as to have no harmful effect, but diminuition of the flow of the stream would properly mean greater concentration of the salts and the concentration might easily be sufficient to make the waters purgative. This seems to be actually the case with the Makindu river, and may be the case with other streams flowing from Kilimanjaro, some of which have a very bad repute in this respect. The Simba river's reputation is so bad that it is quite likely that even dilution by heavy rain is insufficient to do away with its purgative properties. It must be remembered, in connection with waters containing magnesium that a person, by constant drinking of such water, may become more or less immune to its ill effects. Such a person will very often be quite sure that there is nothing wrong with the water, but it is in dealing with such waters that the layman's opinion is worth even less than in dealing with polluted waters. The old hand may suffer no ill effects from drinking such a water, but the new comer, or the person with weak digestion may

may suffer acutely and seriously.

Another mineral found in some of the waters is iron. In a shallow well, sunk in the river bed at Kibos, iron was present in such quantities as a lower salt, that, when the sample was opened and exposedto the Oxygen of the air, the iron salts were oxidized up to the higher salts, and the water turned slowly red from above down. Such a water is of course useless for domestic purposes.

3. Wells a he coast.

A large numebr of waters from coast wells have lately been examined. Many of these came from Mombasa, and others came from Malindi and Lamu. The features common to all were excessive foulness and large quantities of hlorides. So far as concerns Mombasa, with the condi ions of which I am familiar, this was all that could be expected. The island is small, and consists largely of coral. The population is large, and t e wells are sunk through the coral to about sea level. The cess-pits of the old Arab houses are also sunk into the coral, though they do not go as deep as the wells. The natural tendency of the fluid contents of these pits is to fi find their way to sea level, and so into he wells. Judging by the results of the analyses, a considerabl portion of the fluid contents does succeed in reaching the wells. It is possible that a well water might be found in some scantily inhabited part of the island which, though it would show an increase of Chlorides, would not show sewage pollu ion. Such a well would probably be little used at the present

time.

time, but the result of increasing the use of the well would be to increase the radius of the area it drained, and so run the risk of tapping either sea water or sewage.

Other coast wells examined have given results very similar to the Mombasa wells. A sample of water from a medicinal spring on the island where it is proposed to establish a leper settlement showed largeed quantities of magnesium, iron calcium and sulphuric acid.

The practical points arising from the conditions of water supply in this country are concerned with the collection and examination of samples, especially as bearing on the site of stations and homesteads, and the provision of a sufficient supply of wholesome water where no natural supply is available.

As regards collection of samples, it is waste of time to either collect or analyse samples taken from a small stream in a populated district. In districts where the population is small, and where what villages there are not near enough to the stream to be dangerous, there still remains the pollution by game. Apart from the possibility of game infecting a water supply with disease causing bacteria, there is another disease - Hydatids - which is largely water borne. In Australia the spread of this disease is attributed in great part to infection of drinking water by domestic or half wild dogs. I have seen, in this country, a case of the disease in a native and in sheep, so that the danger is real one. The conclusion must be, that no small

stream

stream, below its source, is a safe supply for drinking water.

As regards springs, it is essential that there should be no human habitation near a spring and uphill from it, so that the surface drainage or subsoil water from the inhabited area can find its way into the spring. Where there is a perrennial spring with habitations in objectionable proximity, it may sometimes be worth while to have the water analysed with a view to the presence of mineral impurities, such as magnesium, and then, if the results are favourable the habitations could be moved and further samples for analysis taken later on. Water from a spring that dries during drought, or from one close to a native village that cannot be moved, if the lie of the land is such that drainage from the village is bound to find its way into the spring, is not worth analysis. Only when the spring comes straight out of the rock if the surroundings are unfavourable, would it be worth while to analyse, and even then analyses would have to be done of samples taken under all probable conditions of rainfall, in order to exclude surface pollution, before a definite favourable opinion of any value could be given.

In the case of wells, probably all wells in this country, at present, come under the class of shallow wells that is, wells up to 50 ft. in depth and not passing through an impervious stratum. These wells collect all the surface and subsoil water and are usually dangerous. A well is considered, as a rule, to drain an area with a radius four times its depth,

but

but various circumstances, such as the taking of an abnormally large quantity of water at a time, may increase its drainage area, and so possibly tap sources of pollution which do not usually affect the well water. Unless there be an area half a mile in radius round the well, containing no possible source of pollution and able to be kept free from pollution, any shallow well is usually regarded with great suspicion. I doubt if any well in this country is likely to fulfil the above conditions. In a well of, say 50 ft. in depth, the water that finds its way in at the bottom might be safe on account of its having come a long way through the soil, but there is the possibility of water recently polluted finding its way into the upper part of the well. Thus drippings from the pump, or water splash near the edge of the well, might easily carry polluting matter into the well. Even a good coping and staining carried low down in the well might not protect the well in porous soil.

As a source of drinking water, the sources of streams come under the head of springs, and the same considerations as to possible fouling have to be taken into account.

Probably very few water supplies in this country fulfil the conditions laid down above, and it is necessary to provide drinking water from some other source. The only possible one is rain water collected off the roof.

