Split by PDF Splitter

On the other hand we have Cases 20, 26, and 32 all showing trypanosomes repeatedly in the cerebro-spinal fluid, and all conspicuous for sleep or other head symptoms, more marked in the later days.

Examples of long-continued mild mania are not infrequent, of which class Case 33 is a good example. This man's blood was examined on many occasions, but no trypanosomes were found until the lumbar puncture revealed them in his cerebro-spinal fluid.

On the whole one cannot say more than that the presence of the parasites in the cerebro-spinal fluid apparently tends to increase the gravity of the case, and predisposes to the more severe head symptoms and other complications likely to bring about a fatal termination. Only in such cases as 8 and 17 do I think the parasite can be said to be solely accountable for the death. In the vast majority of cases death is the result of complications, mainly bacterial.

As in the blood, where the appearance of a large number of parasites is frequently coincident with an unusually high rise of temperature, if the patient is not too far advanced in the disease to be irresponsive, so also the rare discovery of large numbers of parasites in the cerebro-spinal fluid is, I have found in several instances, coincident with an unusual rise in the temperature curve. This no doubt accounts for the occasional unexplained rises of temperature and aggravation of symptoms occurring where few or no parasites can be found in the circulation. An access of temperature is probably in these cases always coincident with the collection or the development of a crop of parasites in one or other of the organs or fluids of the body.

All cases punctured, whether with or without parasites in the cerebro-spinal fluid, had well-marked fever, characterized by an afternoon rise and a morning fall to near the normal, showing that no connexion can be traced between the commencement of the fever and the entry of the parasites into the cerebro-spinal fluid from the blood. Some of the cases in Table I died without ever having trypanosomes in their cerebro-spinal fluid, but showed nevertheless the characteristic temperature curve.

It would appear from Cases 26, 28, and 38, that just as in the blood, the parasites may come and go in the cerebro-spinal fluid irrespective of their presence or absence elsewhere in the system.

Case 23 shows that they may be in enormous numbers in the blood without appearing in the cerebro-spinal fluid, where, however, they do occur occasionally in large numbers as is seen in Cases 28, 38, 44, and 49, but in this fluid they are most frequently very scanty.

The amount of fluid drawn off is no indication of the total amount present. Occasionally the pressure is considerable, and in these cases very marked temporary benefit is often derived from the puncture.

Cerebro-spinal fluid with no admixture of blood or increase of white cells is as clear and limpid as distilled water. According to the amount of mixture with red

Split by PDF Splitter

or white cells, or both, I have here described it as clear, slightly cloudy, or cloudy. If with blood only the cloudiness has a pink tinge, but if with white cells only it has no pink tinge. It is invariably clouded almost immediately after death by excess of white cells. The colour and extent of the cloudiness is best gauged by looking down and not through the centrifuge tube.

The fluid, as soon as drawn, should be centrifugalized gently for fully five minutes. It can then be poured off to the last drop into another tube, leaving only the resulting small deposit, which can then be picked up with a fine pipette, placed on a slide and systematically examined under a coverglass well ringed with vaseline, with a one-eighth or one-sixth objective, and a No. 4 eyepiece. If centrifugalized violently for a length of time the activity of the trypanosomes may be much decreased, and, consequently, the labour of searching for them more difficult, and if there is much deposit they may even be mutilated by the pressure of the cells. I have found it far better to centrifugalize the fluid a second time after the deposit from the first centrifugalization has been examined, for, owing to degeneration changes, which commence in the cells almost as soon as the fluid is drawn, it is best to examine it and fix some films without delay. It is imperative that the fluid should be centrifugalized a second or even a third time if possible, for, on two occasions at least, I have found trypanosomes in the second deposit and not in the first. If there is no deposit in the tube the lowest fluid should be pipetted without pouring off, for the parasites are easily poured away with the fluid.

With regard to the white cell elements, I have described them as very scanty, scanty, increased, and much increased, and I have assumed that very scanty is the normal condition. The difference between these various degrees is difficult to make out, and is apt to depend upon the amount of fluid allowed to remain with the deposit.

TABLE V

L.P.	Very Scanty	Scanty	Increased	Much Increased	Totals
Tryps. present	3	10	11	7	31
Tryps. absent	7	25	10	1	43
Total ...	10	35	21	8	74

The majority of the punctures come under the headings of scanty or increased, viz., forty-six per cent. under the former, and twenty-six per cent. under the latter, leaving about thirteen per cent. for both very scanty and much increased.

Split by PDF Splitter

One might conjecture that where the cellular elements are increased the examination would be positive for parasites, but the following table shows that this is not so evident as might be expected.

Case 32 shows that, although a large number of parasites were found at each puncture, there was an apparent decrease of cells in the fluid. In Case 17, no parasites were ever found in the cerebro-spinal fluid, and the cells were invariably scanty ; and in the ten cases not proved to be sleeping sickness it will be seen that the cell elements of the fluid are almost invariably scanty. In the majority of the early Cases, 19, 39, 40, 42, 43, 47, 51, whether positive or negative, the cells are scanty or very scanty.

In Case 28 the cells seem to have disappeared from the fluid in much the same proportion as the parasites. In Cases 44 and 49 a very large number of parasites was accompanied only by a comparatively small increase of cells.

For those who are not familiar with the operation of lumbar puncture, I will describe the method I have found best.

The patient is placed on his right side, on a table if possible, with his knees drawn up to his face. After thoroughly cleansing his back with soap and water and again with alcohol or ether, cocaine is injected, with a short strong needle if the patient is a black man, both subcutaneously and deep into the muscles over the interspace above the last lumbar vertebra. This interspace is on a straight line drawn between the two iliac crests, and the needle should be passed half an inch to the left of the middle line, not midway between the two interspinous processes, but slightly nearer to the upper one. The next lower space between the sacrum and the last lumbar vertebra can be selected if for any reason it is desirable, but owing to the flattening of the canal in this situation the operation is not quite so easy to perform without drawing blood.

After waiting a few minutes the knees are adjusted so as to be exactly opposite each other, and while the assistant secures the position of extreme flexion, the tips of the fingers of the left hand are placed firmly upon the left iliac crest, leaving the thumb to indicate not only the interspace but the exact spot and direction as well.

The puncture needle is then passed through the skin, the precise direction again gauged, and the needle then passed on slightly upwards and towards the middle line, or downwards and to the right, with reference to the table. If the spot and direction have been well chosen, no bone is encountered, the passage of the needle point into the canal can easily be felt, and the clear fluid at once appears drop by drop. The syringe is then adjusted, and sufficient for examination is slowly drawn off. With a little practice and a docile patient no operation is easier, and I have performed it on the floor in native huts, in the open bush, in my tent, and in a canoe. Having learnt the exact spot and direction, the only difficulty is to gauge the depth to which the needle should be passed, for if the point is allowed to prick the cord or the membranes opposite, blood immediately appears and the results of the operation are valueless for statistical purposes.

Split by PDF Splitter

With regard to anaesthetics, cocaine is the best. Cases of excitement or mania necessitate chloroform, but it is inadvisable to give chloroform if it can be avoided, for, in two cases, the struggle and subsequent exhaustion have I believe hastened a fatal issue.

The needle selected should be as fine as possible, consistent with sufficient strength to withstand the grip of the powerful back muscles, if in the early stages of the disease the patient is restless or insufficiently cocainised. In length it should be from two to three inches. It is important that the diagonal surface at the point should be as short as possible, and the actual point not too sharp. In no case should the syringe be used as a handle for the needle, but into the base of the needle should be screwed a metal handle, which, when the needle has been passed into position, can be substituted for a glass 10 c.c. serum syringe with a short rubber connexion. The careful sterilization of all instruments is of course necessary. Although the skin may be cleansed as thoroughly as possible, it cannot be sterilized, but, in my cases, no introduction of septic matter has resulted from the operation. It would, however, probably be wisest, after the cocaine has been injected, to cauterize the site of the puncture with some small cautery made for the purpose.

In the cases of septic meningitis, pus is frequently found in the ethmoidal or other sinuses, and the infection cannot be traced to the lumbar puncture. In Cases 7 and 9, in Table II, and others in Table I, symptoms of meningitis were apparent before the puncture was made, and in other cases death occurred from the same cause without lumbar puncture. The discovery of purulent lymph round the cord in Case 31 might possibly point to infection introduced with the needle, but in this case the symptoms did not commence till a fortnight after the puncture.

These notes are the outcome solely of work done in connexion with the Congo disease.

The duration of the cases in Tables I and II is gauged chiefly by the date of the commencement of symptoms, that is in many cases the date at which the patient finds himself unable to work, the actual duration probably being much longer. The disease can frequently be diagnosed by the intimate friends or fellow workmen of the patient long before he himself realizes it.

The total number of cases here recorded is too few to permit of any very definite statements, but I think it is sufficient to allow of the following provisional conclusions.

1. That in many cases the trypanosomes never find their way into the cerebro-spinal fluid, and in those cases in which they do they are more likely to be found towards the termination of the disease.

2. That the commencement of the fever or other symptoms is in no way co-related to the entrance of the parasites to the cerebro-spinal fluid.

3. That a large number of trypanosomes in the cerebro-spinal fluid is rare, but when it does occur there is usually an access of temperature.

Split by PDF Splitter

4. That the parasites may come and go in the cerebro-spinal fluid as in the blood.

5. That enormous numbers may appear in the blood without appearing in the cerebro-spinal fluid, and, to some extent, *vice versâ*.

6. That when trypanosomes are present in the cerebro-spinal fluid its white cell elements are apt to be increased.

7. That in cases where the parasites gain access to the cerebro-spinal fluid early in the disease, mania and other head symptoms are more likely to be prominent.

A description of the various developmental forms of trypanosomes to be found in sleeping sickness cases in the cerebro-spinal fluid ; of the various cells of the fluid, in particular a peculiar large mulberry-shaped cell ; of its chemistry ; of certain large organisms with actively dancing particles, met with occasionally ; of the occurrence of nematode larvae and ova resembling those of *Ankylostoma duodenale* in connexion with the fluid in many cases, and of other matters of interest, must be left for a future publication.

Split by PDF Splitter

A COMPARISON OF THE ANIMAL REACTIONS OF THE TRYPANOSOMES OF UGANDA AND CONGO FREE STATE SLEEPING SICKNESS WITH THOSE OF TRYPANOSOMA GAMBIENSE

(DUTTON)

Split by PDF Splitter

A COMPARISON OF THE ANIMAL REACTIONS OF THE TRYPANOSOMES OF UGANDA AND CONGO FREE STATE SLEEPING SICKNESS WITH THOSE OF TRYPANOSOMA GAMBIENSE*
(DUTTON)

A PRELIMINARY REPORT[1]

BY

H. WOLFERSTAN THOMAS, M.D., C.M., McGILL
J. H. TODD MEMORIAL FELLOW IN TROPICAL MEDICINE

AND

STANLEY F. LINTON, M.B., B.Sc., VICT.
ASSISTANT DEMONSTRATOR

(*From the Johnston Tropical Laboratory, University of Liverpool*)

THE strains we have used in our work are as follows :—Three strains of *Trypanosoma gambiense* from Gambia. (See below). Two strains from Uganda : (1) from the cerebro-spinal fluid of a case of sleeping-sickness ; and (2) from the blood of a case of trypanosome fever. We take this opportunity of thanking Colonel D. BRUCE, R.A.M.C., F.R.S., to whom we are indebted for these two strains. Four strains from the Congo Free State : (1)[2] from the cerebro-spinal fluid of a case of sleeping sickness ; (2)[2] from the blood of a case of trypanosome fever ; and (3) and (4) from the blood of two natives at present under observation in Liverpool.

Trypanosoma gambiense (DUTTON).—Three strains of *Trypanosoma gambiense* were brought home by Dr. J. E. DUTTON and Dr. J. L. TODD, from their Senegambia expedition[3] ; of these three, which are called 'Gunjur,' 'Lammin,' and 'Q' strains, we have worked almost entirely with the 'Gunjur' strain, which was derived from the boy at Gunjur, case 4.[4] Since that time the strain has been passed through a great number of animals under varying conditions ; the direct strain is that passed from rat to rat, to ascertain whether increased virulence or attenuation of the trypanosomes could be produced. It is not our purpose to present here the results, but

* *Reprinted by permission of the publishers of the* LANCET, *14th May*, 1904

1. In the forthcoming Thompson Yates and Johnston Laboratories Reports a fuller report will be published, together with serum and agglutination experiments, and the results of therapeutic experiments.

2. Sent to us by our expedition to the Congo Free State.

3. J. E. Dutton and J. L. Todd, *First Report of the Trypanosomiasis Expedition to Senegambia* (1902), Liverpool School of Tropical Medicine. Memoir XI.

4. *Ibid.*

Split by PDF Splitter

we believe that a definite increase of virulence, as well as an attenuation, can be achieved, the former by the passing of the trypanosomes through a large series of animals of the same species, and the latter by constantly changing the species of animal employed.

Rats.—Young rats, thirty experiments, shortest incubation two days, longest thirty-five, average from four-and-a-half to seven-and-a-half days. Usual duration from twenty to forty-one days. Some have survived one hundred and thirty-two days. Adult rats, thirty-three experiments, incubation from four to forty-seven days, average eight-and-a-half days. Duration from forty-five to three hundred and eighty-eight days. Some rats inoculated in Senegambia in November, 1902, still survive, but their blood is negative microscopically, and non-infective. The parasites are present in the blood of both young and adult rats in fair quantities, though in many of the animals they are not constantly present, being at one time numerous in the blood, and a few days later absent altogether, or only demonstrated after a most careful search.

Mice.—Twenty-five experiments. Incubation period from one to thirty-seven days; average from four to seven days. Usual duration from eleven to fourteen days. In some cases the parasites have been very numerous, and continually present in the blood, but very often the animal shows only a few parasites, or there may be a marked irregularity as to the appearance and disappearance of the organism.

Guinea-pigs.—Ten experiments. Three guinea-pigs have become infected after twelve, fifty-three, and seventy-three days, respectively, and have lived three, four, and eight months. One, Experiment 114,[1] inoculated May 13 and positive twelve days later, never showed parasites again in its peripheral blood until September 11. On November 1 thirty to a field[2] were observed. The trypanosomes continued to increase in numbers, and on December 3 reached eighty to one hundred to a field. On December 20 the numbers decreased and death ensued on January 4. A guinea-pig, Experiment 133,[3] inoculated on July 20 from a rat, was positive on September 11, parasites became very numerous on November 1 (twenty to field), and continued so to the end on November 20. Rupture of the spleen was the cause of death. Four guinea-pigs, inoculated one hundred and twenty-four days ago with large quantities of blood containing numerous trypanosomes, have remained negative up to the present time, despite re-inoculations. Their controls—*i.e.*, rats and rabbits—became infected in the usual time. Three guinea-pigs, inoculated on March 7 from rat 279A with large doses of blood containing countless trypanosomes, showed parasites in their blood in twelve hours in two cases, and in three days in the other. The

1. J. E. Dutton and J. L. Todd, *First Report of the Trypanosomiasis Expedition to Senegambia* (1902), Liverpool School of Tropical Medicine. Memoir XI.

2. We have, throughout, used three-quarter inch square cover-slips, and examined with one-sixth inch objective, and No. II eye piece.

3. Dutton and Todd, *loc. cit.*

Split by PDF Splitter

parasites were seen in their blood for a few days (about twenty-four to a cover). Since March 20 these animals have been negative.

Rabbits.—Incubation period from five to fifteen days; average from seven to nine days. Duration from fifty to one hundred and twenty-eight days. In some cases the organisms have been fairly constant in the peripheral blood, in others they appear and disappear at irregular interva s, and the numbers vary from a few to twenty to a field. In these animals loss of weight and diminution of red cells and haemoglobin are constant features of the disease. In only one rabbit, which lived one hundred and twenty-eight days, have we noticed a purulent discharge from the nose, eyes, etc., with loss of hair, and then only in the last six weeks of its existence.

Cats.—Two experiments, both inoculated intravenously. Experiment 422, inoculated March 12 from a mouse. Trypanosomes were observed on March 19. Parasites were constantly present, the numbers usually being small. The temperature rose on March 20 to 104·4° F. and on the 22nd to 104·6°. Some loss of weight and anaemia have been observed. Experiment 447, inoculated March 22 from a rat; positive on March 26. Parasites were constantly present and in fair numbers—often one to each field. No rise of temperature was observed.

Puppies (from three to seven months).—Three experiments. Incubation periods, five days after intravenous and ten days after intraperitoneal and subcutaneous inoculation. Duration from thirty-three to forty-three days. In two cases the parasites were to be found almost constantly and in fair numbers which increased in the later stages of the disease; before death the blood became negative again. In the remaining experiment trypanosomes were only to be found at intervals and in small numbers. Loss of weight occurred in all three, and in two cases there was a marked diminution in the number of red corpuscles with a corresponding decrease in the percentage of haemoglobin. Subnormal temperature was recorded in one case before death.

Goat.—Small female, Experiment 518. Inoculated intraperitoneally on April 14 from a rat showing numerous trypanosomes. Strain 'Lammin.' Parasites appeared in the blood on April 21, but have not been found since. No rise of temperature nor other symptoms have yet been observed.

Donkey.—Inoculated subcutaneously on February 23 from a rat. Positive on March 9. Parasites were found on rare occasions, and then only in very small numbers. There was no definite rise of temperature. Some diminution in the percentage of haemoglobin and the number of red cells has been observed.

Monkeys.—Macacus rhesus, Experiment 311. This monkey had been infected by Dr. H. E. Annett with blood from the European Case H. K.[1] Parasites were found only at intervals and in small numbers, though the animal appeared to be very

1. H. E. Annett, *First Report of the Trypanosomiasis Expedition to Senegambia*, 1902, Liverpool School of Tropical Medicine, Memoir XI, p. 4.

Split by PDF Splitter

ill and emaciated ; at the end of nine months it had quite recovered. In January, 1904, rats inoculated from it during the preceding four months not having become infected we decided to attempt to reinfect the animal. On January 29, thirteen months after its original infection, it was inoculated with blood from a rabbit ('Gunjur' strain). On February 6 parasites were found in the blood ; they were almost always present, though not in great numbers, up to March 24, from which date until death, on April 3, the blood remained negative. Very marked oedema of both upper and lower eyelids, intraorbital space, and eyebrows occurred on March 27 ; this persisted for three days ; no parasites were to be found in the oedema fluid. No other symptoms other than loss of weight and anaemia were observed.

Macacus rhesus, Experiment 517. Inoculated intraperitoneally on April 14 from a rat showing numerous trypanosomes. Strain 'Lammin.' Parasites appeared in the blood on April 16. Death occurred on April 18 from purulent and haemorrhagic peritonitis caused by a parasite found in the intestinal walls and not yet identified.

A chimpanzee, Experiment 134,[1] inoculated by Dutton and Todd in July, 1903. Parasites were rarely seen in the blood, and only in small numbers. After the third week in September trypanosomes were found only once in the blood, on January 27, when one was seen. On this date the temperature rose from its usual level of between 99° and 100° to 103·6° F., falling again next day. Parasites were not seen again before death, which occurred from broncho-pneumonia on February 10.