Even where the rainfall is sufficient to provide a supply, two objections are usually raised to this

method

method. The first is that water in a tank gets unpleasantly hot in the sun. This is easily remedied by putting a thatch erection over the tank in such a way that there is room for free passage of air between thatch and tank. The second objection is that that dust and filth are washed into the tank off the roof. I have had some years experience of this method of providing drinking water in New Zealand and Australia and I never remember hearing evil consequences attributed to it, and the possible disadvantages may be minimized by using a rain water separater. This is a simple contrivance put on the down pipe from the roof, and is so arranged that the first fall of rain flows into the open air. After a certain time, a small hole lets enough water run into a chamber which acts as a counterpoise, the spout of the separater rises and sends the rest of the rain fall into the tank. After the rain has stopped, the water in the counterpoise evaporates and the spout tilts back, so that the first part of the next shower also flows into the open air. I find that one 500 gallon tank is sufficient, in Nairobi, to supply a minimum of two baths a day, and this should be ample when only used for drinking purposes. Where more than one tank is put up, it is a good plan to have a locked tap on the tank under the down pipe and let the other tanks be filled by the over flow from this tank. If more than one extra tank is provided, the extra tanks may be connected at the bottom, so that one tap is sufficient.

The locked tank, then, remains as a reserve supply when the tanks filled from its overflow are emptied.

I consider tanks preferable to underground or partially underground cisterns. The latter have to be very well constructed in the first place, and need constant supervision afterwards. The roof of such a cistern must be water tight, and the water as must be removed from it by a pump so arranged that drippings will not find their way back. Even with the greatest care, underground cisterns are apt to get most unaccountably foul, and, judging by the extraordinary foulness of some of the cistern waters that I have examined, those in this country are no exception to the rule.

Whatever receptacle be adopted to hold the rainfall, it is most important that it be covered to keep out dust and to prevent the access of mosquitoes. In some tanks, there is a solid circular lid, into a hole in the middle of which fits the end of the down pipe. Even when this fits tightly, which it very seldom does, there still remains the downpipe for mosquitos to enter and leave by. The top of the down pipe may be covered with gauze, but this is very likely to get choked with leaves and so cause loss of rainwater. A better plan is to have the opening into the tank filled with gauze, and a break between the lower end of the down pipe and the gauze. In this situation, the gauze is more accessible, if it does become blocked, and there

is no danger of leaking roofs from holding up of the water in the guttering.

The chief conclusions are, that, when on safari, one should boil all waters that one does not know, and also, that it is safer to boil the waters that one thinks one knows, and that settlers and officials in out stations should make arrangements for proper storage of rainwater unless prepared to boil all water that is drunk. And no one can be sure that this is done unless he does it himself.

Appendix 1.

Extract from Laboratory report for 1906.

For some years Mr. Stordy, Chief Veterinary Officer has been acquainted with a disease among calves, known in Uganda as M'Kabbe and in this Protectorate under various native names. The disease is characterised by fever, enlargement of superficial lymphatic glands, especially the cervical and precrural, wasting and often death. An opportunity occurred of studying the disease in the case of a calf sent into us from the Government farm, Nairobi The animal did not appear part particularly ill, but it showed large groups of glands the size of a pear on both sides of the neck. The temperature was found to be high (v. chart). The animal eat well but grew constantly thinner and finally died with subnormal temperature.

During life a gland was punctured with a large hypodermic needle, and fluid drawn up into a syringe. In a fresh preparation made from this fluid numbers of dancing granules resembling blood dust were seen among the normal glandular elements. Groups of 6 - 8 of these granules were noticed to keep together and on careful focussing and lighting, it was seen that each group was contained within a clear circular body of definite outline. Within the limits of this body the granules continued to move, some of them singly, others in pairs. Although watched for some considerable time, no sign of amoeboid movement in the large bodies was observed, nor were they seen

to

to undergo any further change.

On staining with Leishman smears made from the gland juice, circular bodies, varying in size from that of a red corpuscle to that of a white cell, were seen. They showed a faintly stained cytoplasm containing a few (3-6) small irregularly placed chromatin dots.

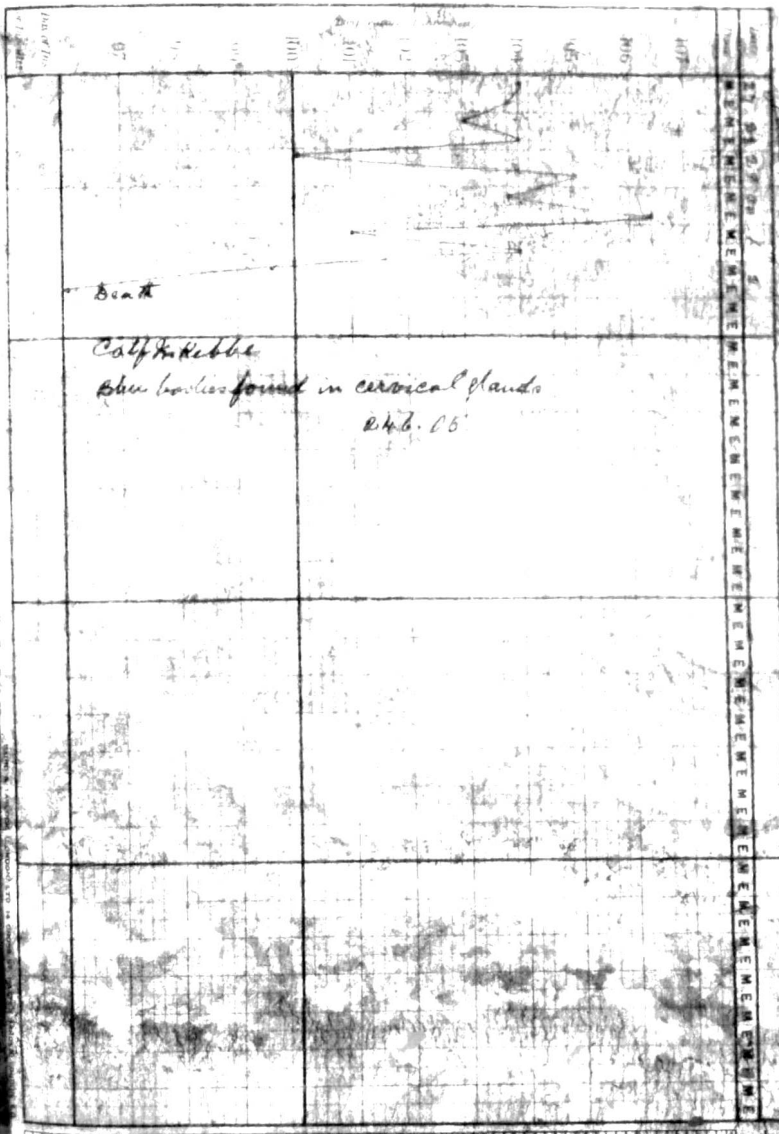
In the peripheral blood, long search showed similar bodies. The relative number found in gland and blood is comparable to the number of trypanosomata found in gland and blood in Trypanosomiasis hominis.

Post-mortem examination.

The calf was much emaciated. The superficial glands, especially cervical and precrural, were much enlarged. On section, their appearance was natural, except the one which had been punctured, which was haemorrhagic. The lung showed small infarcts along the edges. The heart had a little jelly like materia round the apex. The spleen was enlarged, but not to the extent seen in Texas fever. Mesenteric glands were slightly enlarged. The other organs appeared natural.

Smears of liver, spleen, and infarction areas in the lungs showed the blue bodies as described. This was the only animal in which we were able to follow the disease for any time, but opportunities occurred of making post- mortem examinations on three more fatal cases and of getting gland juice from two more living animals. The post-mortem appearances were exactly as described, and the blue bodies were

also


Death
Calf to Rabbit
Blue bodies found in cervical glands
Feb. 05

found. In a blood smear from another calf these bodies were discovered, and it was found that the animal from which the smears were taken had enlarged cervical glands.

Disease among goats in the Kibwezi district.

During the year, it was reported that goats were dying near Kibwezi, It was not possible to see the animals myself, but my Indian assistant, Compound Pillay, saw a number of the affected animals. He reported that he found the goats with high temperature and enlarged superficial glands. On making a post - mortem examination, he found some jelly like material in the pericardium, and infarcts in the lung, the spleen and other organs were apparently normal. In blood smears I found scanty bodies resembling those found in M'Kobbe, but showing more chromatin dots and very much resembling a sporulating body. No intracorpuscular bodies could be found.

October 1909			November 1909			December 1909		
Max.	Min.	Rain	Max.	Min.	Rain	Max.	Min.	Rain
85.0	55.0	0.0	67.0	58.0	0.32	70.0	58.0	0.20
83.5	55.0	0.0	66.0	57.0	0.30	71.0	58.0	0.02
86.0	55.0	0.0	66.0	57.0	0.70	71.0	59.0	0.0
83.0	57.5	0.0	73.0	57.0	0.25	73.0	59.0	0.0
80.0	59.0	0.0	73.5	57.0	0.0	71.0	59.0	0.0
80.5	59.0	0.0	79.5	54.0	0.0	72.0	57.5	1.0
81.5	59.0	0.0	80.0	54.0	0.0	66.0	0.0	0.0
78.5	59.0	0.0	78.5	58.0	0.0	68.5	59.0	0.48
81.5	56.0	0.0	74.0	59.0	1.1	67.0	59.0	0.06
82.0	57.5	0.0	76.5	60.5	0.41	69.5	58.0	0.52
84.0	57.0	0.0	75.0	59.5	0.01	70.0	59.0	0.0
86.0	58.5	0.0	75.5	60.0	0.0	68.0	58.0	0.38
83.0	58.5	0.0	75.0	59.0	0.0	67.0	57.0	0.03
87.0	60.0	0.0	76.0	59.0	0.0	68.0	57.5	0.40
84.5	54.5	0.0	78.0	59.0	0.07	67.0	57.0	0.87
80.	61.0	0.0	77.5	56.0	0.0	69.0	57.0	0.10
81.0	59.0	0.0	78.0	59.0	0.0	70.0	57.0	0.09
82.0	58.0	0.0	72.0	58.0	0.41	71.0	54.0	0.0
82.5	59.0	0.09	71.0	57.0	0.78	72.0	56.0	0.0
82.5	56.0	0.0	73.0	56.0	0.10	73.0	57.0	0.02
79.5	58.0	0.05	68.0	58.0	0.0	73.0	56.0	0.0
80.5	59.0	0.0	68.0	59.0	0.47	71.0	59.0	0.09
78.5	58.0	0.0	69.5	56.5	0.09	71.0	56.0	0.0
83.5	58.5	0.0	71.0	56.5	0.0	73.0	57.0	0.0
82.0	56.5	0.0	72.0	58.0	0.0	73.0	58.0	0.0
84.0	58.0	0.0	67.0	59.0	0.05	73.5	55.0	0.08
80.0	57.0	0.0	67.0	58.0	0.58	69.0	56.0	0.0
75.0	59.0	0.33	66.0	56.0	0.45	72.0	57.0	0.0
66.0	58.0	1.10	66.0	57.0	0.62	68.0	58.0	0.35
74.0	56.0	0.07	66.0	56.0	0.44	67.0	58.0	1.05
70.0	58.5	0.05				70.0	57.0	0.10