Sub-inoculations.—Two mice and a rat inoculated on November 20 did not become infected. Of the two mice and a rat inoculated on November 27 the mice did not become infected, while the rat was positive once, January 7, when one trypanosome was found in its blood. Two mice and a rat inoculated with large doses of heart blood immedately after death never became infected.

Symptoms.—There were occasional rises of temperature to 102° to 103° F. with no apparent cause. One of these occasions (November 27) one trypanosome was found in the blood. There were temporary loss of weight and appetite and falling off in condition towards the end of December, 1903. The animal subsequently improved and regained appetite. A blood count in July, 1903, showed haemoglobin 85 per cent. and red cells 8,360,000 per cubic millimetre. One made on February 6, 1904, showed haemoglobin 60 per cent. and red cells 4,540,000 per cubic millimetre.

Horse.—Experiment 87. The small bay stallion[2] inoculated in West Africa by Dutton and Todd in February, 1903, and brought to England in July, 1903, is alive and in good condition, and seems to have recovered. Trypanosomes have not been seen in its blood since it was brought to England. Two rats inoculated from it at the end of July became infected. Rats and mice inoculated on October 2 and

1. Dutton and Todd, *loc. cit.*
2. Dutton and Todd, *loc. cit.*

Split by PDF Splitter

November 6 have not become infected ; and one large rat and two small ones inoculated on April 22 have not, so far, become infected. On October 9, 1903, the weight of the horse was 513 pounds. On April 26, 1904, it was 506 pounds. The animal shows no symptoms, its temperature is regular (from 99° to 101° F.), and its appetite is good. There is no oedema, and its coat is in good condition.

Strain Derived from Cerebro-spinal Fluid of Uganda Cases of Sleeping Sickness[1]

Rats.—1. Young rats : Twelve experiments. Incubation period from four to thirteen days ; average length, nine days. Parasites were fairly constantly present, but usually rather in small numbers. Duration from fourteen to forty-one days. 2. Adult rats : Twelve experiments. Incubation period from four to twenty days ; average length, thirteen days. Parasites were fairly constantly present in small numbers in the early stages of infection, later they became rare. Duration from sixteen to one hundred and forty-nine days.

Mice.—Incubation period from five to six days. Parasites were rarely present in the blood after the first appearance. Duration was from nineteen to forty-seven days.

Guinea-pigs.—Four experiments. None yet infected. Five weeks have elapsed since inoculation. Sub-inoculations into mice and rats so far have been unsuccessful. No symptoms have yet been observed.

Rabbits.—Incubation period from seven to nine days. Parasites are constantly present, tending to become more numerous as the disease advances. Marked and fairly rapid loss of weight is observed. The rabbits are still living. Anaemia is a noticeable symptom.

Cats.—One experiment. A large grey cat was inoculated intravenously from a rat. Incubation was six days. The temperature rose on the evening of the sixth day to 105° F.

Dogs.—One experiment. Inoculated intravenously from a rat showing fairly numerous parasites. Trypanosomes appeared in the blood on the seventh day. The temperature has remained normal. The animal has, so far, shown no symptoms.

Puppy.—One experiment. Age four-and-a-half months. Inoculated on March 20 from a rat. Trypanosomes appeared in the blood on March 27 and have since been constantly present, although not more numerous than from two to five to a field. The temperature has varied between 101° and 103° F. There was no rise with the appearance of parasites in the blood. Diminution in haemoglobin and red cells has been observed. The animal has lost strength considerably.

1. This was sent to us in a rat which had been inoculated from a monkey infected from the cerebro-spinal fluid of a case of sleeping sickness ; it was, therefore, only in its second passage.

Split by PDF Splitter

Goat.—One experiment, a female. Incubation period, nine days. Parasites were fairly constant in the blood during the first week of infection, but afterwards were found only rarely. There was no rise of temperature with the appearance of parasites in the blood, but five days later, when eight trypanosomes were seen to the cover, the temperature rose to 104° F. No other symptoms have as yet been observed.

Donkey.—Inoculated on March 28 subcutaneously from a rat. On April 7 the temperature rose to 102·7° F., and on the 9th to 103·2°. A rat inoculated from the donkey on April 8 showed parasites on the 26th. The incubation period in the donkey was therefore ten days. Parasites were seen for the first time in its blood on April 18, and again on the 22nd.

Monkeys.—1. *Cercopithecus callitrichus.* Inoculated intraperitoneally on April 2 from a rat. Trypanosomes appeared in the blood on the 6th, and were constantly present for a week, when they became rare, occasionally being absent altogether. On the 7th the temperature rose to 105·5° F., and has since been irregular (with occasional rises to 104° to 105°, and over). No other symptoms have so far been observed, the appetite is preserved, and the animal is in good condition. 2. *Cercopithecus callitrichus.* Inoculated intraperitoneally on March 6 from a rat showing very few parasites. Trypanosomes did not appear in the blood before death, which took place from dysentery on the 10th. A monkey (*Macacus rhesus*), a rabbit, and one out of four rats inoculated with large doses of its heart blood became infected. Two guinea-pigs inoculated at the same time are still negative. Two mice inoculated with its blood died without becoming infected. 3. *Macacus rhesus.* Inoculated on March 10 intraperitoneally and subcutaneously with the heart blood of preceding monkey. Parasites were found in the blood on March 18, and were constantly present, although never very numerous, until April 6, when the animal died. On March 18 the temperature rose to 104·6°, with the appearance of parasites in the blood. During the last two days of life the temperature was subnormal (from 95° to 96°). Diminution of red cells and haemoglobin was observed. *Post-mortem*, purulent peritonitis was found due to a parasite found in the intestinal walls, and not yet identified. 4. *Macacus rhesus.* Inoculated on March 14 intraperitoneally with the heart blood of a rat. Trypanosomes appeared in the blood on the 18th, and were fairly numerous for four days ; on the 31st there were from thirteen to eighteen to a field. They became rarer again before death, which occurred on April 1. The temperature rose on the 18th, and on the 19th reached 105·8°, there being six parasites to a field at the time. The red cells decreased from 4,000,000 to 2,500,000 per cubic millimetre, and haemoglobin from fifty to twenty-seven per cent. 5. *Macacus rhesus.* Inoculated subcutaneously on April 22 with blood from a rabbit showing many trypanosomes. This monkey is not yet infected (April 27).

Split by PDF Splitter

STRAIN DERIVED FROM CEREBRO-SPINAL FLUID OF SLEEPING SICKNESS, CASE 6,[1] IN THE CONGO FREE STATE.[2]

Rats.—Twenty-three experiments. Incubation period: young rats from three to nine days; adult rats from four to ten days. Duration from seventeen to one hundred and seventy-six days. Some of the animals have shown parasites fairly constantly, and in moderate numbers; in others the organisms have disappeared for some time or have been present in small numbers. We have rats which have lived as long as one hundred and seventy-six days, but in the blood of such animals the parasites are either found only in rare instances or not at all.

Mice.—Incubation from four to eleven days. Duration over ninety-two days. Parasites usually rare.

Guinea-pigs inoculated more than fifty days ago have not shown parasites as yet.

Rabbits.—Incubation after intravenous inoculation from three to four days. There was a slight rise of temperature on the day of infection and the following day.

Cats.—Two experiments. 1. Intravenous inoculation from a rat. Incubation period, eight days. Parasites were constantly present. On the twelfth day there were five to a field. 2. Intraperitoneal inoculation from a rat. Incubation period, eight days. No symptoms have as yet been observed.

Dogs.—Two experiments. 1. An adult dog inoculated intravenously from a rat. Parasites were seen on the fifth day. They were not numerous at first, but are increasing and constantly present. 2. A puppy, four months old, inoculated intraperitoneally from a monkey. Incubation period, eight days. No symptoms have as yet been observed.

Goat.—An adult, inoculated intraperitoneally from a monkey. The temperature rose on the evening of the fifth day to 106·5° F.; next day the temperature was 104·2°; a rat inoculated on this day is not yet positive. Parasites have not yet been seen in the blood of this goat.

Monkeys.—1. *Macacus rhesus.* Experiment 497. Inoculated intraperitoneally from a rat. Incubation period six days. Parasites have been constantly present in the blood and have steadily increased in numbers. On the day of the appearance of the parasites the temperature rose to 106° F. 2. *Cercopithecus callitrichus.* Inoculated February 15 intraperitoneally from a rat. Parasites appeared in the blood on February 20. The temperature on the 21st was 103·8° F. Trypanosomes were constantly present in fair numbers until April 5. Since then they have been rarely found, and in only small numbers. No symptoms were observed. The animal was in good condition. There was slight diminution of haemoglobin and red cells.

1. Dutton, Todd, and Christy, *Human Trypanosomiasis on the Congo, etc., Brit. Med. Jour.*, Jan. 23, 1904, pp. 186-188.
2. This strain was sent to us in a rat inoculated with cerebro-spinal fluid from a case of sleeping sickness.

Split by PDF Splitter

STRAINS DERIVED FROM THE BLOOD OF CASE 4[1, 2] AND FROM TWO CONGO NATIVES AT PRESENT UNDER OBSERVATION

Rats.—Incubation period from four to eleven days, average about seven days; duration, some of the animals have survived after eighty-seven days. In these animals trypanosomes have been scanty in the blood, with periods of some days to even weeks when none were to be found. This perhaps may be accounted for by the fact that the majority of the animals have been direct inoculations from the natives, whereas the sleeping sickness and *Trypanosoma gambiense* strains have been passed through a series of animals.

Mice.—Parasites were always very rare and the duration was indefinite in direct inoculations. In mice inoculated from one of the guinea-pigs sent to us from the Congo Free State (see below), the incubation period was three days and parasites were more frequently present.

Guinea-Pigs.—Two guinea pigs inoculated by us directly from the natives, and two young guinea-pigs inoculated from monkeys have been negative for a period of one hundred and forty-six days. Two adult guinea pigs inoculated from Case 4[2] on the same day by the members of the Congo expedition, and sent home while still negative, have shown parasites for the first time in their blood on the seventy-ninth and one hundred and thirty-fourth days after inoculation. No symptoms have as yet been observed. They are still living one hundred and fifty-two days after inoculation.

Rabbits.—Incubation, direct inoculations nine and eleven days; sub-inoculation from rat ten days. Duration from twenty-one to eighty-seven days. Parasites have been fairly constantly present but only in small numbers. Loss of weight, slight rise of temperature, and anaemia have been the only symptoms observable.

Monkeys.—Macacus rhesus. Two have been inoculated intraperitoneally directly from the natives. Experiment 331. Inoculated on February 9. Parasites appeared in the blood on the fifth day. On the next day the temperature rose to 104·9° F., the following day it registered 105·8°; at the same time the parasites were observed to increase in numbers. Trypanosomes were constantly present at first. On March 5, there were from twenty-five to thirty to a field. About the middle of March the trypanosomes became scanty and were not found at all after March 17. Death occurred on March 25. Rises of temperature were observed in this monkey coinciding with temporary increase of numbers of parasites in the blood. Experiment 316. Inoculated on February 6. Parasites appeared on the 13th, and at the same time the temperature began to rise, and on the 19th it registered 104°, up to the end of March parasites were constantly present in its blood, since that date they have been scanty and sometimes absent. On March 27, marked oedema of the upper and lower eyelids, especially the left, was observed. This persisted for three days; the puffiness was confined entirely to the eyelids; no parasites were found in the oedema fluid. At

1. Received in a rat inoculated directly, and therefore in its first passage. 2. Dutton, Todd, and Christy, *loc. cit.*

Split by PDF Splitter

this time the appetite was poor, and the animal seemed to be failing. From April 15 to 22 parasites were present in fair numbers again, but are now once more scanty. No rise of temperature was associated with this temporary increase. Slight diminution of haemoglobin and red cells has been observed. The animal is now in better condition than it was a month ago.

Strain derived from the Blood of Trypanosome Fever Cases in Uganda

Rats.—Incubation from twenty-four to thirty-one days. Duration from one to four months. This strain was an attentuated one and has died out. Parasites were rarely present, and only in very small numbers.

Comparison of Symptoms in Animals inoculated with the above different Strains

It will be seen that our results have been practically the same whatever the strain used. In rats and mice the same chronic disease, periodicity in appearance of parasites, and absence of symptoms are in all cases observed as were described by Dutton and Todd. M. Brumpt and M. Wurtz have described[1] very marked symptoms in mice and rats inoculated from Congo sleeping sickness cases—*e.g.*, progressive emaciation, intermittent paralysis of the posterior quarters, oedema of the perineum, and sometimes acute nervous affections. We have observed none of these symptoms ; occasionally we have noted slight oedema *post-mortem*, but never in sufficient degree to be detected before death. In guinea-pigs there is with all strains the same lengthy incubation period. In those infected up to the present (with Gunjur and Congo blood strains) there is the same more or less chronic disease, characterized by loss of weight and constant presence of parasites in the blood. In rabbits we have produced with all strains the same chronic disease with fairly constant presence of parasites, loss of weight and anaemia. In cats the disease is the same with all strains, with rise of temperature on appearance of parasites, fairly constant presence of parasites, and absence of other symptoms so far as we have yet observed. In dogs and puppies there are no differences to be noted. Incubation periods are the same, and whatever strain be used there is the same constant presence of parasites in the blood, with loss of weight and anaemia. In goats and donkeys no differences have been observed between the strains used. In monkeys infection is readily produced with all strains, even with very small doses, and parasites are fairly constantly present in the blood, often in considerable numbers. Similar symptoms are observed with the different strains—*viz.*, slight loss of weight, anaemia, rise of temperature, especially with the first appearance of parasites in the blood, and occasionally localized oedema. We have observed no marked tendency to sleep in our monkeys ; when a

1. Brumpt et Wurtz : *Maladie du Sommeil Experimentale, etc*, *Comptes Rendus de la Société de Biologie*, tome lvi, 1904, No. 12, Avril 1er pp. 567-73.

Split by PDF Splitter

monkey is ill it sits on its haunches with its head between its knees ; this position, which has been termed the typical sleeping sickness position, is not characteristic of trypanosomiasis or 'sleeping sickness' ; it is the position assumed by any sick monkey from whatever disease it be suffering. We have noted no nervous symptoms at all.

In stained specimens we have not observed any differences between the trypanosomes of Uganda and Congo sleeping sickness cases on the one hand and *Trypanosoma gambiense* (Dutton) on the other. In the same species of animals and at corresponding stages of the infection the size and appearance of the former trypanosomes are precisely the same as those of the latter as described by Dutton and Todd and since observed by us. In rats inoculated either directly or from monkeys inoculated directly they present the same stumpy and long forms, the former being more numerous in the early stages than in the later. After passage through some generations of rats the stumpy forms show the same tendency to disappear. In rabbits trypanosomes of all strains show the same preponderance of short stumpy forms as compared with rats, mice, and guinea-pig, while in guinea-pigs, so far as we have yet observed, there is the same greater tendency to length in most of the forms met with. In no animals infected with either the Uganda or Congo sleeping sickness trypanosome have we ever seen any form differing in measurements or appearance from *Trypanosoma gambiense*.

Pathological lesions.—In none of our animals have we found anything differing from the lesions described by Dutton and Todd. Enlargement of the spleen is a feature in all the animals, more especially in rats and mice. In a guinea-pig, Experiment 133 (Gunjur strain), which died forty-two days after infection, rupture of the spleen was found, the rupture extending directly across the organ on its upper surface and near the posterior end for about one and a quarter inches. A profuse haemorrhage occurred and the animal bled to death. No history of an injury is known. Another guinea-pig inoculated with *Trypanosoma dimorphum* (Dutton and Todd)[1] has died from rupture of the spleen. This case will be published in a forthcoming report on *Trypanosoma dimorphum*. The glands are very little, if at all, enlarged, and there are no haemorrhagic glands to be met with as in animals infected with *Trypanosoma dimorphum*. Petechial haemorrhages are rarely seen. In monkeys the mesenteric glands are enlarged, but this is without significance, as all our monkeys were infected with intestinal parasites. No macroscopical changes in the nervous system have been noted. In none of our animals, whether allowed to die or killed for special purposes, have we been able to find trypanosomes in the cerebro-spinal fluid, although the blood may have contained many trypanosomes, nor have any of the animals inoculated with this fluid ever become infected.

1 Laveran et Mesnil, *Comptes Rendus de l'Académie des Sciences*, tome cxxxviii, 1904, p. 732.

Split by PDF Splitter

In the majority of animals which have died we are unable to say definitely that trypanosomiasis was the sole cause of death. Very frequently an intercurrent affection has occurred which, the animal's vitality having become impaired, has caused death. We would instance in rats broncho-pneumonia, caseous lung disease, and enteritis. In rats which have survived a few to many months it is exceedingly rare to find a single parasite,[1] nor has the negative blood appeared to be infective. Experiments are being conducted along these lines. In the majority of cases those rats which have been negative for months die without the presence of trypanosomes being again recognized. In some cases, however, rats which have been negative for months have at death once more shown parasites. As instances of this the following experiments are given.

Rat 95a[2] ('Q' strain) was inoculated on March 17, 1903, from horse Experiment 87; incubation period, eight days; parasites were found at irregular intervals and in small numbers. On September 13, 1903, a single parasite to a whole cover-slip preparation was seen, and the animal continued negative until its death on March 24, 1904, three hundred and sixty-five days after infection. At the necropsy a few parasites were found in the heart. Animals inoculated from it have not yet shown the infection.

Rat, Experiment 89[3] ('Lammin' strain). Inoculated February 26, 1903, from rat 26; incubation, eighteen days. Trypanosomes were present in its blood until April 21. From that time parasites were never seen except on the following dates, July 27, September 7, and November 1, 1903, until its death on March 15, 1904, three hundred and sixty-six days after infection. At the necropsy complete red hepatization of the whole of the left lung was found. The left pleural cavity contained over five cubic centimetres of slightly yellowish clear exudate containing one parasite to three fields. Animals inoculated with this exudate became infected, and from these sub-inoculations we have been able to infect a goat Experiment 518, and a monkey, Experiment 517.

We have observed that animals with extraordinary numbers of trypanosomes in their blood usually exhibit some lesion which tends to impair their vitality. The following experiment is a good example of this. A rat, 279a ('Gunjur' strain), inoculated on December 30, 1903, from a guinea-pig became positive on January 7, 1904. From that time until it was killed on March 22 the parasites were constantly present in increasing numbers in its blood. At the necropsy caseous lung disease was very far advanced, involving both lungs. Its blood on examination showed trypanosomes in countless numbers. Two rats, two mice, three guinea-pigs, one rabbit, and a puppy were all inoculated intraperitoneally with heart-blood. Twelve hours later the mice and rats, the rabbit and two guinea-pigs were found to be positive, the rats and mice having as many as three to eleven to a field, the rabbit two hundred and forty to the cover-slip preparation, and the two guinea-pigs eight to the cover. The puppy did not show parasites in its blood until five days later.

Very little, if any, immunity is conferred by infection with *Trypanosoma gambiense*. The two following experiments are of interest in this connexion.

1. A piebald rat was inoculated directly from Mr. Q. by Dutton and Todd on November 3, 1902. Parasites were found in its blood on November 12, and again on February 27, 1903. After this the blood was always negative. On November 23, 1903, it was reinoculated intraperitoneally from a rat ('Gunjur' strain) showing very numerous trypanosomes. It became infected, and on December 9 its blood was swarming with trypanosomes. Death took place on December 26.