	October.	November.	December
Mean maximum	80.661	72.22	70.145
Mean minimum	57.613	57.65	57.516
Maximum recorded	83.0	80.0	73.5
Minimum recorded	53.0	54.0	51.0
Extreme daily range	30.	25.0	1[illegible]
Extreme monthly "	26.0	8[illegible].0	19.5
Mean monthly range	23.048	14.5897	12.628
Rainfall			
Total	1.69	7.20	3.85
Average daily	0.0845	.24	0.1283
No. of wet days	5	1[illegible]	1[illegible]
Average fall on "	0.281	0.4	0.624
Greatest fall in 24 hrs.	1.10	1.1[illegible]	1.40

Index to water analyses

Results of analyses of waters in the E.A. Protectorate.

	No.1	No.2.	No.3	No 4	No
	parts per 100000				
monia -free	0.002	0.0082	0.0004	0.004	0.004
albuminoid	0.0084	0.016	0.018	0.012	0.018
dness-total	8.0	8.0	5.4	3.8	4.6
permanent	3.0	5.6	4.6	3.4	4.2
temporary	5.0	2.4	0.8	0.4	0.4
orine	3.9	5.5	4.8	4.0	4.5
rogen as nit- es & nitrites	barest trace	distinct trace	distinct trace	distinct marked trace	marked
rogen as rites	nil	nil	nil	distinct trace	distin tra
Oxygen consumed 3 hrs. at room perature		0.295	0.201	0.058	

1. Nairobi water - new supply. 1.2.05.
2. Sample No. 1 from Director P.W.D. 21.12.05
3. Sample No.4 from Director P.W.D. 21.12.0
4. Sample No.7 from Executive Engineer, Nairobi. 5.1.06.
5. Sample No 8 Executive Engineer, Nairobi. 5.1.06

	No.6	No.7	No. 8	No 9	No 10
monia - free	0.054	0.004	0.001	0.012	0.008
albuminoid	0.04	0.025	0.02	0.012	0.03
rdness - total	2.0	2.0	5.0	4.0	3.0
permanent	1.0	1.0	3.0	3.0	2.3
temporary	1.0	1.0	2.0	1.0	0.7
orine	4.2	1.6	0.3	0.6	0.6
rogen as nit- es & nitrites	marked trace	faint trace	barest barest		0.075
trogen as nitrites	marked trace	nil	nil		
ygen consumed 3 hrs at room perature	0.179	0.012	0.0014	0.206	0.27

6. Sample labelled - Naivasha well water. 24.-1 -06
7. Sample labelled - Proposed new supply, Yambe. 7.2.06
8. Nzoia drinking water. 25.2.06
9. Fort Hall. 28.3.06
10. Mathioya river. Fort Hall. 17.3.06

	No. 11	No. 12.	No. 13	No. 14.	No. 15.
nia-free	0.016	0.002	0.0016	0.015	0.0125
lbuminoid	0.025	0.013	0.013	0.0425	0.0325
ness-total	4.5	14.0	14.0	7.0	7.0
rmanent	3.5	12.0	12.0	3.0	3.5
emporary	1.0	2.0	2.0	3.0	3.5
orine	0.5	1.6	1.6	1.6	1.6
rogen as nit-		marked	marked	distinct	distinct
s & nitrites	nil	trace	trace	trace	trace
rogen as rites	nil	trace	trace	trace	trace
gen consumed 3 hrs at room perature	0.376	0.1	0.096	0.416	0.216

11 Kampala. Uganda. 18. .06
12. Shallow stream near Fort Hall. 3.10.06
13 Fort Hall. 3.10.06
14. Sample No 1 Naivasha Lake among papyrus 100 yds from shore. 12.1006
15. Sample No. 2. Naivasha Lake near end of lake in 10 ft of water 12.10.06

	No. 16.	No. 17.	No. 18	No. 19	No. 20
nia -free	0.005	0.01	0.005	0.0020	0.0025
lbuminoid	0.01	0.029	0.0263	0.03125	0.02525
ness-total	1.0	3.5	3.0	3.0	3.0
rmanent	1.0	1.5	2.0	2.0	2.0
emporary	0.0	0.5	0.5	1.0	1.0
orine	0.8	0.8	0.5	2.0	0.8
rogen as nit -	marked	distinct	distinct	marked	marked
s & nitrites	trace	trace	trace	trace	trace
rogen as nitrites rites	trace	nil	nil	distinct trace	distinct trace
gen consumed 3 hrs at room perature	0.29	0.3	0.276	0.14	0.24

16 Nakuru water supply. River at intake of pipe. 14. 10. 06
17 Nakuru water. Merovoni river, 4 mile from Plummer's farm 17.10.0
18 Kibos river at mouth of gorge in Nandi escarpment. 25.10.06
19 Njoro stream below Syndicate farm buildings 27.10.06 n
20 Moreudat river near Government farm 27.10.06