2. A monkey (*Macacus rhesus*) infected by Annett from H. K. (Dutton's original case) in 1902 recovered, its blood being non-infective to rats. On January 29, 1904, it was reinoculated (Experiment 311) from a rabbit ('Gunjur' strain), and became infected (see above).

As one would expect, there is no transmission of immunity to offspring. Several of the young rats which we have infected have been born from parents which either were infected at the time or had

1. This is also the case in other animals. See chimpanzee experiment.
2. Dutton and Todd, *loc. cit.*
3. *Ibid.*

Split by PDF Splitter

recovered from an infection. And one guinea-pig (Experiment 216) which we infected with 'Gunjur' strain was born from a guinea-pig infected at the time (also with 'Gunjur' strain). There is a certain amount of natural immunity or resistance to the human trypanosome to be met with in individual rats and other animals. Every now and then we have come across animals which have exhibited this feature. For example, of two rats A and B of the same size, inoculated at the same time with equal amounts of virulent blood from an infected animal, A will become infected while B remains uninfected or shows a prolonged incubation period. Again, A receives a larger dose than B; it frequently happens that B will show the infection earlier than A. Guinea-pigs show considerable resistance to infection. As instances of this we would mention those inoculated from Rat 279A (see above). Baboons (*Cynocephalus sphinx*) have up to the present been absolutely refractory.

Conclusions

1. The trypanosomes found in (*a*) cerebro-spinal fluid of Uganda sleeping sickness cases, (*b*) cerebro-spinal fluid of Congo Free State sleeping sickness cases, (*c*) blood of Uganda trypanosome fever cases, and (*d*) blood of Congo Free State trypanosome fever cases, are all identical in animal reactions and morphology with *Trypanosoma gambiense*. The specific name *gambiense* (Dutton) must therefore for the future include the trypanosomes from the above-mentioned sources.

2. There seems to be no acquired immunity against infection.

3. There is no transmission of immunity to offspring.

4. An animal which seems to have recovered may months later show parasites once more, apparently as the result of lowered vitality.

Split by PDF Splitter

TWO CASES OF TRYPANOSOMIASIS IN EUROPEANS

Split by PDF Splitter

TWO CASES OF TRYPANOSOMIASIS IN EUROPEANS

(Third Interim Report of the Expedition of the Liverpool School of Tropical Medicine to the Congo, 1903) *

BY

J. EVERETT DUTTON, M.B., Vict.

WALTER MYERS FELLOW, UNIVERSITY OF LIVERPOOL

JOHN L. TODD, B.A., M.D., C.M., McGill

AND

CUTHBERT CHRISTY, M.B., Edin.

THE following cases seem well worthy of record since they tend to indicate with what uniformity the accepted signs of the disease may be expected to occur in Europeans infected with *Trypanosoma gambiense*.

The completeness of the history of the onset of the disease in Cases I and II makes them particularly interesting. The history of Case I is compiled from notes and temperature charts taken by the patient's husband during her illness. Case II was seen very soon after the probable date of his infection.

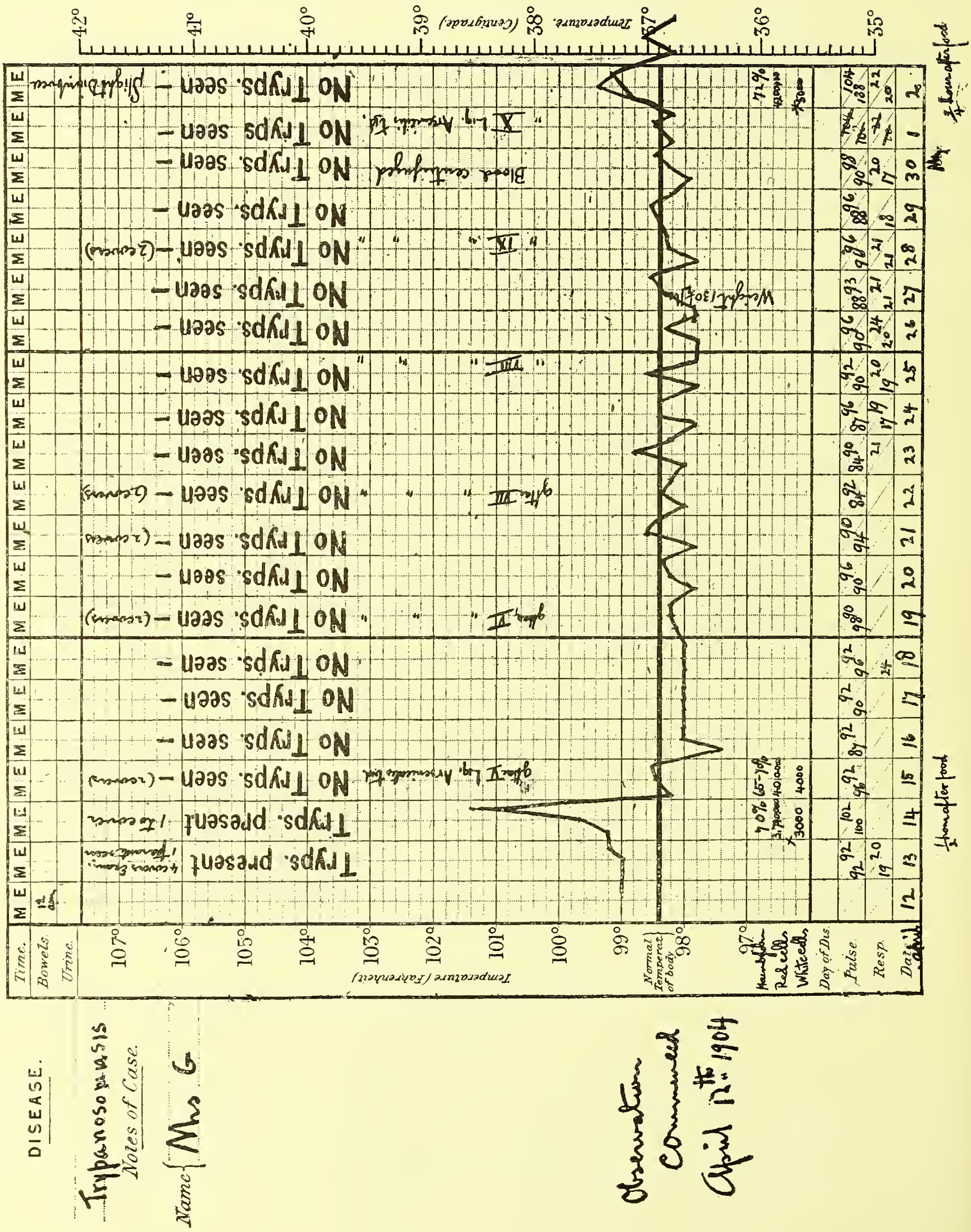
Case I

Mrs. G., *aet.* 35, a missionary. The patient's first stay in Congo was during the years 1895-99. During this period she had four small fevers, yielding to quinine—maximum temperature 103° F. ; and a supposed attack of haemoglobinuric fever. One year without fever was then spent in England, and in June, 1900, patient, weighing then 147 lbs., again went to the Congo. Soon after her return she had three attacks of fever—maximum temperature, 104° F.—which were successfully treated by quinine ; and from November, 1900, to July, 1901, she was in good health.

During the first days of August, 1901, the patient took a long canoe journey from Bolobo to her station at Bongandanga on the Lopori, and was severely bitten by 'river flies.' At the end of August, six days after the completion of the canoe trip, a severe fever commenced and lasted, without interruption, for twenty-five days. 'The highest temperature was 104° F., but the fever was very persistent and remained constant for two or three days at 103° F., then at 102° F., and so on. Quinine and phenacetin had no effect and the temperature was relieved only temporarily, but

* Received for publication July.

Split by PDF Splitter Baluba 1



Split by PDF Splitter

unfailingly, by baths. For the next three months, weekly fever. First day, temperature about normal ; second day, slight fever ; third day, marked temperature ; fourth day, 'always just one degree higher than third day'—highest temperature recorded, 104·6° F.—fifth and sixth days, temperature much lower ; seventh day, 'about normal.' From January to April, 1902, the temperature ranged between 99° and 100° F., and was never normal.

In January, and again in February her eyes, particularly the left, were 'inflamed,' and five days were spent with bandaged eyes in a darkened room. At the end of February, and during March, while on her way from her station to the sea-coast, four more attacks of fever occurred—temperature rising to 102°-103° F. During the voyage to England, where she arrived at the end of April, 1902, the patient's temperature gradually fell to normal. She remained in Europe until August, 1903, and then again returned to Africa. While at home she, on two occasions, suffered from fever, rising to 103°F. ; quinine efficacious. During June, 1902, and again in January, 1903, her eyes were once more affected, and oculists were consulted. At various periods during her stay in Europe 'red patches' as large as a 'half-crown piece,' lasting for three or four days, appeared on her legs ; they were tender, and the surrounding skin seemed hard. At one time patient's joints seemed stiff, at another she suffered from an 'inflamed throat. Three months were spent in Switzerland, the patient gained rapidly in health, and on leaving for Congo, August, 1903, seemed well, and weighed 145 lbs. Her medical history from her last arrival at the Congo to April, 1904, when we first saw her, is as follows :—

'*October* 10, 1903. Fever on the river steamer ; lasted for two days ; maximum, 102° F.

'*November* 9. Still on steamer ; temperature suddenly rose to 105° F., reduced by bath ; throat bad next day, relieved by gargling ; discharge of matter for two days. On Tuesday, November 10, Wednesday, and Thursday, slight fever. Friday, 13, 5 a.m., 105° F., bath ; 10 a.m., 105° F., bath ; 1 p.m., 105° F., bath ; 3.30 p.m., 107° F., bath ; 8 p.m., 105° F., bath ; the temperature fell to about 101° F. after each bath ; patient delirious.'

'*November* 14. Patient too weak to walk, was carried from the steamer ; highest temperature, 102° F. At 2.30 on the morning of the 15th the temperature rose to 105° F., a bath was given, and temperature brought down. On the 16th the temperature was 100° F., and on the 18th normal. There was no more fever until March, 1904.'

For two or three weeks she was apparently quite well. About Christmas, 1903, severe headaches commenced ; about the middle of January these began to be accompanied by vomiting. At first the vomiting and headache 'appeared at irregular intervals, later as follows :—'First day, comparatively well ; second day, malaise with slight headache ; third day, bad headache, vomiting two to six times (on one

Split by PDF Splitter

occasion eight times). There was no tenderness or pain, save headache, and no nausea or loathing of food. On the bad days an attempt at any exertion, even to read a letter, was certain to precipitate an attack of vomiting. About February 14 there was vomiting, once or twice, on alternate days. Took Liquor Arsenicalis, two to six drops three times a day.'

March 10. Stopped arsenic ; left her station for a change.

March 16. Headache and vomiting.

March 17. Severe vomiting, bile-stained vomitus.

March 18-20. Well.

March 22. Vomiting and headache, next day emesis more severe ; vomitus bile-stained.

March 24. Fairly well.

March 25. Severe headache, vomiting, fever (maximum 104·4° F.) The fever gradually lessened during the two following days, and from March 29 to April 12 patient was 'quite well.'

Quinine was given during this fever, but was, probably, never retained, since the ingestion of anything, liquid or solid, provoked emesis.

Physical examination.—April 15, 1904. General condition : Well-made woman ; height, 5 feet 6 inches ; weight, 126 lbs. ; rather anaemic appearance ; complains only of shortness of breath and of becoming easily fatigued.

Skin : No erythemata ; no distinct oedemas, although the skin of legs has a distinctly doughy feel ; on scratching skin capillaries contract.

Lymphatic glands : Slightly enlarged, palpable in axillae and neck.

Circulatory system : Slight venous pulsation in neck ; slight epigastric pulsation.

Heart : Apex beat normal in position ; cardiac dulness normal ; no thrill over heart or in neck ; sounds, a slight blowing systolic murmur limited to apex area, the aortic and pulmonary second sounds are rather loud ; no venous hum in neck.

Pulse : Frequent (96), tension medium, regular in time and force, artery normal.

Respiratory system : Nothing abnormal subjectively or objectively.

Digestive system : Appetite good ; bowels fairly regular, occasional slight constipation ; tongue clean.

Liver : Dulness normal, no tenderness on pressure.

Spleen : Not enlarged nor tender.

Nervous system : No headache or pain ; sensation to pain acute ; sensation to touch, heat, cold, and distance between pin points perfect ; there were distinct localized hyperaesthetic areas on different parts of the body, under right nipple, at apex of heart and on shins, slightest pressure causes acute pain. Superficial reflexes normal ; knee jerks just obtainable. Mental condition normal.

Eyes : Pupils react to accommodation and light ; both discs definitely congested (left more than right).

Split by PDF Splitter

Throat : Tonsils not enlarged, no redness.

Generative system : Menstruation regular, flow normal in amount, generally slight temperature on first day.

Urine. April 29. Twenty-four hours specimen (preserved with thymol), volume 1,100 c.cm. ; acid, color normal ; cloudy precipitate, Sp. Gr. 1,020 (82° F.) ; no albumen or sugar ; urea, 1·85 grammes to 100 c.cm. urine.

April 30. Twenty-four hours specimen, volume 1,740 c.cms. ; color, normal ; acid, no albumin or blood ; urea, 1·55 grammes to 100 c.cms. urine.

Faeces. Careful examination showed no signs of intestinal parasites.

Liquor arsenicalis five drops three times a day was prescribed, and the patient was directed to increase the dose by one drop every third day. This treatment was followed until the 3rd of June (twenty drops t.i.d), when symptoms of saturation were evident, and this drug was discontinued for a time and iron and arsenic pills were substituted.

During 1895-96-97 quinine, grains V, was taken daily as a prophylactic against malaria. Its use was discontinued as it was thought to be the cause of 'neuralgia.' From January, 1903, to the present about three grains have been daily taken.

April 21. Slight epistaxis ; bleeding at the nose had occurred on three previous occasions, once in Switzerland, twice in Africa, always slight.

May 22. For past three days has had swollen wrists, first one then the other ; to-day one side of face is swollen, no redness or tenderness, or evidence of insect bite ; these swellings are fugitive, and last only for a day.

June 2. For last few days patient has complained of lack of appetite and loss of energy ; the swellings on face and hands persist ; a papular eruption has appeared on the chest.

The accompanying chart shews the type of temperature and the result of examinations for parasites during the first three weeks of our observations. On the 15th of April the parasites disappeared from the peripheral blood, and the temperature fell to normal. In spite of daily examinations of coverslips and periodic centrifugalization of blood, trypanosomes have not been again seen. The temperature (with one slight exception) has, during this period, always been normal.

Until signs of arsenical saturation commenced to show themselves the patient felt 'much better' ; she felt stronger and was less easily fatigued. There has been a slight increase in body weight, and in the value of erythrocyte and haemoglobin estimations.

May 12	May 27
Haemoglobin, 68 per cent.	74 per cent.
Red Cells, 4,510,000	4,450,000
White Cells, 4,650	4,000

We have never seen malarial parasites in this case.

Split by PDF Splitter

It was through the kindness of Mr. M., a missionary stationed at Leopoldville, and the husband of the case 'Mrs. M.,' described by Broden and Manson, that this case was brought to our notice. He felt convinced that he had, in October, 1903, seen an erythema on Mrs. G.'s forehead in every way similar to those which he had previously seen in each of the cases from the Congo described by Manson.

We have been unfortunate in never seeing this case when erythemata were present.

Case II

T., a steamer captain, *aet.* twenty-eight, serving his first term in Congo. Patient left Antwerp, November 26, 1903, and arrived at Leopoldville, December 30. He reached his station, a wood post for steamers, on the banks of the Congo, just below its junction with the Kasai, on December 31, and remained there until April 13, 1904, when he was invalided for 'fever' to Leopoldville.

Here he came under the care of Dr. Grenade, the State Physician, who found that quinine was without effect, and, suspecting the nature of the patient's fever, very kindly allowed us to study the case.

History.—Six years ago the patient spent eight to nine months in a cargo steamer plying between Sierra Leone and the Gold Coast ; the steamer often remained in various ports for some little time. In spite of this he never had 'fever,' and in 1898 he returned to Europe. Since then, until leaving for the Congo, November, 1903, he had been employed on vessels plying between European ports. After frequent questioning, the patient admitted that during this period he had had very occasional 'fevers' preceded by a 'cold feeling,' and followed by sweating. No quinine was ever taken for these 'fevers.'

While on the East Coast of South America, during six months in 1894, he had yellow fever.

In 1901 he was in hospital for four or five weeks with rheumatism in legs and arms. With these exceptions, he has always had good health.

Complains of constipation since leaving Europe.

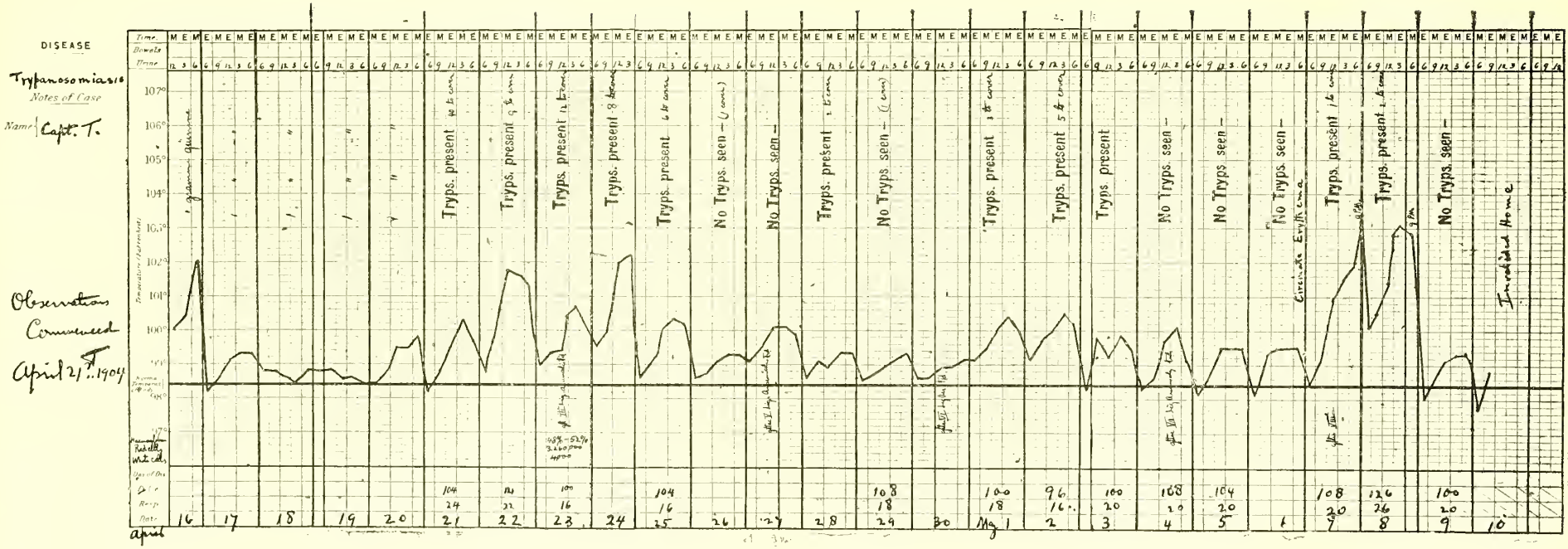
During his stay at the wood post he had five attacks of fever. The first commenced January 26, 1904, about four weeks after he reached the post, and lasted to February 3 ; during nine days he was ill, maximum temperature, 106·7° F.