	No. 21.	No.22.	No. 23.	No. 24.	No. 25.
monia-free	0.0028	0.0016	0.0025	0.0026	0.00125
Albuminoid	0.045	0.05	0.04125	0.025	0.03
Hardness-total	4.8	4.4	4.4	4.5	4.0
" permanent	4.3	4.3	4.3	4.0	4.5
" temporary	0.2	0.1	0.1	0.5	1.5
Chlorine	0.7	0.7	0.7	0.7	0.5
Nitrogen as nitrates & nitrites	trace	faint trace	trace	trace	trace
Nitrogen as nitrites	nil	nil	nil	nil	nil
Oxygen consumed in 3 hrs. at room temperature	0.144	0.175	0.1936	0.188	0.144

. 21. Kisumu water scheme. Water taken 150 yds from shore 28.10.06
. 22 Kisumu water scheme. Water taken ¼ mile from shore. 28.10.06.
. 23. Kisumu watersupply. Water taken at water works intake. 28.10.06
. 24. Kisumu water scheme. Water taken from M'towani river 31.10.06
. 25. Kisumu Water scheme. Water taken from stream near Roman Catholic Mission 31.10.06.

	No. 26	No. 27.	No. 28.	No. 29	No. 30
monia -free	0.0025	0.006	0.006	0.005	0.0025
Albuminoid	0.003375	0.011	0.01	0.02625	0.05125
Chlorine	0.9	0.7	1.0		
Nitrogen as nitrates & nitrites	distinct trace	faint trace	faint trace	marked trace	marked trace
Nitrogen as nitrites	nil	nil	nil	nil	nil
Oxygen consumed in 3 hrs at room temperature	0.17	0.084	0.016	0.276	0.24
Alkalinity-total				31.0	29.0
" volatile				20.0	21.0
" non volatile				11.0	8.0

. 26. Nakuru water supply. Costello's stream 11.11.06
. 27. Nyeri river water. 14.3.07
. 28 Spring near Fort Hall 18.1.07
. 29. Nakuru water supply scheme. Costello's stream at first escarpment 1.6.07
. 30. Nakuru water supply scheme. Merevemi river at first escarpment 4.6.07

	No. 31.	No. 32.	No. 33	No. 34.	No. 35
monia-free	0.00087	0.00	0.0075	0.07	0.001
albuminoid	0.0175	0.012	0.032	0.02	0.006
rdness-total	nil	6.0		13.0	11.0
permanent	nil	2.0	.0	10.0	0.5
temporary	nil	4.0	1.0	3.0	10.5
lorine	0.5	1.5	.0	11	20.0
trogen as trates &	marked	Were	marked	marked	
ritea	trace	trace	trace	trace	
trogen as ritos	nil	nil	marked	arked trace	
gen abs rbed in 3 hrs. from temperature	0.150	0.01	.200	0.264	nil
lids-total	30.0	14.0	33.0	.....	35.0
olatile	25.0	.0	8.3		0.0
n volatile	5.0	.0	26.7		0.0
nesium as Mg P O 2 2 7					0.704

. 31. Nakuru water supply. Mereteni river at first encampment.
. 32 Mission spring Kisaru. 21.8.07
. 33 Old Nairobi supply. 24.12.07
. 34 Kumeni water 21.7.08
. 35 Spring at Machakos Mission. 27.4.08

	No. 36	No. 37	No. 38	No. 39	No. 40
monia-free	0.0	.006			0.00625
albuminoid	0.0237	.014			0.08
rdness-total	12.0	2.0			
ermanent	10.0	1.2			
emporary	2.0	0.8			
lorine	1.6	1.6	1.0	1.0	0.9
trogen as trates &	1.	0.07	marked trace	marked trace	marked trace
ritos					
trogen as rites	trace	nil	marked trace	marked trace	marked trace
gen absorbed 3 hrs. at room mperature	0.472	0.00	.036	0.2608	0.174
lids-total	62.0	42.0			
olatile	40.0	27.0			
volatile	22.0	15.0			
	Fe rust salts in large amount				

36. Water from Kibos boring. 27.3.0
37. Water from Ripingabi river. Kibos. 12.3.08
38. Kitui district. Kumeni. 28.7.08
39. Kitui district. Nyee. 28.7.08
40. Kitui district. Kalumba. 28.7.08

	No. 41.	No. 42.	No. 43.	No. 44.	No. 45.
monia-free	0.0125	0.[illegible]	0.00120	0.48	0.42
uminoid	0.05	0.[illegible]	0.00875	0.28	0.25
rganic-total	1.0	nil	0.5	5.0	5.0
rmanent	0.2	nil	0.3	1.0	1.0
ardness	0.2	nil	0.2	4.0	5.0
hlorine	2.1	11.0	1.0	22.0	20.0
itrogen as	0.0	0.5	0.05	6.25	2.8
ilica &	marked trace	marked amount	trace	large amount	large amount
itrogen as	marked amount	marked amount			
ater consumed					
3 hrs at room	0.139	0.0696	0.08	0.25	nil
mperature					
olids-total	130.0	218.0	14.0	140.0	145.0
olatile	118.00	148.0	10.0	45.0	36.0
n volatile	12.0	70.0	4.0	100.0	109.0
n ignition			some blackening	blackening & odour	blackening odour & sparking

41. Well in Naivasha district. 6.8.06
42. Well in Naivasha district.
43. Chiuba hills. 7.8.06
44. Well on Mombasa island. 12.8.06
45. Well on Mombasa island. 12.8.07