The second attack occurred on February 17 and 18, two days' duration, fourteen days interval between it and first fever.

The third attack lasted two days, February 22 and 23, five days' interval between it and preceding fever.

The fourth fever also lasted two days, March 9 and 10, interval sixteen days.

During these last two fevers temperatures of 102·2° F. to 104° F. were recorded.



Split by PDF Splitter

Split by PDF Splitter

The fifth fever commenced March 17, and lasted eleven days, ending on March 27 ; temperature, 104° F. to 105·8° F.

The patient stated that the second, third, and fourth 'fevers' came on suddenly and without any premonitory signs ; for instance, while sitting at dinner he found himself in a high fever without any shivering fit or other prodrome. Before the first and fifth fevers, on the other hand, there was definite malaise, but no rigors.

From March 2 to April 10 he was alternately in bed and sitting in his chair ; on March 31 and April 1 and 5 his temperature was raised.

During these fevers and until his arrival in Leopoldville, April 13, he took about a gramme of quinine daily.

During the last fever he was greatly troubled by daily vomiting, which did not occur, however, unless something had been ingested.

The patient's friends say that he has lost flesh.

Physical examination.—April 18, 1904. Present condition : Man of average height and build ; distinctly sallow and anaemic appearance ; slight blepharitis (old-standing), complains of weakness ; says 'knees are weak ;' loses breath quickly.

Skin : Has a doughy feel, and is distinctly oedematous, this is most marked over ankles, where there is pitting ; there is no erythemata or other eruption ; dermatography not marked.

Lymphatic glands : Palpable, not enlarged.

Circulatory system : Heart, action rapid ; dulness, normal ; difference between first and second sounds, less marked than normal ; no bruits ; pulse, frequent, regular in time and volume ; artery, normal.

Respiratory system : Normal ; no complaint.

Digestive system : Bowels constipated, goes two to three days without movement ; tongue, flabby, not much furred, no tremor ; throat, normal ; appetite, fair.

Liver : Not enlarged (width in nipple line 6 cm.), a suspicion of tenderness.

Spleen : Just palpable ; slight tenderness.

Nervous system : Sensation to pain, touch, heat, cold, and distance apart of pin points, normal ; superficial reflexes, normal ; knee jerk, slightly increased.

Eyes : Left eye is seen by ophthalmoscopic examination to have a markedly congested disc, there is deep cupping ; choroidal vessels show very plainly.

Urine. April 29. Twenty-four hours specimen (preserved with thymol), volume, 660 c.cm., dark sherry color, acid ; urea, about 3 grammes to 100 c.cm. urine ; spectrum of urobilin, marked.

May 4. Twenty-four hours specimen ; volume, 1,075 c.cms., dark-brown sherry color ; acid, no albumen ; Sp.Gr. 1,016 (temperature, 79° F.) ; urea, 2·6 grammes to 100 c.cm. urine.

May 10. Twenty-four hours specimen ; volume, 700 c.cm. ; dark color ; Sp.Gr. 1,027 (temperature, 78·8° F.) ; acid, no deposit ; no blood or albumen ; urea, 2·6 grammes to 100 c.cms. urine.

Split by PDF Splitter

April 30. Physical examination repeated, no change observed.

May 7. Patient drew attention to a redness on chest which he said was very obvious last night. On examination, red diffuse areas seen under nipple and on epigastrium, not itchy or painful ; one annular area about 5 cm. in diameter on right lower costal margin, had slightly swollen periphery with injected vessels, while the centre remained uncoloured. Five diffuse injected areas, varying in diameter from 2 to 4 cm., were seen on back.

May 8. Says that temperature rose to 104° F. at about twelve last night. To-day there is marked oval ring of faint, slightly raised erythema, measuring 1 by 5 cm. just above the right eye ; it is not tender or itchy, and the skin is distinctly thickened. The ring seen yesterday on right hypochondrium still persists, its capillaries are injected, and its general appearance is much the same as yesterday, its centre is yellowish ; there is no extravasation of blood (glass slide test) in either of these annular areas. On left hypochondrium were more or less blotchy areas of redness, mixed with very faint greenish or yellowish discolouration.

Patient has more colour and looks better than when he was first seen, he has more appetite and says that he feels stronger and does not become so easily fatigued as when he first came to Leopoldville.

May 9. The ring of erythema over right eye has almost entirely disappeared, the blotchy areas on body are vanishing. Although patient's temperature has been about 103° F. for the past two days, he says that he has felt no inconvenience from it. His appetite has been good, and he walked about as usual.

May 10. Patient leaves Leopoldville, invalided home. The remains of ringed erythema are seen on chest. Malarial parasites were not seen in this case.

The first attack of fever occurred within six weeks of this man's arrival in Congo. He spent approximately the first week in the Free State in Boma, and then went as directly as possible to his station. In twenty-seven days after reaching the wood-post his illness commenced. It does not seem at all probable that he acquired his infection so long ago as 1898 when he was on the Gold Coast, nor do we believe that he became infected either at Boma or while travelling by train to Leopoldville. We are inclined to think that he became infected with trypanosomes after his arrival at his post. It, therefore, seems probable that the 'incubation period,' between the time of infection with *Trypanosoma gambiense* and the appearance of the symptoms associated with human trypanosomiasis, may be so short as four weeks.

It is extremely interesting to note in this connexion that *Glossinae* were extremely numerous at this post, situated on the river bank, and were a most disagreeable and constant pest.

Split by PDF Splitter

SUPPLEMENTARY NOTES ON THE TSETSE-FLIES

Split by PDF Splitter

SUPPLEMENTARY NOTES ON THE TSETSE-FLIES
(GENUS GLOSSINA, WIEDEMANN)

BY

ERNEST E. AUSTEN*

ZOOLOGICAL DEPARTMENT, BRITISH MUSEUM; AUTHOR OF 'A MONOGRAPH OF THE TSETSE-FLIES,' ETC.

SINCE the publication of *A Monograph of the Tsetse-Flies* a little more than a year ago, our knowledge of these interesting insects, so important to the student of African trypanosomiasis, has been extended in various directions. It has, therefore, seemed advisable to embody these additions in a short paper, which it is hoped may not prove altogether unworthy of the attention of the members of this Section, and may serve to bring the author's Monograph so far as possible up to date.

In the work in question seven species of Tsetse-flies were recognized and described. But within the last few months an eighth species has been described under the name *Glossina decorsei*, by Dr. EMILE BRUMPT, from specimens recently obtained by Dr. DECORSE on the River Shari and the shores of Lake Chad.[1] An examination of some of Dr. DECORSE's specimens, however, kindly submitted by Dr. BRUMPT, shows that the supposed new species is in reality none other than *Glossina tachinoides* (WESTWOOD), which was described as long ago as the year 1850. In his Monograph, *Glossina tachinoides* was regarded by the present author as a variety of *Glossina palpalis* (ROBINEAU-DESVOIDY), the species that, since Colonel DAVID BRUCE's investigations in Uganda last year, has become widely known as the disseminator of *Trypanosoma gambiense*, now recognized as the cause of sleeping sickness. The study of further material, however, and especially of a long series of specimens obtained two months ago on the Benue River, Northern Nigeria, by Mr. W. F. GOWERS, and kindly presented by him to the British Museum, shows that *Glossina tachinoides* (WESTWOOD) is in reality a perfectly distinct species, nearly related to *Glossina pallidipes* (AUSTEN) but distinguishable at once, apart from its much smaller size, by the fact that the hind tarsi are either entirely dark, or, as in the female, are dark with the bases of the first three joints usually pale. The total number of species of Tsetse-flies now known

* *Reprinted by permission of the publishers of the* BRITISH MEDICAL JOURNAL, *August*, 1904

Split by PDF Splitter

therefore amounts to eight. In the paper already referred to Dr. Brumpt considers that *Trpanosoma brucei*, the parasite of nagana or Tsetse-fly disease in domestic animals, is carried by at least five of these species,[2] and he further states that the investigations that he is making upon sleeping sleepness lead him to suppose that this malady may also be transmitted by several species of Tsetse-flies. The mere possibility that this supposition may ultimately prove to be true is perhaps sufficient warrant for thinking that no detail concerning the morphological characters, distribution, or bionomics of any of the species of *Glossina* is without importance for those interested in the sanitation of tropical Africa. In the present paper, therefore, the eight species will be considered in order, and any new facts regarded as worthy of notice recorded under each, the arrangement adopted in the Monograph being adhered to, and *Glossina tachinoides* inserted in its proper place. At the end of the paper a revised 'Synopsis of species' will be given, which it is hoped may prove useful for the determination of specimens.

Glossina palpalis (Rob.-Desv.)

The form of this species designated in the Monograph as 'Var. *tachinoides* (Westw.)' must now be regarded as a variety which for the present may remain unnamed. It is characterized by the possession of pale femora, buff-yellow median stripe on the abdomen, and narrow pale hind margins to the abdominal segments. Specimens obtained by Drs. Todd and Dutton on the Gambia during the Gambia expedition of the Liverpool School of Tropical Medicine belong to this form, which may eventually have to be raised to specific rank. A second variety also has the femora paler than usual; the palpi, except the tips, pale; and the abdomen somewhat reddish-brown, with the pale area on the second segment oblong instead of triangular. Owing to the colour of the abdomen this form presents a certain resemblance to *Glossina pallicera* (Bigot). A specimen of variety No. 2 was obtained at Old Calabar on May 14, 1900, by Dr. Annett, of the Liverpool School of Tropical Medicine.

As many of the members of this Section are doubtless aware, our knowledge of the life-history of Tsetse-flies was originally due to Colonel Bruce, who, during his investigations upon Tsetse-fly disease, or nagana, among domestic animals in Zululand in 1895, discovered that the species studied by him—either *Glossina morsitans* (Westw.) or *Glossina pallidipes* (Austen)—'does not lay eggs as do the majority of Diptera, but extrudes a yellow-coloured larva nearly as large as the abdomen of the mother.'[3] Specimens of the pupa of this species, kindly supplied by Colonel Bruce, were described and figured on pp. 26-28 of the author's Monograph. Owing to the kindness of Colonel Bruce, Captain E. D. W. Greig, I.M.S., and Dr. Nabarro, all of the Sleeping Sickness Commission, who forwarded specimens from Entebbe, Uganda, it is now possible to describe the larva and pupa of *Glossina palpalis*.

Split by PDF Splitter

Larva of Glossina palpalis

I have been enabled to examine a series of sixty-two larvae of this species, ranging in length from 2 mm. to 7 mm., but only one of these (the largest) can be regarded as adult. The colour of these specimens, which have been preserved in 5 per cent. formalin, varies from cream to buff yellow. In all the larvae the tumid lips on the last segment, as seen in the pupa, are plainly visible, and in a larva of $2\frac{1}{2}$ mm., which may perhaps be considered to be in the first stage (*i.e.*, before the first moult), the size of the lips is relatively, if not even actually, considerably greater than in a larva measuring $3\frac{1}{3}$ mm., which is perhaps in the second stage (*i.e.*, between the first and second moults). In the former stage, too, the lips are much wider apart than in the second, and the very young larva viewed from above may be said to be conical in shape, with a protuberance on each side of the truncate posterior extremity. In the second stage (larvae from 3 mm. to $3\frac{1}{3}$ mm. in length) the lips are nearer together, and separated by a much narrower interval than in larvae in the third stage (about $3\frac{1}{3}$ mm. in length and upwards), in which they have their final position, as seen in the pupa. In the first stage the lips, or anal protuberances, appear slightly brownish all over ; in the second stage they are blackish at their extremity and at the margin of the intervening notch ; in the third stage they are uniformly deep black, and the granules with which they are covered can now be easily discerned under an ordinary platyscopic lens. In the second and third stages the body of the larvae in front of the bifid anal extremity (twelfth segment) is seen to be composed of eleven clearly marked segments. In the larger larvae the tips of the mouth hooks can be seen slightly protruding from the cephalic end. The larva already referred to as being the only one that can be regarded as adult, measures 7 mm. in length, by 3 mm. in greatest width, and was obtained by Captain Greig, at Entebbe, Uganda, in April of the present year. In this larva, in the median ventral line, each of the segments from the fourth to the tenth shows on its anterior margin a narrow ridge, measuring about $\frac{2}{3}$ mm. in transverse width. The object of these ridges may be to assist the adult larva on extrusion to crawl away to some hiding place in which the pupal stage may be assumed.

All of the larvae here referred to were deposited by the parent flies in boxes, and, since all, with a single exception, are immature, it follows either that *Glossina palpalis* differs from the species described by Colonel Bruce, in that the larva feeds and grows outside the body of the mother after extrusion, or else that the parents of these larvae, probably owing to their being in captivity, gave birth to their offspring prematurely. The latter supposition would appear to be the more reasonable.

Pupa of Glossina palpalis

The pupae examined were all obtained at Entebbe, Uganda—those forwarded by Dr. Nabarro in September, 1903, while others were collected in April, 1904, by Captain Greig. Additional specimens were sent home last year by Colonel Bruce.

Split by PDF Splitter

The pupa varies in length from $5\frac{1}{4}$ mm. to $6\frac{1}{2}$ mm., and in the greatest width from 3 mm. to $3\frac{1}{3}$ mm. In general appearance it is precisely similar to that of the Zululand species, figured on page 27 of the author's Monograph. The tumid lips on the last segment, however, are much closer together, the space between them being reduced by quite one-half, while the lips themselves are somewhat larger, and covered with sparser and therefore more conspicuous granules. The notch between the lips is somewhat deeper, and consequently approaches slightly closer to the preceding segment than in the species figured in the Monograph. Other points of difference are that the edge of each lip bears only two grooves or furrows instead of four, while the ridges connecting the lips at the base on the dorsal and ventral side, besides being lower owing to the greater depth of the notch, have a broad, shining black margin, instead of being almost dull.

Whatever be the case with regard to the larvae, it would seem probable that, did we but know them, all the species of Tsetse-flies might be distinguished in the pupal stage by the characters afforded by the last segment. At any rate, in a pupa forwarded from Entebbe by Captain GREIG with those already referred to, the lips are extremely low, much wider apart than in either of the forms previously mentioned, and separated by a wide and shallow notch instead of a deep and narrow one. The longitudinal grooves with which the connecting ridges are deeply scored at the base are very conspicuous, and the connecting ridges themselves are without a broad and shining black margin. This pupa, of which the dimensions are :—length, $7\frac{1}{3}$ mm., greatest width, 4 mm., should perhaps be assigned to *Glossina pallidipes* (AUSTEN), in which case the specimen figured in the Monograph would belong to *Glossina morsitans* (WESTW.).

DISTRIBUTION OF GLOSSINA PALPALIS

Since the publication of the author's Monograph, our knowledge of the distribution of this species has been considerably extended. As regards Uganda, BRUCE, NABARRO, and GREIG have published[1] a map showing the localities in which the species was obtained in the Uganda Province and Usoga. Here the fly is found on the forest-lined shore of Lake Victoria and the adjacent islands, passing down the Nile until Lake Albert is reached, all round which the species was met with last year by Mr. W. Y. WYNDHAM. In a letter to Dr. NABARRO, dated 'Wadelai, November 2, 1903,' Mr. WYNDHAM states that he has found the fly on all the shores of the Albert Nyanza, and also on the Congo side of the Nile, about eight miles to the south of Wadelai. He adds that from the results of his investigations 'there is little doubt that the fly is prevalent in this part of Africa, wherever the local conditions are favourable.' North of Lake Albert *Glossina palpalis* was encountered at Nimule, in the Nile Province of Uganda, by Dr. BRUMPT, who also found it to the west of the Nile in the Belgian enclave of Lado, and all down the Congo system, from the source of the Welle to the mouth of the Congo. Eastwards Dr. BRUMPT had previously met with the species on

Split by PDF Splitter

the river Omo, which falls into the north of Lake Rudolf. In West Africa (Sierra Leone) Major Fred Smith, D.S.O., R.A.M.C., writing to the author from Freetown on May 16 last, stated that in April of the present year he had found *Glossina palpalis* all the way from Freetown to Kakena in the north of the Sierra Leone Protectorate. It was the only species met with, though Major Smith's native boys talked of a larger one (probably *Glossina fusca*), which, however, he did not encounter. In Northern Nigeria *Glossina palpalis* was found in March of the present year in the Kadima River Valley, thirteen miles south of Wushishi, by Dr. S. H. Jones, who kindly presented the three specimens collected by him to the British Museum. The National Collection has also received four specimens from Mr. W. F. Gowers, collected by himself on the Forcados River, Southern Nigeria, on June 18, 1904. Lastly, it may be noted that a large series of specimens of this species were obtained by Drs. Dutton, Todd, and Christy near Leopoldville, on the islands in Stanley Pool, and at other localities on the Lower Congo from November, 1903, to May, 1904, during the expedition for the study of trypanosomiasis, recently dispatched to the Congo by the Liverpool School of Tropical Medicine.

Habits of Glossina palpalis.

Contrary to what has been found to be the case with regard to *Glossina morsitans* in South Africa, *Glossina palpalis* does not appear to be dependent for its existence upon big game, and in Uganda, at any rate, the members of the Sleeping Sickness Commission seem to have come to the conclusion that this species of Tsetse-fly subsists largely upon human blood. This is supported by the experience of Mr. W. Y. Wyndham on the Albert Nyanza. Writing to Dr. Nabarro from Wadelai on November 2, 1903, Mr. Wyndham says :—

'The fly cannot depend for its existence upon game, as in most of the places in which I found it there was none or next to none.'

On the subject of habits, Mr. Wyndham writes :—

'The fly seems a rapid feeder, to judge from some caught on the men. They do not appear early in the morning, but continue until evening has well set in, and I caught one which was decidedly lively after dark by candle-light.'

The following field notes concerning *Glossina palpalis* on the Congo have been kindly furnished by Dr. Cuthbert Christy :—

'We found *Glossina palpalis* to be extremely common on the banks of the Congo and its tributaries, even on the smallest streams, as far up as the mouth of the Kassi River. As to its presence beyond that I cannot as yet give you any information. We frequently observed that it was commoner and more blood-thirsty at bridges and fords, or in places where ferry canoes were kept, or where the women go down to draw water or wash, than on either side further up or down the stream. On the approach of either animal or man at a river crossing or in the densest forest, the victim is soon scented out by the Tsetse-fly if there be one in the vicinity, and then either silently or with a peevish buzz the fly makes straight for the most accessible spot, by preference the leg or foot in man, or in the ear in the pig, to which animal it seems especially partial.

Split by PDF Splitter

'At Leopoldville we employed a brigade of boys, to whom we supplied nets and bottles. On wet or dull days their total catch was often not more than a dozen or so between them ; but on other days from December to May they brought in regularly twenty or thirty each, the boys being paid according to the number each caught. The low-lying forest and scrub by the banks of the river was the best hunting ground. During the last week in January, by the kindness of the State authorities, who placed a steamer at our disposal, Dr. Dutton and myself were enabled to make an exploratory tour of the islands in Stanley Pool. On the large forest-covered island of Bamou, where I spent two consecutive days hunting, *Glossina palpalis* were literally in myriads, and for the whole two days my hands, face, and neck were bitten unmercifully, seldom less than ten or a dozen flies attacking at the same time whenever I remained within one hundred yards of the abrupt edge of the forest. Surrounding this forest are areas of marsh many miles in extent, where patches of solid ground are few, and where not a Tsetse is to be found. In the dark, cool interior of the forest the Tsetse, although not nearly so numerous or so bloodthirsty as at the margin, were still a pest. On one occasion I counted thirty-eight probing the body of a large monitor (*Varanus niloticus*) that I had shot only a few minutes before. In the blood of this animal were numbers of *Drepanidia sp.* (*? nov.*), but no trypanosomes.

'On this island the question again rose :—"Has the buffalo any connexion with the Tsetse"? There were many small herds which passed backwards and forwards between the forest and the marsh, spending, however, most of their time in the marsh. One occurrence, namely, the fact that I came upon a herd of buffalo resting during the hottest part of the day, actually at the extreme edge of the forest, where, as I have said, the flies were, and always are in my experience, the most numerous and tormenting, tends to show that the skin of the buffalo, which is enormously thick, is too much for the Tsetse.

'Speaking from personal experience alone, the initial stab of *Glossina palpalis* is very painful, but no subsequent irritation follows. At the seat of the bite there soon appears a hard nodule, which may remain for many days, but is unaccompanied by any marked swelling or discoloration.

'I may add that at the end of April, I again visited Bamou Island, and was surprised on that occasion to find that *Glossina palpalis* was conspicuous by its almost total absence, hardly a fly being encountered, while the few that were seen appeared to have little inclination to bite. I have long suspected that this fly only sucks blood during certain months in the year.'

Glossina pallicera (Bigot).

There is nothing to add to the account of this species given in the Monograph, and no further specimens have been received. The typical specimen, and a second one referred to on page 80 of the Monograph, have been kindly presented to the British Museum by Mr. G. H. Verrall.

Glossina morsitans (Westw.)

From a gravid female of this species taken near Yola, Northern Nigera, on October 10, 1903, by Mr. W. F. Gowers, I have extracted an immature larva measuring 4 mm. in length by $2\frac{2}{3}$ mm. in greatest width. It is of the normal type, and the tumid lips on the last segment, which in this specimen are only slightly brownish in colour, are separated by a narrow notch but almost meet together at their margins, which appear to be marked by only two grooves.

Split by PDF Splitter

Specimens of *Glossina morsitans* from one or two new localities have been received at the British Museum since the publication of the author's Monograph. These include seven males and five females from the Mwangazi River, on the borders of North-Eastern Rhodesia and Portuguese East Africa (latitude 14° 10′ S., longitude 32° 30′ E.) ; presented by Mr. Robert Codrington, Adminstrator of North-Eastern Rhodesia. Besides these, Mr. W. F. Gowers has forwarded a series of individuals of both sexes, taken by himself near Yola, Northern Nigeria, on October 10, 1903, and March 12, 1904. In a letter to Professor Ray Lankester dated 'Yola, October 21, 1903,' Mr. Gowers writes as follows :—

'These specimens were caught about twenty-five miles north of Yola (the exact locality being 9° 36′ 40″ N. latitude, and 12° 41′ 20″ E. longitude), on the bank of the River Loko, a small tributary of the Benue, at the place where it is crossed by a well-used native path. There is here a belt of large trees with thick undergrowth, and, so far as the road is concerned, the fly appears to be confined to this belt, which is not more than one hundred yards across. I cannot yet say how far it extends into the bush to the east and west (the road runs nearly north and south). To the north, east, and south of this spot are many farms and villages. There are cornfields within two or three hundred yards, and a village not more than half a mile away. To the west is a stretch of uninhabited bush where game, including buffalo, is said to be plentiful, but there is no indication of game in the immediate vicinity, and it is not likely that it exists, at any rate in any quantity, in the neighbourhood of the road and cultivated land.

'The fly is found here in considerable numbers ; altogether about one hundred were secured in two hours by tying up a horse there as "bait."[5]. . . I have no absolute proof at present that the bite is fatal, but the local natives all agree that cattle, horses, and donkeys are killed by it, while it is harmless to sheep and dogs[6] ; the reason, however, given for the immunity of the sheep is that it is protected by its wool. I am going to test its effect on the latter two animals. Within a radius of three or four miles from the spot where the flies were caught no cattle are kept, the alleged reason being that the fly prevents it. Natives travelling with horses or cattle avoid this part of the road by making a detour to the east. Death is said to ensue from the bite in from one to three months, and from descriptions I gather that the symptoms are very much the same as in the case of fly-disease in South Africa. I fancy that Tsetse-fly will be found to be pretty well distributed throughout the southern portion of Northern Nigeria.'

In addition to the foregoing, a single female, presented by Colonel Griffiths, Chief Veterinary Officer, Egyptian army, has been received from the Pongo River, between Wau and Dem Zibehr, in the Bahr-el-Gazal Province, Egyptian Soudan, where it was taken in 1903. Since this is another new locality for the species, it may be worth while to add that the place of origin is in Goro, west of the Rol country, near the intersection of the twenty-seventh parallel E. long. and eighth parallel N. lat., and that the fly is said to be very abundant there. Other specimens of *Glossina moristans*, collected by the donor in North-Western Rhodesia in 1899 and 1902, have been presented by Mr. Val Gielgud.

Split by PDF Splitter

As regards the connexion between Tsetse-flies and big game in South Africa, it may be noted that Mr. Robert Codrington, Administrator of North-Eastern Rhodesia in his Report on the Administration of North-Eastern Rhodesia for the year ending March 31, 1903 (Fort Jameson: Printed at the 'Administration Press,' North-Eastern Rhodesia), pp. 15-16, writes as follows :—

'The general increase of game of late years has been remarkable . . . The Tsetse-fly is now, for presumably the same reason, found in districts where it was before unknown.'

Similarly, on p. 23 of the same pamphlet, in a Report by the Civil Commissioner (Charles McKinnon, Esq.) for the year ending March 31, 1903, on North Luangwa and Awemba districts, it is stated that :—

The Tsetse-fly is increasing to an alarming extent to the south of Mirongo, which I take to be due to the increase of game.

These observations support the statements on this subject in the writer's Monograph, pp. 14-15.

Glossina tachinoides (Westw.)

As has already been stated, this species is nearly related to *Glossina pallidipes* (Austen), which, except in size, it closely resembles, but is readily distinguishable by the colour of the hind tarsi. These are either entirely dark, as in the male, or have the first three joints somewhat lighter at the base. The front and middle tarsi are pale, with the exception of the last two joints, the tips of which are usually faintly brownish. The abdomen is marked with deep interrupted bands of dark brown, leaving the hind margins of the segments only narrowly pale. In the present paper there is no necessity to enter into a detailed description of this species, more especially since its diagnostic characters will be found in the appended 'Synopsis.' It may, however, be stated that it is the smallest of all the Tsetse-flies, the males not exceeding 6 to $6\frac{1}{2}$ mm. in length, while the females measure $7\frac{1}{2}$ to 8 mm., exclusive of the proboscis in each case.

In addition to the extensive series of specimens of this species, taken, as already stated, on the Benue River, Northern Nigeria, in the latter half of May and beginning of June of the present year by Mr. W. F. Gowers, the British Museum has received, through the kindness of Professor Mensil, of the Institut Pasteur, and Dr. Brumpt, of the Laboratoire de Parasitologie, Paris, seven other individuals from the series collected on the river Shari, French Soudan, by Dr. Decorse. Lastly, a single female obtained by himself thirteen miles south of Wushishi, in the Kadima River Valley, Northern Nigeria, at the beginning of last March (with three specimens of *Glossina palpalis*), has been presented by Dr. S. H. Jones.

As regards the occurrence of *Glossina tachinoides* on the Benue River, Mr. Gowers has kindly contributed the following note :—

'This species of Tsetse-fly is found along the Benue River between Lau and Lokoja. With the exception of one or two small spots, no horses or cattle can be kept in this area. Above Lau, however,

Split by PDF Splitter

the river banks are swarming with cattle, and there are large encampments of herdsmen in the dry season. After the rains have commenced the fly is present on the river in sufficient numbers to be an annoyance to travellers, and continually bites the canoe-men. In the dry season, however, which lasts from October to April, it is much less numerous.

'On the banks of the Benue River within the area in question almost the only species of game to be found is *Kobus kob*, which is very numerous indeed. West African buffalo, waterbuck, and reedbuck are met with in the swamps near the river; but in the Benue Valley there are, in the immediate vicinity of the river, more kob than specimens of all the other species of game put together.'

According to Dr. Brumpt,[7] on the Shari River and on the shores of Lake Chad *Glossina decorsei* (that is, *Glossina tachinoides*) seems to be exclusively confined to the water's edge. The author in question further writes as follows :—

'The stab of *Glossina decorsei* is disagreeable, as is that of all the species of *Glossina*, but not very painful; it causes some time after the bite a rather acute itching. Both sexes feed on blood . . . The natives of the Shari dread the effects of the bite of the *Glossina* on their herds; like the inhabitants of many other countries, they have recognized the existence of a close connexion between the presence of nagana and the bite of this fly. Nagana is very widely spread on the Shari, where it was stated to occur by Morel, and met with again by the Chevalier Expedition.'

Glossina pallidipes (Austen) *and Glossina longipalpis* (Wied.)

There is nothing to add to the account of these species given in the Monograph. Additional specimens of the former, however, have been received from Colonel Bruce, including six individuals collected by Dr. Moffat at Simba, East Africa Protectorate, in a carriage on the Uganda railway, and six examples from Busoga, Uganda. The latter is a new locality for *Glossina pallidipes*. In addition to the foregoing, a long series of *Glossina pallidipes* from Kibwezi, East Africa Protectorate, has been presented by Dr. Nabarro.

Glossina fusca (Walk.)

Since the publication of the Monograph the specimens of this species in the National Collection have been augmented by a large number of examples from Kibwezi, East Africa Protectorate, received from Dr. Nabarro. Besides these, five specimens, also from Kibwezi, collected in a railway carriage by Dr. Moffat, have been presented by Colonel Bruce; while three specimens, obtained on the Congo by the Trypanosomiasis Expedition of the Liverpool School of Tropical Medicine, have been received from Dr. Christy. Of the specimens last mentioned, which are all females, two were captured near Leopoldville, on December 26, 1903, and February 6, 1904, respectively, while the third was taken at Leisha on April 14 last. With reference to these flies Dr. Christy has been good enough to furnish me with the following notes :—

'During our stay at Leopoldville three specimens of *Glossina fusca* were collected. One was brought in by a native alive, folded up in a leaf; another was captured among *Glossina palpalis* by our juvenile fly brigade, and the third was caught under the following circumstances :—On April 14, while sitting after dinner with two State officials, as late in the evening as 10 p.m., under the verandah of the Chef de Poste

Split by PDF Splitter

of Leisha, a wood post some four days' steaming above Stanley Pool, I noticed one of the men, who as usual in addition to shoes and socks wore nothing on his legs more protective than a thin pair of trousers, holding between his finger and thumb a fly which I recognized as a Tsetse and immediately secured. It had been biting the man's ankle, and its abdomen was half full of blood. The man assured me that there was very little pain or irritation, but within ten minutes a large swelling arose obliterating the malleolus. In the morning this had somewhat subsided, but in its centre was a very distinct purple mark, as of a bruise, surrounded by a greenish-yellow area. During the next five day two more specimens of *Glossina fusca* were caught, I believe, by the same individual, at the same place and under precisely similar circumstances, but these I am sorry to say never reached me. Leisha wood post is on the bank of the river, surrounded by forest, and when I camped there for two days in April in the rainy season, *Glossina palpalis* and a large *Simulium* bit unmercifully from morning till night. At this post there were two advanced cases of sleeping sickness.

'A few days before the above occurrence, on my way up river on one of the small stern-wheelers, we found ourselves one afternoon tied up to the bank, while all the available hands on board were set to work to cut wood for our next day's steaming. At dinner that evening I wore, as a protection against mosquitoes, a pair of thin putties beneath my flannel trousers, and afterwards sat talking in the dark on deck. Towards 11 p.m. I felt a severe bite through the puttee, and, putting my hand to the spot, caught a Tsetse full of blood. By the light of the lamp in the saloon I recognized the fly as *Glossina fusca*, but unfortunately allowed the insect to escape while trying to put it into a tube. A quarter of an hour afterwards the swelling from this bite had extended nearly round my ankle. I experienced scarcely any pain or irritation, and in the morning the swelling had almost subsided, though the purple and yellow stain described above remained for days.

'On my return to Leopoldville Dr. Dutton, before I had said anything about *Glossina fusca*, told me that while I had been away a certain official from higher up the Congo, who had taken some interest in biting flies, had, while visiting the laboratory, volunteered the information that the larger of the two species of 'mvakwa'—the native name for the Tsetse—bit at night, an assertion of the greatest interest in the light of my experiences up-river.'

It may, perhaps, be remembered that specimens of *Glossina fusca* found by Captain Crawshay sitting on a path at Kaporo, at the north end of the Lake Nyasa, at sunset in February, 1895, did not bite (Monograph, p. 289). In view of Dr. Christy's observations, their failure to do so cannot have been due to the fact that they were not met with in the heat of the day, as previously suggested by the writer (Monograph, p. 99).

Glossina longipennis (Corti).

Of this species the only specimens received since the publication of the Monograph are a male and female collected in the East Africa Protectorate on the Uganda Railway in 1903, by Captain E. D. W. Greig, I.M.S., and presented by Colonel Bruce; of these the male was obtained at Kibwezi station in thorny bush.

It was pointed out in the Monograph (p. 103) that *Glossina longipennis* 'is the Tsetse-fly of Somaliland and the adjacent regions, but that its range overlaps that of *Glossina fusca* (Walk.), somewhere in the vicinity of the Sabaki River.' Dr. Brumpt states[8] that *Glossina longipennis* was the only species of Tsetse met with by him in Somaliland between July and October, 1901. According to the same author[9] this

Split by PDF Splitter

species is responsible for the dissemination of a form of trypanosomiasis among camels and mules, which is probably identical with nagana, and, like the fly itself, is known to the Ogaden Somalis by the name 'aïno.'

The other species of *Glossina* considered by BRUMPT to be carriers of *Trypanosoma brucei* in the case of domestic animals were referred to at the commencement of this paper, and it may be pointed out in conclusion that this author believes[10] that, in addition to trypanosomiasis in its various forms, Tsetse-flies must play an important part in the dissemination of other diseases due to haematozoa. BRUMPT states that in certain districts on the Upper Congo a filariasis due to *Filaria volvulus* is very widely spread; the disease occurs only among the canoe paddlers—that is, among those who are most exposed to the bites of Tsetse-flies. 'The only cases hitherto known,' writes BRUMPT, 'have been observed in the regions (such as Nigeria and Dahomey) in which Tsetse-flies abound. The lymphatic tumours caused by *Filaria volvulus* are met with, especially in the places towards which the lymphatics of the exposed regions converge.'

REVISED SYNOPSIS OF THE SPECIES OF GLOSSINA

1. Hind tarsi entirely dark, or at least all the joints more or less dark (in the ♀ of *Glossina tachinoides* the basal half of the first joint and the extreme bases of the following joints are usually pale) 2
   Hind tarsi not entirely dark; last two joints alone dark, remainder pale 4
2. Ground colour of abdomen ochraceous-buff, with interrupted dark-brown deep transverse bands, and sharply-defined pale hind borders to the segments; a very conspicuous square or oblong pale area in the centre of the second segment; small species, not exceeding 8 mm. in length (exclusive of proboscis), the males considerably smaller ... *tachinoides*, WESTW.
   Abdomen not so marked, very dark or for the most part uniformly brown, hind borders of segments if lighter extremely narrow and cinereous; pale area in centre of second segment usually triangular, with the apex directed backwards and continued into a cinereous median stripe; larger species 3
3. Third joint of antennae dusky brown to cinereous black ... ... *palpalis*, ROB.-DESV.
   Third joint of antennae pale (orange-buff) ... ... *pallicera*, BIGOT.
4. Large species: length at least 11 mm. ($5\frac{1}{4}$ lin.), wing expanse (measured from tip to tip, when wings are set at right angles to body) at least 25 mm. ($11\frac{3}{4}$ lin.) 7
   Smaller species: Length rarely reaching 11 mm. ($5\frac{1}{4}$ lin.), often considerably less; wing expanse not exceeding 25 mm ($11\frac{3}{4}$ lin.). 5
5. Last two joints of front and middle tarsi with sharply defined dark-brown or black tips ... 6
   Last two joints of front and middle tarsi without sharply defined dark-brown or black tips—front and middle tarsi entirely yellow, or last two joints of former faintly tipped with pale brown ... ... *pallidipes*, AUSTEN.
6. Generally distinctly larger; head wider; front darker and narrower in both sexes, sides parallel in ♂; abdominal bands deeper, leaving hind margins of segments only narrowly pale; hypopygium in ♂ smaller, darker, and more hairy; tip of ♂ abdomen more thickly clothed laterally with short black hair, bristles on sixth segment finer and less prominent ... ... *longipalpis*, WIED.

Split by PDF Splitter

Usually smaller ; head narrower ; front paler and wider ; eyes in ♂ as well as in ♀ distinctly converging towards vertex ; abdominal bands less deep, pale hind margins of segments therefore deeper ; hypopygium in ♂ larger, paler, somewhat more oval in outline, and clothed with fewer fine hairs ; tip of ♂ abdomen less hairy laterally ; bristles on sixth segment in ♂ stouter and more conspicuous... ... ... *morsitans*, Westw.

7. Dorsum of thorax with four sharply defined small dark-brown oval spots, arranged in a parallelogram, two in front of and two behind transverse suture ; bulb at base of proboscis brown at the tip ... ... *longipennis*, Corti.

Dorsum of thorax without such spots, though with more or less distinct longitudinal stripes ; bulb at base of proboscis not brown at the tip* ... ... *fusca*, Walk.

Notes and References

1. Sur une Nouvelle Espèce de Mouche Tsétsé, la *Glossina decorsei*, n. sp., provenant de l'Afrique Centrale. Par M. E. Brumpt (*Comptes Rendus des Séances de la Société de Biologie*, Séance du 16 Avril, 1904), T. lvi, p. 628-630.

2. *Glossina Longipennis* in Somaliland ; *Glossina morsitans* and *Glossina pallidipes* in Zululand and elsewhere ; *Glossina palpalis* in the basin of the Congo ; and *Glossina tachinoides*, Westw. (*Glossina decorsei*, Brumpt) on Lake Chad and the Shari. Mr. Gowers also found that the latter species carries the disease on the Benue River.

3. *Preliminary Report on the Tsetse-fly Disease or Nagana in Zululand.* By Surgeon-Major David Bruce, A.M.S. Ubombo, Zululand, December, 1895 (Bennett and Davis, Printers, Field Street, Durban), p. 2.

4. *Reports of the Sleeping Sickness Commission*, No. iv, November, 1903.

5. Mr. Gowers has recently informed me that this horse died in three weeks, undoubtedly from Tsetse-fly disease. —E. E. A.

6. In South Africa dogs, at any rate, succumb to Tsetse-fly disease.—E. E. A.

7. *Loc. cit.*, p. 629.