	No. 46.	No. 47.	No. 48.	No. 49	No. 50
monia-free	0.04	0.025	0.005	0.005	0.00375
			0.02		
uminoid	0.0125	0.22	0.06	0.01375	0.022
rganic-total	4.8	6.0	4.8	26.0	9.0
rmanent	4.6	4.0	4.0	10.0	9.0
mporary	0.2	1.0	0.8	16.0	0.0
hlorine	60.0	2.7	2.0	20.0	5.0
itrogen as					
ilica &	3.125	marked trace	marked trace	0.125	trace
itrogen as	large amount	marked trace	marked trace	nil	nil
ater consumed					
3 hrs. at room	0.064	0.262	0.158	0.097	0.116
mperature					
olids-total	180.0	80.0	8.0	70.0	13.0
olatile	155.0	15.0	2.0	10.0	4.0
n volatile	225.0	65.0	3.0	10.0	9.0
n ignition	blackening sparking odour	blackening	blackening odour sparking	blackening sparking slight	blackening & slight sparking

agnesium.

46. Well on Mombasa island. 12.8.06
47. Mombasa. Cisterns tank. Cistern No. 1. 3.10.06
48. Mombasa. Cisterns tank. Cistern No. 6. 3.10.06
49. Kilindini Camp. Railway Pipe. 21.10.06
50. Spring in Chiuba hills. 15.11.06.

	No. 51.	No. 52.	No. 53.	No. 54.	No. 55.
...nia-free	0.004	0.005	0.005	0.04	0.01
...minoid	0.01	0.04	0.013	0.013	0.0275
...e total	12.5	13.6	23.0	29.0	72.0
...anent	10.5	12.0	21.0	27.0	42.0
...orary	2.0	1.5	2.0	2.0	30.0
...	0.8	28.0	7.0	9.0	25.0
...en as ...	marked	marked	marked	nil	marked
...ites	trace	trace	trace	trace	trace
...en as ...	marked	nil	marked	marked	mark...
...ites	trace		trace	trace	trace
...en consumed ... hrs. at room ...	0.0305	0.11	0.106	0.23	0.239
...ide-total	3.0	95.0	106.0	50.0	102.0
...atile	1.0	25.0	5.0	10.0	35.0
...relatile	2.0	70.0	101.0	40.0	67.0
...ignition	nil	slight shavring	faint discolouration	blackening	slight sparki... blackenin... & odour

...nesium 0.7

51. Gilgil. Kariendae river. 26.1.09
52. ...-bagne. Well water. 8.3.09
53. ... river. 12.3.09
54. Sultan Hamoud. Stream 7 miles from station. 16.4.09
55. Mombasa. Makuru well. 22.4.09

	No. 56	No. 57.	No. 58	No. 59	No. 60
...nia-free	0.01...	0.0125	0.006	0.006	0.00112
...minoid	0.01...	0.01	0.00676	0.01	0.015
...e-total	19.0	6.8	6.0	6.0	20.0
...ent	17.0	5.0	4.5	5.0	16.0
...orary	2.0	1.8	1.5	0.0	1.0
...	8.0	1.0	1.0	1.5	4.0
...en as ...	0.08	0.8	0.1	0.06	4.0
...ites	0.08	0.8	0.1		trace
...en as ...	nil	faint trace	trace	distinct trace	nil
...en consumed ... hrs at room ...	0.12	0.17	0.217	0.248	
...ide-total	72.0	18.0	10.0	10.0	100.0
...atile	27.0	13.0	5.0	8.0	38.0
...volatile	45.0	5.0	5.0	2.0	62.0
...ignition	slight blackening & odour	some blackening	some blackening	blackening & odour sparking	nil

...nesium 9.9 9.137
...ric acid 13.606

56. ... water supply. 28.8.09
57. ... Kariandusi. 1.6.09
58. ... Dwelling house. 1.6.09
59. ... Office 1.6.09
60. Mariakani river 9.9.09

	No. 61.	No. 62.	No. 63	No. 64.	No. 65.
monia-free	0.0225	0.0075	0.01875	0.0675	0.04
albuminoid	0.03	trace	0.0125	0.035	0.032
rdness-total	52.0	26.0	8.0	7.0	12.0
rmanent	28.0	20.0	7.5	7.0	9.0
mporary	24.0	6.0	0.5	0.0	3.0
rine	25.0	35.0	48.0	52.0	2.0
rogen as nitrates					
rogen as nitrites	3.2	2.5	5.0	2.0	0.1
our	very marked trace	marked trace	marked trace	marked trace	nil.
ygen consumed in hrs. at room mperature	0.03	0.092	0.0417	0.0416	0.0
lids-total	122.0	120.0	280.0	196.0	37.0
olatile	60.0	60.0	120.0	55.0	3.0
n volatile	122.0	60.0	260.0	140.0	34.0
n ignition	blackening slight spark- ing & odour	blackening slight sparking odour	blackening slight sparking & odour	black- ening slight sparking odour	blackening
gnesium lphates	present present	present present			

No. 61. Sample of soda water. Mombasa 23.9.09
No. 62. Sample of soda water. Mombasa. 23.9.09.
No. 63. Bora mosque well. Mombasa. 30.9.09
No. 64. Well behind Scoil Hotel. 30.9.09
No. 65. Customs House tank. Mombasa. 30.9.09