8. *Comptes Rendus des Séances de la Société de Biologie* (Séance du 23 Avril, 1904) T. lvi, p. 673.

9. *Ibid* ; see also *op. cit.*, T. lv, p. 1497.

10. *Op. cit.*, T. lv, p. 1497.

---

* N.B.—The ordinary dark-brown patch on each side of the bulb on its upper margin, which is often especially well marked in West African specimens, must not be mistaken for a brown tip.

Split by PDF Splitter

REPORT ON THE SANITATION AND ANTI-MALARIAL MEASURES IN PRACTICE IN BATHURST, CONAKRY AND FREETOWN

Split by PDF Splitter

LIVERPOOL SCHOOL OF TROPICAL MEDICINE—MEMOIR XIV

REPORT

ON THE

SANITATION AND ANTI-MALARIAL MEASURES IN PRACTICE IN BATHURST CONAKRY AND FREETOWN

BY

RUBERT BOYCE, M.B., F.R.S.

PROFESSOR OF PATHOLOGY, THE UNIVERSITY OF LIVERPOOL, ONE OF THE PUBLIC ANALYSTS FOR THE CITY OF LIVERPOOL, DEAN OF THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE

ARTHUR EVANS, M.R.C.S., L.R.C.P.

AND

H. HERBERT CLARKE, M.A., B.C. (CANTAB.)

LIB... TROPICAL...

FEBRUARY, 1905

PUBLISHED FOR

THE UNIVERSITY PRESS OF LIVERPOOL

BY

WILLIAMS & NORGATE

14 HENRIETTA STREET, COVENT GARDEN, LONDON

Split by PDF Splitter

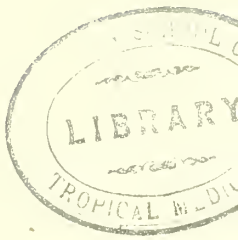
At the University Press of Liverpool
No. 59. *February*, 1905. 1000

Split by PDF Splitter

ISSUED BY THE COMMITTEE

OF THE INCORPORATED

LIVERPOOL SCHOOL OF TROPICAL MEDICINE



Hon. President : Her Royal Highness Princess Christian
Hon. Vice-President : The Duke of Northumberland K.G.

COMMITTEE

President : Sir Alfred L. Jones, K.C.M.G.
Vice-President : Mr. William Adamson

Vice-Chancellor Dale	*Liverpool University*
Mr. W. B. Bowring Dr. Caton	*Council of Liverpool University*
Professor Boyce, F.R.S. Professor Sherrington, F.R.S.	*Senate of Liverpool University*
Dr. W. Alexander Professor Carter	*Royal Southern Hospital*
Mr. J. O. Strafford	*Chamber of Commerce*
Mr. T. F. Harrison Mr. Charles Livingstone	*Steamship Owners' Association*
Mr. A. R. Marshall Mr. H. F. Fernie	*Shipowners' Association*
Mr. Stanley Rogerson	*West African Trade Association*
Mr. C. Booth (Jun.)	
Mr. A. F. Warr	
Mr. F. C. Danson	

Mr. George Brocklehurst, *Hon. Treasurer*
Mr. A. H. Milne, *Hon. Secretary*

Sir Alfred Jones Professor : Major Ronald Ross, C.B., F.R.S., F.R.C.S., etc.
Walter Myers Lecturer : J. W. W. Stephens, M.D. Cantab., D.P.H.
Dean of the School : Rubert Boyce, M.B., F.R.S.

Split by PDF Splitter

ACKNOWLEDGMENT

ON behalf of the Authors of this Report the Committee wish to express their grateful thanks to the Right Honourable Alfred Lyttleton, M.P., Secretary of State for the Colonies, to Reginald L. Antrobus, C.B., and Charles P. Lucas, C.B., of the Colonial Office ; for much assistance whilst in Bathurst to his Excellency Sir George Denton, K.C.M.G., Mr. H. M. Brandford Griffith, C.M.G., Mr. F. Bisset Archer, Dr. Forde, P.M.O., Dr. Franklin, Dr. Baldwin, and to Mr. T. Pierce ; in Conakry, to the Colonial Secretary, Dr. Tautain, Major Dr. Touin, Chef du Service de Santé, and to Mr. Lepetan ; and in Freetown, to his Excellency Leslie Probyn, C.M.G., to the Principal Medical Officer, Dr. Prout, to Dr. Hood, Dr. Renner, Captain Grattan, R.A.M.C., the Officials of the Bank of British West Africa, and the Sierra Leone Coaling Company ; and finally, as well, to the numerous Merchants and Officials of these three towns who were ever ready to forward the objects of the Authors.

ALFRED L. JONES

Chairman

Split by PDF Splitter

CONTENTS

Split by PDF Splitter

Split by PDF Splitter

INTRODUCTION AND SUMMARY

TO those who watch the progress of the study and prevention of disease in Tropical Countries not only has the foresight and wisdom of the Colonial Minister and the Merchant who first set the example of founding Schools of Research in Tropical Diseases been abundantly proved, but the expenditure of time and money which their creation involved has been very amply justified. In six years the schools, not only of this country but also of France and Germany, have sent forth many hundreds of medical men far better equipped than formerly to grapple with the diseases peculiar to the Tropics. Nor have they remained content with organizing education in this country, they have also given a great impetus to the encouragement of the study of Tropical Diseases in those countries themselves where the diseases are prevalent. The majority of the expeditions which have left Liverpool have made West Africa their centre, and since the first Expedition in 1899 to Freetown, under Major Ross, there has been, with very short intervals, a continuous succession of investigators in West Africa, embracing the Gambia, Senegambia, Sierra Leone, Gold Coast, Nigeria, and the Congo. Freetown has been the seat of numerous investigations, commencing with Ross, Annett, and Fielding-Ould in 1889 ; Christophers and Stephens, 1899-1900 (Royal Society and Colonial Office Expedition) ; Logan Taylor, Ross, and Daniels, 1901-2 ; and again Logan Taylor, 1903. Bathurst and the Gambia were investigated by Dr. Dutton in 1902. At the present time Drs. Dutton and Todd are in the interior of the Congo Free State, and Colonel Giles and Dr. McConnell are visiting the Gold Coast and Nigeria.

As only a very limited time was at our disposal this winter, we rigorously confined ourselves to a comparative study of the sanitation and anti-malarial measures in actual practice in Bathurst, Conakry, and Freetown, and to the investigation of how far the teaching of Ross was accepted and acted upon, and if it could be said that, as the result of anti-mosquito measures and sanitation during the last four years, there had been a noticeable improvement in health.

Split by PDF Splitter

In our Report we have made short analyses of the chief sanitary features of each town, we have described the anti-malaria measures and the results which may be attributed to them, and we have also ventured to make some suggestions.

In the following paragraphs we summarize the results of our observations and restate our suggestions:—

1. The essential part which the mosquito plays in the transference of malaria is becoming generally understood both by officials and merchants, and greater precautions are taken against them. Great misconceptions, however, still exist, and malaria is by some attributed to smells and the turning over of new ground. Old Coasters are often sceptical, and their indifference is copied by the fresh merchants' assistants and others who proceed to the Coast.

2. Greater care should be taken to instruct merchants' assistants proceeding to the Coast, how malaria is conveyed by certain mosquitoes (*Anopheles*), and by them only.

3. Great care should be exercised by the seniors of the factories to ensure that mosquito nets are rigorously used by their staff and that there are sufficient nets. The comparatively small annual outlay which this will entail will be repaid by the better health of the assistants.

4. A mosquito net is absolutely essential. If used intelligently and in a proper way mosquitoes are never found inside. On no account should the slightest hole be left unmended. They should always be tucked in under the mattress of the bed.

5. The Europeans should make certain that mosquitoes are not bred in their own houses or in their yards. Personal supervision is essential.

6. Until malaria in the native population is substantially reduced from its present exceedingly high percentage, it is essential for the European community to live away from the native quarters at night. There is no half-way measure as long as *Anopheles* are present in the town.*

7. As water, in the form of streams, wells, rain-water pools, marshes, and artificial collections, is necessary to the life of the mosquito, it follows that water should be the first care in tropical malarial towns, and that—

(*a*) Drinking water should be under public control, and that private wells should be rigorously abolished.

(*b*) That streams and springs in a town should be regarded from quite a different standpoint to the European one. They should be constantly inspected for the presence of larvae, and should be overhauled and rechannelled, where necessary, in order to prevent *Anopheles* breeding.

(*c*) Drainage should be carried out in a comprehensive manner by an engineer who is thoroughly conversant with the life history of the *Anopheles*. Want of the latter knowledge may render any scheme of drainage useless, as the great object in view is the prevention of mosquitoes breeding.

(*d*) In order to ensure the prevention of the breeding of mosquitoes in yards, odd receptacles, barrels, and cisterns, there should be an ample and competent sanitary staff.

(*e*) Where possible every attempt should be made to fill up marshes or to so treat their margins as to diminish the facilities for mosquito breeding. Rubbish should not be shot into them.

* This measure was first strenuously advocated by Stephens and Christophers in a Report to the Royal Society, Oct., 1900, and subsequently and independently by Annett, Dutton, and Elliott in Memoir III of the Tropical School Reports.

Split by PDF Splitter

8. Open storm-water and slop-water drains are safer than closed drains. They should be more carefully constructed and more rigorously supervised.

9. Cess-pits should not be allowed—the dry earth and pail systems are the best.

10. The grant for sanitary administration should be increased.

11. In view of the importance of scientific investigation in connexion with both the preservation of the health of man and animals and the industrial progress of the colonies we consider that it would be of great economic value to devote a small sum to the establishment in each of the principal coast towns of a pathological laboratory and to obtain the services of a pathologist.

12. Greater attention should be devoted to the study and prevention of diseases in domestic and transport animals. The appointment of skilled veterinary officers for this purpose, as well as for conducting experiments upon the acclimatization and propagation of animals of economic value would be a very great gain.

13. Greater attention should be given to the cultivation of vegetables. Conakry shows a good example in this respect.

14. It is essential in order to measure the results of sanitation and anti-mosquito measures that the health statistics of the European population should be made complete. That all classes of Europeans should be included, and that in the case of malarial fever an effort should be made to trace, if possible, the place where the patient contracted the infection.

15. Considering the very great interest which is taken in the health problems of our Colonies we think that fuller information might, with advantage, be furnished in the annual colonial reports.

16. The anti-mosquito measures have made for cleanliness and order, and they have made people think and become more careful, and we are of opinion that both as the result of the knowledge of the means whereby malaria is spread and can be prevented, as well as by the more careful selection of those who proceed to the Tropics, the health of the Europeans is improving.

Split by PDF Splitter

REPORT ON THE SANITATION AND ANTI-MALARIAL MEASURES IN PRACTICE IN BATHURST CONAKRY AND FREETOWN

THE GAMBIA

Bathurst

MEMOIR X, published by the School in 1903, consists of a report of the Expedition of 1902 to the Gambia, in which Dr. Dutton describes in detail the topography, climate, and health problems of Bathurst, thus rendering it unnecessary for us to go over the ground so carefully covered by him. We will confine ourselves to those features of interest, from a sanitary point of view, which appeared to us worthy of note and useful in comparing the means adopted for the preservation of health in the three coast towns which we visited, namely, Bathurst, Conakry, and Freetown.

Bathurst is well laid out, there is an extensive sea front, and the streets are for the most part broad, except in the back of the town in the native quarter where many of the streets are narrow. The population consists of about eight thousand natives and one hundred and five Europeans.

The soil is porous and sandy and, therefore, water does not tend to remain upon the surface, and drying after rain is in consequence rapid. But at the same time, as so often happens, the sub-soil water comes to within some eight feet of the surface ; a well is most easily scooped out in the ground, and in certain places the town is below sea-level—this of course together with the uniform flatness of Bathurst complicates drainage.

There is not much vegetation in the town of Bathurst, and the native compounds are for the most part free from bush or grass. Grass and weeds, it is true, are present in most of the streets, but there they bind the loose soil and help to maintain the sloping banks of the central street drain ; they become a great disadvantage, however, when they grow long and impede the water in the drains or make pools where mosquito larvae breed.

European Quarters.—The houses of the Europeans and the public buildings are close to the sea front, and there is no undue overcrowding amongst them. The older houses are built of stone and the rooms in them are large, airy, and cool ; the new houses are built on the bungalow plan and are excellent. There is no definite separation of the European houses from those of the natives, the latter often come close up to the former, only the European houses have the advantage of an open sea front.

Split by PDF Splitter

Recreations.—Bathurst possesses in McCarthy Square a magnificent open space in the middle of the town, and shows a good example to other West African towns in respect to the encouragement which is given to out-door sport ; the Square affords an excellent centre for it. The Europeans go in for tennis, polo, cricket, and bicycling. When we visited Bathurst the town sports were being held ; they were witnessed by many thousands of spectators, and the competitions amongst the native inhabitants were excellent.

In spite of the presence of the tsetse fly in the neighbourhood horses are procurable.

Climate.—Arriving late in December we were not long in becoming aware of one of the reasons why Bathurst presents a favourable contrast to other coast towns. Almost surrounded by the sea and with the harmattan blowing from the end of October to the beginning of May, the climate is by no means disagreeable to the European ; and the great diurnal variations of temperature which occur at this period, whilst they are not so much felt by the European, are very trying to the native population. The wet season, on the other hand, from June to September, accompanied as it is by a most equable temperature and with no breeze, is the season most felt by the European.

The following is the meteorological return for the year 1903 made by Dr. Forde :—

Month	Temperature °F.					Rainfall	
	Solar Maximum	Shade Maximum	Shade Minimum	Range	Mean	Amount in inches	
January ...	160	93	56	37	71·9	—	
February ...	160	100	60	40	75·3	—	
March ...	164	100	61	39	76·5	—	
April ...	160	93	64	29	75·2	—	
May	165	88	67	21	75·4	—	
June	160	89	69	20	79·2	5·91	Total rainfall 57·13 in.
July	165	89	68	21	79·0	7·13	
August ...	159	89	70	19	79·3	35·87	
September ...	160	89	67	22	79·4	4·15	
October ...	162	91	67	24	79·7	4·07	
November ...	165	92	63	29	79·0	—	
December ...	157	89	57	32	73·1	—	

Split by PDF Splitter

Night-Soil and Refuse Disposal.—The town of Bathurst, except near the swamps, is remarkably free from offensive smells—a fact which is entirely due to the simple system of sewage disposal largely employed. The Europeans invariably use earth closets, which are emptied daily into the sea ; and a considerable proportion of the native population also make use of receptacles, which are cleansed once a day, morning or night, in the river. Were cess-pits the rule, as in Freetown, the subsoil water would become in a short time dilute sewage. Unfortunately, however, modified cess-pits are also in use, a tub placed in the ground is used as a privy. 'Only occasionally earth or lime is mixed with the excretal matter. When full, which takes from one to two years, the tub is discarded, and another inserted in a fresh place in the compound. Both tubs and privies were found to be infested with multitudes of fly maggots' (Dutton).

These pits are undoubtedly a source of great danger to Bathurst ; from them percolation takes place freely into the well-water, and must lead to its extensive pollution, besides acting as a fertile source for breeding flies, which, in their turn, may act as the carriers of disease. Cess-pits and wells are incompatibilities, and as long as the condition obtains, especially in Bathurst, where underground mixing must take place owing to the nature of the soil and abundant ground water, dysentery and intestinal affections must be common and be the cause of a great proportion of the mortality found in the native population, and constitute a most serious menace in the case of the introduction of typhoid and cholera.

Sir George Denton and the Chief Medical Officer, Dr. Forde, have both given their most careful attention to the subject, and there is little doubt that a great improvement will be made. Judging from what we saw in those compounds in Bathurst, where pans are so successfully used, and also from Conakry, where no cess-pits are allowed, we are strongly of opinion that the simple dry pail or pan method should be universally adopted, and that no form of buried receptacle should be allowed, cemented or otherwise. In a soil like that of Bathurst it would be costly to construct water-tight middens ; water carriage is out of the question, and incineration would be most costly. Taking into consideration the short distance of any part of this town from tidal water, we think that the plan which has yielded such admirable results in Conakry would also prove a success in Bathurst, and it is not too much to expect of the native when the advantages are put to him, that he should co-operate with the Sanitary Authority and empty his own pail into the sea, either at night or in the early morning (compare Conakry), and so save expenditure upon additional labour. In addition, increased public latrine accommodation could be provided for at suitable places, both in the town and on the shore. The method has the advantage of absolute simplicity and freedom from nuisance, and can be carried out at small cost. Incineration or complex methods of any kind are liable even in Europe to frequent failure, and the risks are much greater in tropical countries.

Split by PDF Splitter

Slop-Waste.—In the native compounds the small amount of slop-waste and the urine, is thrown on to and is readily absorbed by the porous soil. There are, however, in some instances deep-cemented underground tanks for the reception of waste water.

Public urinals of a very simple and efficacious kind, and containing special receptacles which are removed daily, have been placed at suitable spots in the town, and there are also public latrines projecting out from the shore.

Refuse.—Owing to the absence of abundant vegetation in the town, there is a comparatively small amount of leaf refuse, and the success which has attended the efforts of the Medical Officer and his staff to prevent the accumulation of bottles, tins, and other receptacles for water, has resulted in the compounds of both European and natives presenting a very clean appearance. The scavenging is done by a gang of twenty labourers and two horses and carts, under the supervision of an Inspector and an Assistant Inspector of Nuisances. All rubbish, consisting of house refuse and leaves raked up in the streets, is carted to the back of the town where it is burnt and utilized for the filling in of the swamp and levelling up depressions in the open areas (Dr. Forde). The more determined the effort to burn the decomposable rubbish the better ; it is a bad material for filling up, more especially where there is water, for then decomposition must set in ; its presence on the borders of Box Bar swamp constituted in our minds the only source of disagreeableness in an otherwise most clean town.

Water Supply.—The ease with which water can be found accounts for the very numerous shallow wells seen almost everywhere in the native quarters, and for the deeper wells for public purposes and for those in the compounds of the merchants. As mentioned above, they can never be free from suspicion, and there can be little doubt that many are badly contaminated, and that they constitute a fertile source for the distribution of intestinal diseases amongst the native population. A great improvement has been brought about by the encouragement of the use, for drinking purposes amongst the natives, of the supply at the public wells. These are placed at advantageous spots in the town as far from contamination as possible. They are covered, and satisfactory pumps have been and are in process of being fitted to them. But it is the history of all places where there is more than one form of water supply that the supply nearest to hand is the one which runs the greater chance of being used. Bathurst is probably no exception, and until the private wells are got rid of altogether they will undoubtedly be frequently used. In the meantime, the deep public wells with their pumps, which are well looked after, are attracting more people, and so mitigating the risk of infection. Whilst the native population make use of the wells, the Europeans and some of the native traders wisely use for drinking purposes the rain water collected from the roofs into large galvanized iron tanks or into large cemented cisterns constructed in the ground. As will be seen later, the wells and imperfectly

Split by PDF Splitter

closed cisterns of Bathurst supply a very large number of the mosquitoes of the town. Failing the bringing of a water supply to the town from a distance, as at Conakry, good water-tight cisterns for the rain water offer a good substitute ; and in the second line come deep public wells carefully cemented for a considerable depth, so as to avoid surface contamination, covered in and fitted with a good pump, and so placed as to be as far from pollution as possible. With the abolition of cess-pits, the possible risk of contamination from the wells will be greatly reduced.