	No. 66.	No. 67.	No. 68.	No. 69.	No. 70
monia-free	0.003	0.0188	0.02	0.0075	0.01
albuminoid	0.0225	0.015	0.035	0.0375	0.0225
rdness-total		9.5	40.0	12.0	41.0
rmanent		4.0	24.0	12.0	19.0
mporary		1.0	16.0	1.0	22.0
rine	2.0	1.0	40.0	90.0	15.0
rogen as nitrates					
nitrites	trace	trace	1.0	16.0	1.5
rogen as trites	trace	trace	marked trace	marked trace	marked trace
ygen consumed in hrs. at room mperature	0.541	0.18	0.09	0.09	0.09
lids-total	35.0	40.0	167.0	368.0	60.0
olatile	20.0	10.0	45.0	98.0	25.0
n volatile	15.0	30.0	122.0	270.0	35.0
n ignition	slight sparking	slight blackening	blackening slight sparking & odour	blackening slight sparking & odour	blackening slight sparking & odour

No. 66. Zanzibar soda water. 11.10.09
No. 67. Spring. Fort Hall. 16.10.09
No. 68. Mombasa. Well of Baraka. 16.10.09
No. 69. Mombasa. Well of Mwanyenga. Portuguese Street. 16.10.09
No. 70. Mombasa. Well of Livali Bondeni. 16.10.09.

	No. 71.	No. 72.	No. 73.	No. 74.	No. 75.
Ammonia-free	0.1075	.012	0.0125	0.01	.0125
albuminoid	0.0175	.012	0.025	0.025	.0125
Hardness-total	71.0	65.0	42.0	47.0	44.0
permanent	39.0	29.0	15.0	19.0	17.5
temporary	32.0	36.0	1.6	28.0	15.0
Chlorine	30.0	30.0	34.0	32.0	18.0
Nitrogen as nitrates & nitrites	8.3	8.0	10.0	8.1	5.0
Nitrogen as nitrites	marked trace	marked trace	marked trace	marked trace	marked trace
Oxygen consumed in 3 hrs. at room temperature	0.07	0.0	0.12	0.09	0.14
Solids-total	170.0	142.0	98.0	110.0	40.0
volatile	40.0	39.0	30.0	30.0	10.0
non volatile	130.0	103.0	68.0	75.0	30.0
On ignition	blackening slight sparking & odour	blackening slight sparking odour.	slight blackening odour	blackening	blackening

No. 71. Mombasa. Well of livali near mosque Mangolakiusama. 16.10.09
No. 72. Mombasa. Well of Ramaiji Jeewanji, near mango tree. 16.10.09
No. 73 Malindi. Sangoro well. 18.10.09
No. 74. Malindi. Salim Khalfan well. 19.10.09
No. 75. Malindi. D.E.A. Corporation well. 19.10.09

	No. 76.	No. 77.	No. 78.	No. 79	No 80.
Ammonia-free	0.025	0.01	0.625	0.0125	0.000
albuminoid	0.035	0.0125	0.05	0.04	0.015
Hardness-total	0.5	79.0	15.0	6.0	31.0
permanent	0.0	18.0	8.0	5.0	23.
temporary	0.5	61.0	7.0	1.	8.0
Chlorine	1.2	24.0	1.4	3.0	34.0
Nitrogen as nitrates & nitrites	trace	8.0	trace	0.2	0.1
Nitrogen as Nitrites	nil	marked	trace	trace	trace
Oxygen consumed in 3 hrs. at room temperature	0.21	0.0	0.05	[illegible]	.17
Solids-total	20.0	80.0	16.0	[illegible]	172.0
volatile	4.0	41.0	8.0	[illegible]	47.0
non volatile	16.0	39.0	16.0	[illegible]	125.0
On ignition		much blackening	slight blackening	blackening sparking	blackenin

No. 76. Nyeri-Irrigation stream. 5.10.09
No. 77. Malindi. Soda water. 19.10.09
No. 78. Port Hall. Soda water. 19.10.09
No. 79. Water from stream on Mr. Larken's land, near Nairobi. 20.10.09
No. 80. Kiu-water from travelling tank at Kilian Hanson. 29.10.09.

monia-free	0.01	.1	.06	.7	.0
buminoid	0.04	.2	.108	.3	.0
rdness-total	1.		.8		
rmanent	17.0	1.		.0	
mporary	2.0				
lorine	1.0				
trogen as trates	0.04	0.06			
trites					
trogen as trite	marked trace	nil	nil		marked trace

gen consumed in 3 hrs at room perature	0.37				
lids-total	90.0	36.		18	
latile	32.0	1.		1.	
n volatile					90.
ignition	much		very slight	charring	charring
	blackening	in	lake-ing	sample colour	

. 81. Water from second stream on ... 's farm.
. 82. Water from spring at Watah ig-ion, ...
. 83. Water from Thiba Hills.
. 84. Water from Kasoma and river ... yards ... well.
. 85. Water from ... normal ...

monia-free	.12	.1	.01		
buminoid	.02	.2	.01		
rdness total	27.				1.
rmanent		10.		11.	
mporary	10.	1.			3.
lorine	5.0	5.0	10.0	10.	10.0
trogen as trates	0.02	1.0	7.0	5.0	10.0
trites					
trogen as trites	very ...	...	...	...	...

			amount	amount	amount
gen consumed in 3 hrs at room- perature	1.0	0.506	0.185	0.097	0.0000
lids-total	20.	104	193.	160.	870.
latile	22.	22.	43.	10.	60.
n volatile	98.	82.	150.	150	210.
ignition	slight charring slight sparkling	slight charring	much blackening	charring slight	charring

. 86. ... water from Dr. ... well ... ...
. 87. Water from Haji Adam's well ... ...
. 88. Water from ... a proposed ... ...
. 89. Water from Majbu ... well ... ...
. . Water from ... well ...