Drainage.—The street drains of Bathurst are a very striking feature in the town, they are conspicuous by their great size, and run in the centre of the roadway, they are for the most part square, cemented, stone or brick ; in the upper portions of the town they tail off into shallow grass drains. No doubt they would be better if they were all U-shaped in section and if they were not so broad. But they have the merit that you can see what is in them—in this respect being superior to the far more costly underground street drains at Conakry—and they are certainly superior to the street drains in Freetown. They suffer from the disadvantage of a proper fall. Dr. Dutton has pointed out that the shallow grass trenches are responsible for the majority of the mosquitoes in Bathurst during the months of September, October, and November. There is no doubt that perseverance and much supervision and the increase of the sanitary staff under the medical officer can do much to lessen the stagnation of water and therefore the mosquito breeding-places in the drainage system of the town during the wet season. But no doubt also the time has come for the making of a general survey of the town, the levelling up of the depressed compounds and streets, the completion of the filling in of Half Die Swamp, and the modification and completion of the present scheme of drainage. Bathurst requires to be treated as a whole, and proper falls made. We trust that the open system of drainage will always prevail.

The filling up of Half Die Swamp was discontinued in 1903 in consequence of the difficulty in obtaining proper labour. A large proportion, however, of that portion which had already been levelled up has now been built upon and streets laid out on it. We agree heartily with the Official Report for the Gambia, 1903, that the filling up of this swamp and the scheme for drainage of the town are intimately connected and demand comprehensive treatment, and we hope that a move will be made.

Public Works.—A noticeable feature of the administration of Bathurst is the excellent public works which have been organized at a moderate outlay by the Government of the Colony. We visited the hospital, market and slaughter-house, prison, and the barracks.

The Hospital.—The hospital is an old stone building, which, however, has been admirably rearranged and adapted to modern requirements at a comparatively small cost. The wards are well lighted and airy. The European ward is protected by

Split by PDF Splitter

wire gauze, and a similar precaution is being adopted for the other wards. Scrupulous cleanliness is everywhere observed. There is a total absence of smells, and the dry-earth closet system is most successful, and there is no danger of a contaminated water supply.

The hospital administration is excellent, and the best practical proof of this is the increasing popularity of the institution. Thus, the number of out-patients treated during the year 1903 was 8,477, an increase of 4,652 over the previous year. There was also a substantial increase in the number of in-patients, and more major operations were performed. The work of the medical staff has been greatly aided by the fitting-up of a new operating-room, excellent dispensary, and a small well-equipped laboratory for microscopic analyses.

A very striking feature in the hospital is the excellent nursing system, due to the introduction of nursing sisters. These ladies reside in a bungalow specially erected for them immediately adjoining the hospital, and, to quote from the official report of the Gambia for 1903, 'it is a pleasant duty to be able to record that to these ladies, who have not spared themselves any trouble, is due much of the improvement noticeable in the internal arrangements of the hospital, where their presence has given the greatest satisfaction to all classes of the community, especially to the lower class, who are much more ready to become in-patients than formerly, as they feel that they will now be cared for.' The natives have commenced to thoroughly appreciate the benefits to be derived from organized medical skill. This is well shown by the increasing severity of the operations which have been successfully undertaken by the medical officers, as well as by the large increase of out and in-patients. The hospital cannot fail to play a most important part in the educational welfare of the community by the excellent example which it sets in the power of medical skill and nursing, in cleanliness, and in organization. It has fully justified the modest expenditure which has been incurred, and to our minds no charity in the colony will yield a richer return for the money invested in it. The success of the hospital is a proof of what can be accomplished by constant personal supervision.

Opportunities for Investigation.—The small, but well-equipped, laboratory in the hospital affords ample accommodation for scientific work both in connexion with the cases treated in the hospital as well as those occurring in the district. It could serve as the central laboratory in the capital of the colony. Investigations could at any time be undertaken in it in connexion with the distribution of disease in man and animals throughout the Gambia. The time of the medical officers is now fully occupied in clinical work and sanitary administration, and the full advantages of the laboratory for the prosperity of the colony would probably be rendered practicable only by the appointment of a scientific assistant under the chief medical officer for the sole purpose of conducting microscopic, bacterial, and chemical analyses, and the collection and investigation of vegetable and animal parasites injurious to man, animals, and to the economic plants of the colony.

Split by PDF Splitter

The Food Market and Slaughter-House.—The construction and arrangement of the market are good. No animal or vegetable offal is allowed to collect, and there is an absence of offensive smells. One of the most noticeable of the sanitary features is the very large wire gauze safe in which the fresh meat is hung and effectively protected from flies. The stalls for the animals brought to market are outside the market enclosure. The slaughter-house on the shore at a convenient distance from the market is new and advantageously built upon a pier projecting into the sea, with the result that all offal and blood is carried away by the tide ; it may, however, be necessary to carry it still further out. It would be very difficult to devise a simpler and more sanitary method of slaughter. The excellence of the market most materially conduces to the health of the community, as it provides an abundance of fresh, wholesome food. It is most satisfactory to note that again strict personal supervision and the rigid enforcement of cleanliness rather than capital expenditure upon elaborate market arrangements has been found to meet all requirements.

The Prison.—The building is of stone, the majority of the cells are large and well-lighted, and the sanitary arrangements thoroughly good, the simple pans, which are cleansed daily, being in use. The water supply is good, and there is no danger from sewage contamination. A few cases of beri-beri have occurred in the prison, and there were three deaths recorded in 1903 ; all three cases, however, came from the same village, in which it was afterwards discovered that the disease existed. It is very difficult to understand how this disease could originate in the prison, where there are few prisoners, no overcrowding, plenty of air, and a very liberal diet. The greatest care is taken with the rice to ensure a uniformly good quality, free from damage of any kind. In the absence of definite knowledge with regard to the causation and propagation of this disease, reliance has to be placed on the enforcement of sound hygiene.

The Barracks are old stone buildings surrounding a square and excellently placed. Alterations, consisting of the substitution of iron for much of the old wood rafters and supports, have been carried out, and further changes are contemplated.

There is ample accommodation for officers and men, and plenty of air and light, mosquito netting, scrupulous cleanliness, and the simple pail system for the removal of excreta.

Health of Bathurst.—The health of the European has remained remarkably good. Quoting from the official report for 1903, there were forty-eight cases on the sick list out of a European population of one hundred and five. The majority of cases were of a trivial character. Two deaths occurred from malaria, one being of the blackwater type. Both had recently arrived from Senegal, where they had been resident fifteen to twenty years. There was a considerable number of cases of dysentery amongst the natives.

Split by PDF Splitter

TABLE OF CASES OF EACH KIND OF DISEASE TREATED IN THE HOSPITAL IN THE YEAR 1903, WITH THE NUMBER OF DEATHS FROM EACH SUCH DISEASE (*Medical Officer's Report*):—

General Diseases			Local Diseases		
Diseases treated	Number of cases	Number of deaths	Diseases treated	Number of cases	Number of deaths
Malarial Fevers ...	106	3	Diseases of the Eye ...	26	...
Blackwater Fever ...	1	1	„ „ Ear ...	2	...
Typhoid Fever	1	1	Nervous System ...	14	4
Beri-Beri	10	3	Circulatory System ...	4	...
Dysentery	11	3	Digestive „ ...	49	2
Debility	8	...	Generative „ ...	7	...
Febricula	5	...	Genito-Urinary „ ...	30	3
Gonorrhoea	7	...	Lymphatic „ ...	12	...
Hemiplegia	1	1	Respiratory „ ...	42	8
Pyaemia	1	1	Connective Tissues ...	2	...
Syphilis	7	...	Organs of Locomotion ...	28	...
Sleeping Sickness ...	11	4	Skin	108	...
Tumour	2	...	Injuries	56	1
Tetanus	1	1	Parasites	4	...
Tuberculosis	1	1	Surgical Operations ...	4	...
Rheumatism	20	..	TOTAL ...	581	37

Anti-Mosquito Measures.—Bathurst is a good natural breeding-ground for mosquitoes. Half Die and Box Bar swamps and all the low-lying parts in the wet season give rise to large numbers. Owing to the want of suitable fall, and in certain places due to the fact that parts of the town are below sea level, uniform drainage of the streets is difficult, and mosquitoes breed in the pools which form in many of the streets in the rainy season. The numerous wells are a fertile source of supply to a less extent, wash tubs, garden tubs, and rain barrels. When Dr. DUTTON investigated the mosquito distribution in Bathurst, in 1902, he found that the compounds of the native inhabitants and of the Europeans were extensive

Split by PDF Splitter

breeding-grounds, and that the number of breeding-places in a compound often increased with the social position of the occupier. At that time also the boats along the foreshore, and innumerable cans and bottles and other waste receptacles in the compounds, furnished a very large number of mosquitoes. Very extensive anti-mosquito measures, instituted by His Excellency Sir GEORGE DENTON, have resulted in diminishing the number of breeding-places in compounds. In 1902, one hundred and thirty-one cart loads of old tins, pots, and other rubbish were removed. In 1903, the anti-mosquito work was kept up steadily. Ten labourers were employed in collecting and removing old tins and broken bottles which were buried or used for filling up depressions. Before the rainy season set in, ten additional labourers were employed in levelling and clearing the grass drains in the streets. The Inspector of Nuisances, with his regular staff of twenty labourers, one assistant inspector, and two carts carried out the general scavenging work. The Inspector visited gardens, yards, and compounds, and reported daily to the Chief Medical Officer. Wells and other receptacles were examined for mosquito larvae, and an attempt was made to keep these covered. At the present time these same measures are in active operation. Dr. FORDE has recently reported (1904) that insufficiently covered wells form the breeding-grounds of a very large number of mosquitoes in the dry season, and steps will be taken to render the public wells, at any rate, free from this complaint. With regard to the shallow private wells, it is obviously very difficult to get the native to realize the necessity of covering them, and we think that the only remedy here is abolition. Private tanks, owing to badly-fitting covers, also are a source of mosquitoes in houses, but this is a matter which increased attention will remove. The Medical Officer has also reported favourably upon the manner in which his instructions with regard to the prevention of mosquito-breeding have been carried out, and the intelligent endeavour which has been made, both by the Europeans and natives, to assist in the anti-mosquito sanitation of the Board of Health.

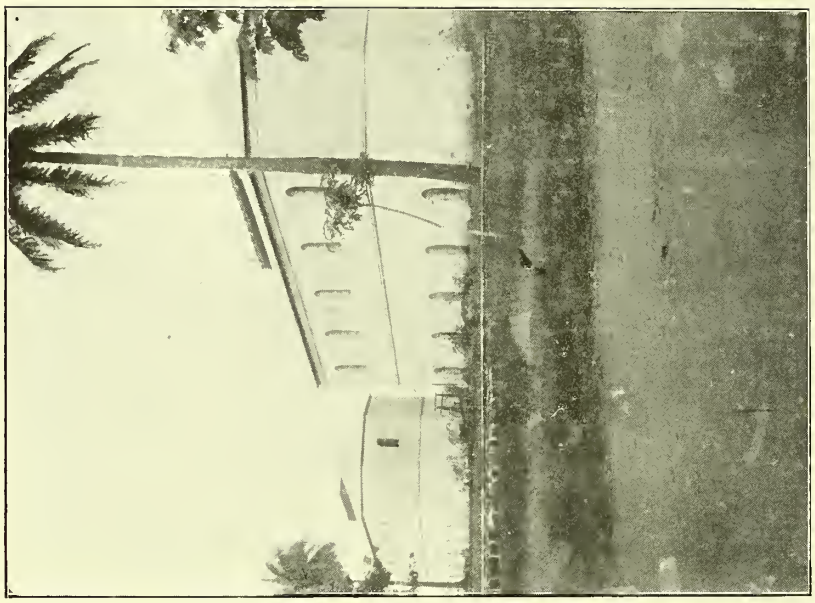
General Result of Anti-Mosquito Measures in Bathurst.—The anti-mosquito measures in Bathurst, as elsewhere, have made for cleanliness and order ; they have made people think and become more careful. The mosquito-net has been more regularly used, and the European population has undoubtedly remained very free from malaria. It cannot be said, however, that the numbers of *Culex* mosquitoes have diminished in the wet season. The compounds of natives and Europeans alike are much cleaner. The European trader recognizes more fully the advantage to be gained by the systematic use of the net and the good which he can do and the assistance which he can render the sanitary authority by most carefully looking after his own compound and preventing breeding-places. We feel sure that when it is realized by the native inhabitants that the mosquito is responsible for a very large

Split by PDF Splitter

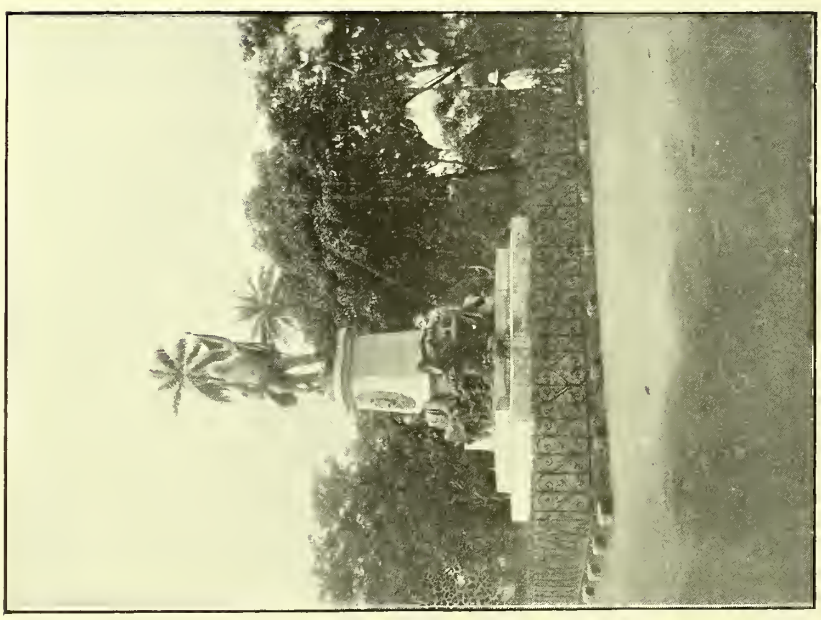
proportion of the infantile mortality and sickness rate, owing to the predominant share it takes in transmitting and propagating malaria; when it is understood by them that the *Filariasis* and *Elephantiasis* present in Bathurst is also due to the mosquito, and that Yellow Fever could at any time appear amongst them because of the presence in their midst of the Yellow Fever carrying mosquito, we venture to think that they will do all they can to strengthen the hands of the local authority by co-operating in what is after all only a movement in favour of cleanliness and general sanitation.

Split by PDF Splitter

PLATE I



WATER TOWERS, CONAKRY *Photo.—Dr. Clarke*



STATUE TO GOVERNOR BALLAY, CONAKRY *Photo.—Dr. Clarke*

Split by PDF Splitter

FRENCH GUINEA

Conakry

A visit to Conakry is a most instructive lesson. One cannot fail to be impressed with the great skill and energy which in a few years has planned and constructed a modern town. Commerce was its *raison d'être*, nevertheless everything has been carried out true to the classic instincts of the French. Wide boulevards intersect at right angles equally wide avenues ; there are fountains and public gardens, and, most striking of all in a West African town, a very fine statue in memory of the services rendered by Governor Ballay (Plate I). A landing stage, a vast railway station, extensive waterworks of the most modern type, a new hospital, and a network of light rails, by means of which the goods landed from the ships on the wharf are conveyed expeditiously and directly into the various factories. The contrast to Freetown, only seventy-eight miles away, is striking, and the French determined that it should be so, for to use the words of the former Colonial Secretary :—'Pour lutter avantageusement contre la colonie anglaise de Sierra Leone, le seul moyen est de créer une ville rivale de Freetown.' And they have done so, and now 'L'example de Conakry est un argument sans replique contre les pretentions de nos concurrents anglo-saxons, dont les journaux repetent qu'il est inutile de nous laisser créer des colonies puisque nous ne savons rien en faire.' (Famechon).[1]

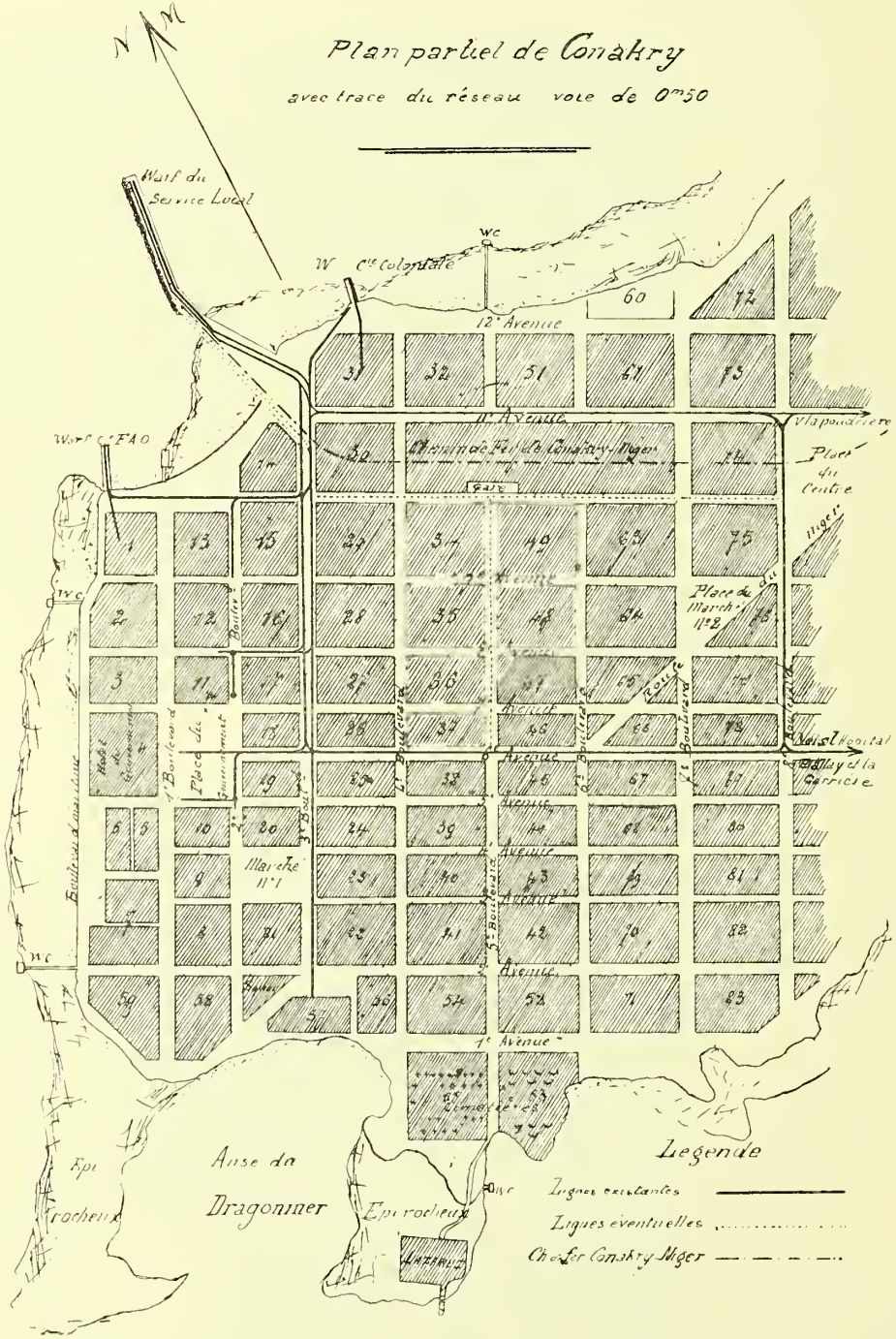
In many respects the town reminds one of Ismailia. Conakry contains some ten thousand to fifteen thousand inhabitants, of which about four hundred are Europeans. It occupies the Island of Tumbo, and is connected to the adjoining mainland by an iron bridge. It is not raised much above sea-level, but a gradual slope takes place from the centre to the beach all round, rendering drainage comparatively easy. It is not intersected by streams, and even after the severest rains in September, pools are not left, owing to the very spongy nature of the laterite. There is an abundant ground-water, and every compound has its well ; they are deeper than those at Bathurst on account of the lower level of the water. The fertile nature of the soil and the non-brackish ground-water produce an abundant vegetation, and the contrast to Bathurst, where the ground water is brackish, is striking ; the increasing growth, however, will no doubt have its corresponding disadvantages, as will be presently shown.

European Quarters and Social Life.—The majority of European houses, both for officials and merchants, are grouped together (Plates II and III). There is no actual segregation, however, and the houses of the natives are as close to those of the Europeans as they are at Bathurst. This, we think, is now being fully realized and its significance appreciated. The European factories are well constructed, and the

1. Preface to the Handbook of French Guinea at the International Exhibition, Paris, 1900.

Split by PDF Splitter

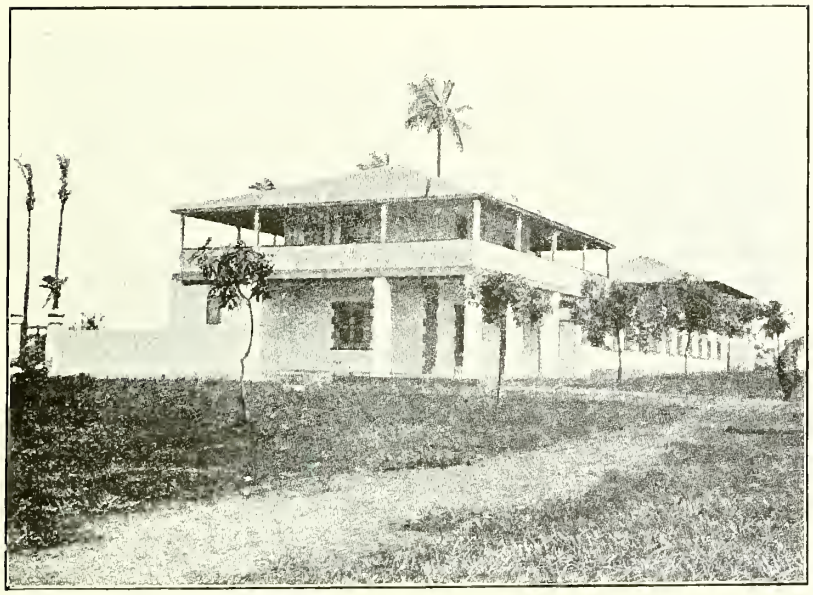
merchant's life appeared to us to be passed in a far more comfortable manner than in many instances in Freetown. The town is kept scrupulously clean—roadways, factories, and compounds alike.



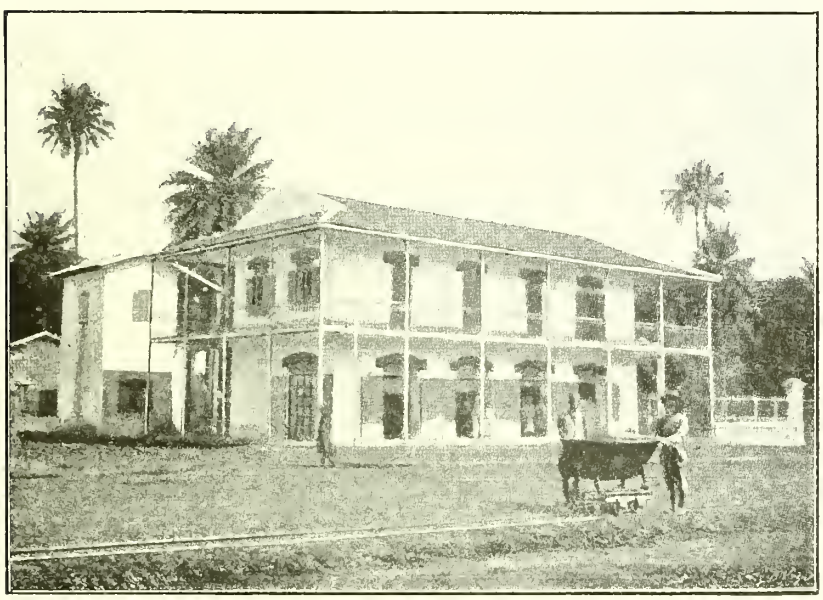
Recreations.—The public gardens are beautifully laid out and well shaded, and there is an excellent tennis court, which is in constant demand. The circular road makes an excellent promenade by the sea. There are very few horses however.

Climate.—The climate is described as good. In the month of January it appeared to us to be quite as hot as Freetown. There are no great variations of

Split by PDF Splitter



TYPE OF FACTORY. CONAKRY (*From Government Report*)



TYPE OF FACTORY, SHOWING DECAUVILLE RAILWAY. CONAKRY
(*From Government Report*)

Split by PDF Splitter Baluba 1

temperature. The harmattan in January and February lasts about thirty days. The wet season extends from the end of March well into November, and the total rainfall is approximately four metres. During the wet season the atmosphere is very oppressive and the heat is more severely felt. During the five dry months the early morning dew is very heavy and does much good to vegetation.

TABLE SHOWING TEMPERATURE, MOISTURE, AND RAINFALL FOR EACH MONTH DURING THE YEAR 1902

		Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Août	Septembre	Octobre	Novembre	Décembre	Année, 1902
Températures extrêmes	Maxima	28·8	21°	31·2	33°	33·2	33·5	28·4	28·4	27·8	29°	29°	29°	33·5
	Minima	23·8	23·2	21°	23°	22·4	22·8	24°	22·9	22°	23·8	24°	23·4	22·4
Moyenne des températures	Maxima de chaque jour ...	27·7	27·8	30°	30·5	31·3	27·1	27·4	26·4	26·7	27·5	28°	28·5	28·1
	Minima de chaque jour ...	24·8	25·1	25·2	25·4	25·6	25·5	25·2	24·9	24·1	25·1	26°	25·3	25·2
	Du mois	26·2	26·5	27·6	27·9	28·4	26·3	26·3	25·5	25·1	26·3	27°	26·7	26·6
Pressions barométriques extrêmes	Maxima	765	767	765	767	768	767	769	768	768	768	766	767	769
	Minima	763	763	762	762	763	764	764	764	763	764	763	764	762
Moyenne des pressions barométriques ...		763·9	764·5	763·3	764	764·8	765·2	766	765·3	765·4	765·8	764·2	764·8	764·7
Etats hygrométriques extrêmes	Maxima	94	94	94	100	100	100	90	92	89	87	88	80	100
	Minima	60	51	17	30	36	71	72	70	72	68	49	32	17
Moyenne des états hygrométriques... ...		84	77	72·5	81·3	80	80	82·5	82·6	80	77	71·7	69	78·9
Nombre de jours de pluie		0	0	4	8	13	25	29	29	27	21	6	1	163
Quantité de pluie tombée		0	0	8 mm. 3	47 mm. 9	170 mm. 3	560 mm.	1·218 mm. 6	1·001 mm. 2	947 mm. 7	583 mm. 1	43 mm. 1	0	1m.580 mm. 2
Etat du ciel compté de 0 á 10 (moyenne) ...		1·7	2·26	1·7	2·8	4	5·5	6	6	7·2	6	4·1	3·6	4·3
Nombre de Tornades		0	0	0	5	11	10	2	2	4	10	3	1	48
Nombre de jours de tonnerre		0	0	0	11	12	22	15	11	8	15	11	1	106

Split by PDF Splitter

Removal of Night-Soil and Refuse.—**Conakry possesses an immense advantage in that there are no cess-pits of any kind.** The bucket and pan system is in use by Europeans and natives alike, and the receptacles are emptied once a day—at night or in the early morning. There are also five public latrines distributed around the island, which project from the shore (See Plan and Plate III) ; but in some cases they do not extend far enough out to sea. They are made much use of. There is remarkable freedom everywhere from faecal or putrid smells, and there is no doubt that this is due to the exceedingly strict police supervision. The native is compelled to assist in maintaining a state of sanitary efficiency with regard to the disposal of excreta, which is in striking contrast to the noxious cess-pit system existing in Freetown.

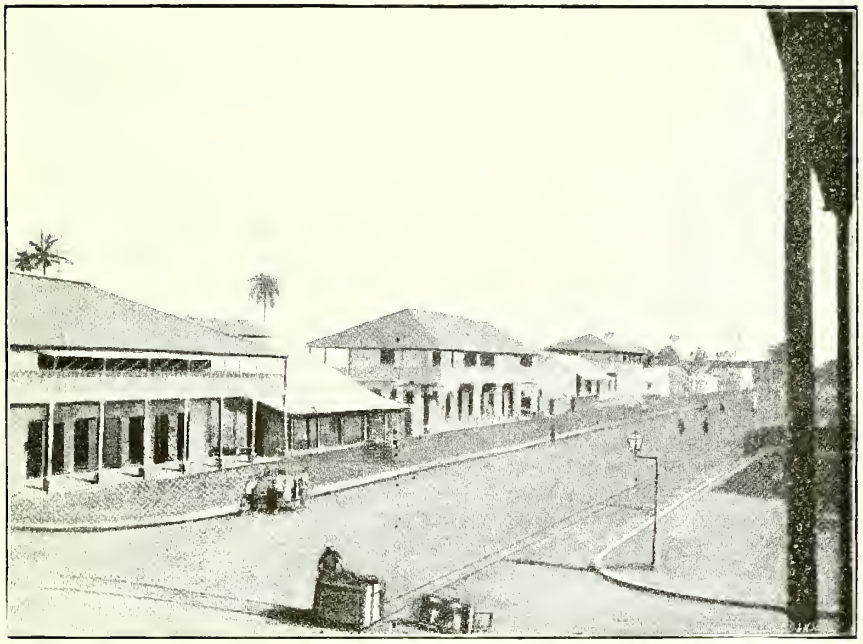
Refuse.—The abundant vegetation leads to a proportionate production of litter, but nevertheless compounds and streets are kept remarkably clean, and there are exceedingly few bottles or other receptacles to be found which might harbour mosquitoes. We did not, however, like to observe that the neighbourhood of the shore had been made a dumping-ground in certain places for rubbish. There are also many waste, unbuilt-upon spaces in the town which favour the production of bush.

Water Supply.—The water was formerly entirely derived from deep wells excavated in the laterite. The authorities early recognized the dangers of such a source of supply ; chemical analysis showed a considerable proportion of organic matter, and, furthermore, at the end of the dry season the level of the ground-water was much lowered, and the supply in consequence curtailed.

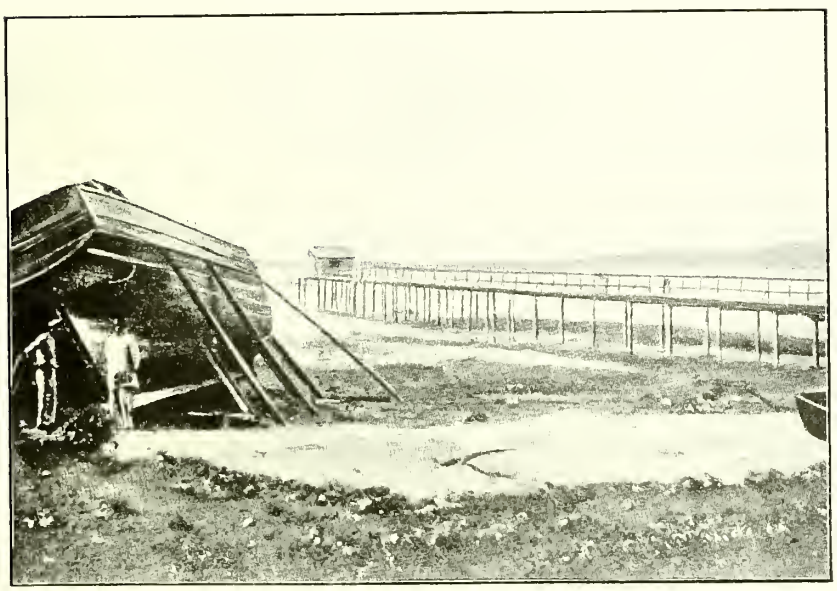
Governor Ballay initiated the undertaking, since completed, of bringing a pipe line from water courses forty-one kilometres distant. The conduit, which is capable of delivering two thousand two hundred and eighty cubic metres of water per twenty-four hours, terminates in solid, handsome, water towers containing the large iron reservoirs, and situated in the highest part of the town (Plate I). The reservoirs are protected in the tower from dust and heat. From this source the water is carried down the various boulevards and distributed to public works, factories, fountains, the public washhouse, and some forty stand-pipes situated at convenient places in the boulevards. The water supply, as shown both by chemical and bacteriological analyses, is of great purity.

The Disused Wells.—With the introduction of this pure source of supply the wells have fallen into disuse ; they are very numerous, one or more being present in all the compounds ; a considerable growth of shrub may now be seen emerging from them, as no attempt at filling in or covering them has, as far as we could observe, been made. Malaria is not on the decrease in Conakry, and the wells must prove an abundant and practically the sole source of *Anopheles* supply. The benefits which are to be expected from this effective and modern water supply cannot be realized as long as the obsolete wells are kept to breed innumerable mosquitoes.

Split by PDF Splitter



PRINCIPAL BOULEVARD IN CONAKRY, SHOWING FACTORIES AND DECAUVILLE RAILS. THE MAIN DRAIN IS UNDER THE FOOTPATH ON THE LEFT (*From Government Report*)



A LATRINE ON THE SHORE AT CONAKRY (*From Government Report*)

to face p. 14

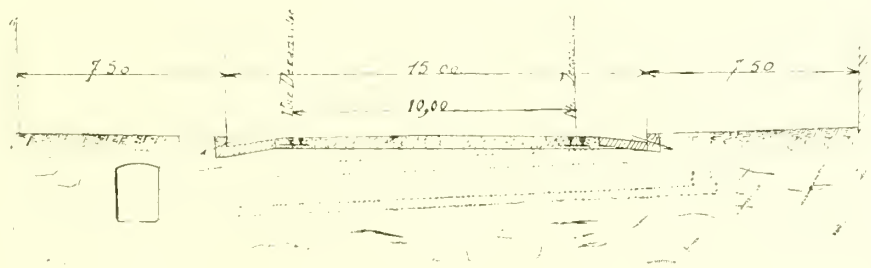
Split by PDF Splitter

The abundant new water supply is not altogether free from blame in favouring the development of mosquitoes, for usually around each standard there is a collection of water, due to the faulty taps from which the water slowly trickles away.

Drainage.—Conakry possesses superior natural advantages to both Bathurst and Freetown in respect to drainage. The soil, as in Bathurst, is porous, but the superior elevation and the deeper level of the ground-water and the freer underground drainage prevent flooding. In the severe rains the roads are not liable to be cut up as in Freetown, where the falls are very steep, and the rush of water in consequence very great.

Only the third or principal boulevard has been completed, and, including drainage, it has cost sixty-five francs per metre run to construct; it will serve as the model for the other boulevards, if it is deemed advisable to complete them. In the construction of the drains the engineer had to calculate upon being able to cope with the maximum storm water in addition to waste water from the factories; the largest amount of rainfall observed in Conakry, viz., 0m. 08, in three hours being made the basis.

In the words of the Report for 1903 the relatively flat form of the Island of Tumbo, upon which the town is mapped out by straight boulevards running north and south and equally straight avenues at right angles to them east and west, caused the authorities to abandon the use of wide section drains which might act as collectors, and to recommend the construction of one drain in each boulevard of sufficient section to deal with nine hundred to one thousand litres of water a second and opening at each end of the boulevard on to the beach. It was planned that the water from the avenues should be led to the boulevard drain by pottery or other form of drain.



Section of Roadway

Slop Waste.—The question of the provision for the domestic drainage was left to the future, and it was thought that special sanitary drains might eventually be constructed against the wall of the storm-water drains in order to avoid the decomposition in the main drains, which would be sure to take place, more especially in a tropical town, if slop-water were allowed access to them. It was intended also to carry the

Split by PDF Splitter

sanitary drains well out to sea. It was also thought that a special system of sea-water flushing might in the future be arranged for. The main drain in the Third Boulevard is built in concrete, and runs beneath the footwalk on one side and receives the drainage of both sides of the road as shown in the above plan. We have very carefully considered the advantages which such a scheme of drainage might possess in a tropical town over the more frequently met with open drain. There is little question that the Third Boulevard in Conakry has the appearance of a modern and well-made street in a European town. But conditions are so totally different in Europe and the tropics. In the first place, the authorities have rightly recognized that it would be fatal to connect any offensive domestic waste water with the main drains, for did decomposition occur in these large covered-in drains with their comparatively little fall, the consequences would be very bad. Covered-in drains in a tropical town would greatly facilitate decomposition, and the offensive gases would necessarily find their way through the untrapped openings by the side of the road and a very serious and dangerous nuisance would be the result. The question of drainage is difficult and costly enough in the civilized world and is far from being settled ; it seems a pity, therefore, to introduce into a West African town a system which depends upon a civilized population, constant supervision, and an abundant water supply, and, moreover, the West African town has to face immense sudden rainfalls, and the drains have to be constructed for the maximum storm water flow, and in consequence in the dry season they are far too large for domestic drainage.

The authorities of Conakry have, however, reserved their drain chiefly for rain-water in the wet season. With regard to the question of the advantage of the covered over the open drain, it appears to us that since the mosquito has now come to be recognized as the sole channel of infection in certain diseases, that the covered-in drain, unless very great care is taken, may even prove a worse breeding-ground than the open drain where, at any rate, the mischief can be seen and readily got at. The covered-in drain has also other serious disadvantages, amongst the worst of which in a tropical country is the rat. The drain suits this rapacious rodent admirably, and it is not necessary for us to dilate on the damage which these pests might do the goods in the various factories or to the health of the community by the introduction of plague. As if to accentuate the unforeseen dangers of the covered-in drain in a tropical town, it so happened that in our short stay at Conakry a young leopard escaped from the gardens and found refuge in the main drain, where it was ultimately caught. We freely admit that the open street drains, as seen in Freetown, are not calculated to impress one at first sight with their advantages over the covered, but we think that the advantage would be on their side if they were of uniform construction in stone or cement, and were rigorously kept free from rubbish. Some of the outlying streets in Conakry have shallow grass drains, concrete gutters are also found ; the majority of streets are, however, undrained.