	No. 91.	No. 92.	No. 93.	No. 94.	No. 95.
pla-free	0.01	0.005	0.0075	0.0125	0.005
lbuminoid	0.04	0.015	0.01	0.0325	0.02
insse-total	12.	15.	20.	9.	9.
rmanent	11.	11.	17.	7.	8.
mporar	1.	4.	3.	2.	1.
rine	40.	30.	25.	25.	900.
rogen as rates					
itrites	6.20	8.8	4.16	0.02	0.86
rogen as rites	marked amoun	marked amount	arked amount	marked	marked amoun
ken consumed 3 hrs. at 27°C	0.03	0.016	0.0645	0.099	0.2057
perature		180.	123.	107.	2015.
lds-total	173.	40.	28.	28.	680
atile	70.	105.	100.	85.	1336.
volatile	103.	slight	slight	much	nil
nition	slight charring	charring	char in	char in	
n					44.4
mes um					40.2554
phuric acid					89.6451
ium (as carbonate)					39.
					3

91. ora cementery well" Mombasa 16.11.09

92. "Akuti mosque well "Makadara" Mombasa 16.11.09

93. Mcosa Jeevanji's well "Kembeni" Mombasa 16.11.09

94. Intake of pipe at Kid 17.11.09.

95. "Water from Ndoa medicinal water" 17.11.09

	No. 96.	No. 97.	No. 98.	No. 99.	No. 100.
monia-free	0.0187	0.005	0.0125	0.00625	0.0125
albuminoid	0.04	0.025	0.0125	0.0125	.02
rdness total	3.0	5.0	3.0	2.5	2.5
manent	2.0	3.0	2.5	2.0	1.5
porary	1.0	2.5	0.5	0.5	1.0
orine	1.8	1.6	2.0	4.0	1.6
rogen as rates	0.06	0.02	0.02	0.03	0.05
rogen as rites	nil	nil	nil	trace	trace
ygen consumed 3 hrs at room	0.6867	0.5428	.074	0.12	.30
mperature					
lids total	30.0	20.0	16.0	5.0	5.0
Matile	14.0	12.0	5.0	8.0	5.0
n volatile	16.0	8.0	11.0	3.0	3.0
ignition	much charring	blackening & sparking	blackening	la ening	blackeni

96. Mweru. Drinking water. 27.11.09
97. Mbu. Rippingasi river. 27.11.0
98 Shimba Hills. 31.12.09.
99. Shimba Hills. 31.12.09.
100. Shimba Hills. 31.12.09.

	No. 101.	No. 102.	No. 103.
monia-free	0.0125	0.015	0.006
albuminoid	.03.	.02	.0162
rdness total	6.0	12.0	7.0
manent	6.0	10.5	4.5
porary	0.0	1.5	2.5
orine	6.0	55.0	1.5
rogen as rates	0.08	0.02	0.04.
rogen as rites	nil	trace	nil
ygen consumed 3 hrs. at room mperature	0.64	0.2	0.66
lids total	18.0	110.0	15.0
Matile	8.0	28.0	4.0
n volatile	10.0	82.0	11.0
ignition	blackening	slight blackening	slight blackening

101. Shimba Hills. 31.12.09
102. Shimba Hills. 31.12.09
103. Fort Hall. Spring Water. 31.12.09.

SUMMARY OF EXAMINATIONS.

Bloods	
negative	108
leucocyte counts	192
increase of large mononuclears and pigment	24
Malaria	
benign tertian	11
quartan	3
sub-tertian	50
sub-tertian & quartan	1
sub-tertian & benign tertian	1
Urines	4
Bilharzia	1
Gonococcus	1
Widal reactions	
positive	8
negative	7
Sputa	
negative	1
pneumococci	5
tubercle	2
Faeces	
negative	
amoebae	
Taenia saginata	1
Koch-Weeks bacillus	
(B.aegyptiacum)	1

Plague	
negative	11
B. pestis (lung & spleen)	2
bubo	2
For gonococcus	
positive	
negative	
For Treponema pallidum	
positive	1
negative	3
Pus smears	5
Tubercle (spleen)	1
For M. leprae	
positive	2
negative	2
Congo floor maggot	1
Rats for plague	
positive	2
negative	2
Various	13
Game	
Reedbuck	
negative	1
spirochaetes	2
Hirax	1
Impala	1
Sheep	1
Zebra	1
Jackson's hartebeest	1

Tsessebe	1
Roan's hartebeest	1
Goat	1
Guinea fowl	
negative	13
Halteridium & leucocytozoon	6
Halteridium	5
Leucocytozoon	5
Halteridium & trypanosomes	1
Bycanistes	
leucocytozoon	1
Spring hares	
Horse	
ulcerative lymphangitis	2
Gland puncture for trypanosomes	
positive	1
Sections	
malarial spleen	1
rodent ulcer	1
malarial liver	1
liver	1
spleen for tubercle	1
gland of hartebeest	1
knee for tubercle	1
chancre for T.pallidum	1
intestine	1
Various analyses	
Water analyses	4
Total	875
Veterinary examinations	1127
Total	2002

January 31st 1910.

Sd/ Philip H.Ross
Bacteriologist